Studies in the Structure of the Stockholm Economy

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TOWARDS A FRAMEWORK FOR PROJECTING METROPOLITAN COMMUNITY DEVELOPMENT

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FOREWORD

This volume, »Studies in the Structure of the Stockholm Economy», will be submitted shortly as a doctor's thesis at the Stockholm School of Economics by its author, ekon. lic. Roland Artle.

Earlier studies on the economic structure and development of the Stockholm area (in a series started in 1952) have mainly concentrated upon specific sectors of the Greater Stockholm economy, particularly the port activities and the marketing of perishable foodstuffs. In 1957 an economic survey in more traditional terms about the Stockholm area was published as part I of »Stor-Stockholms ekonomiska struktur» (the economic structure of Greater Stockholm). The authors were a team, among them Mr. Artle. In part II Mr. Artle alone published a popular and abbreviated version of some of the findings in the present volume. Roughly speaking, this Swedish version covered mainly chapters 1 and 4 in this volume as well as the input-output tables, while no mention was made of the contents of chapters 2 and 6.

Like the other volumes in the Stockholm series this volume has to a very large extent been financed through a generous research grant from the City of Stockholm to the Institute of Business Research at the Stockholm School of Economics where the studies have been carried out. In other ways, too, the City administration has been most helpful. Their cooperation is acknowledged with gratitude.

Stockholm, March 16th, 1959

Folke Kristensson

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The research to be reported here was performed at the Business Research Institute at the Stockholm School of Economics, and I acknowledge my indebtedness to that institution for the assistance which has made this report possible. To Professor Folke Kristensson goes the credit for the initiation of the study and for the selling of the project to the many institutions whose cooperation was indispensable. Through all stages of the work, he gave me his generous support.

My general frame of reference is indicated in Ch. I, but I would like to add a special note of thanks here to my former teachers, among whom I would especially like to mention Professors Bertil Ohlin, Gerhard Törnqvist and Folke Kristensson, all of the Stockholm School of Economics, and Professors D. G. Champernowne and F. Seton of the University of Oxford. I also feel a great debt to Professor Wassily Leontief of Harvard University, who has given me much encouragement and with whom I have had most stimulating discussions on methodological issues; to Professor Ragnar Frisch of the University of Oslo, who also showed me his interest and who kindly gave me helpful comments on my conceptual framework; to Professor Eduard Poom of the Business Research Institut, who in so many ways deepened my understanding of economic theory and method; and to Professor Gunnar Westerlund of the Stockholm School of Economics, who deeply influenced my views on scientific methodology in general.

Particularly during the preparatory stage of this study I benefited very much from almost daily discussions with Lars Adler, Stig Gustafsson and Mrs. Margareta Härnqvist, all at the Business Research Institute at the Stockholm School of Economics.

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I received the greatest cooperation from the City administration and its office of statistics, from various national government institutions, among them the *Kommerskollegium* and the *Konjunkturinstitut,* from several private institutions and from a very large number of private business enterprises. In the wearisome task of gathering and organizing the statistical material, substantial contributions were made by Helge Edgren of the *Mantalsverk* and Mrs. Härnqvist, who was furthermore responsible for the punch-card tabulations. Others who assisted in the work of data gathering and arrangement were Olle Eriksson, Sven Hammarskiöld, Sven Hed, Yngve Hedin,

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Mrs. Ruth Werthén helped me to see this volume through the press. Typing, tabulating and checking were undertaken by Mrs. Ingrid Ekenäs, Gunilla Fristedt, Mrs. Margareta Keijser, Lilian Levin, Mrs. Harriet Lundh and Mrs. Britt-Marie Wallberg, under the guidance of Mrs. Werthén.

Mrs. Nancy Adler kindly read through my manuscript and corrected my English.

Various parts of the preliminary manuscript were read and criticized by Professor Vera Cao-Pinna in Rome; Professor Ragnar Frisch in Oslo; Professor Wassily Leontief at Harvard; Professors Trygve P:son Frenckner, Folke Kristensson, Bertil Ohlin, Eduard Poom and Gerhard Törnqvist, all of the Stockholm School of Economics; and by Sture Berglund, Stig Gustafsson, Bengt Höglund, Bertil Näslund, Lars Persson and Lars Werin. My sincere thanks are due to them for their fruitful criticism and most particularly to Professor Frenckner who went over Chs. I—III, V and parts of IV, line by line, giving me many helpful suggestions.

As a result of the criticism received, I extended Ch. II, in order to make it less compact, rearranged some of the text and material in Chs. IV and V, and made several other revisions.

Roland Artle

CONTENTS

CHAPTER I

An Introductory Note on the Problem and its Setting

Shifts between different occupations are recognized by several students as one of the components of economic growth in society.[1] Such shifts, it is maintained, may at least in part be comprehended in terms of economic theory.[2] The redistribution of manpower from agriculture to other occupations, long witnessed in many countries, is cited as a case in point.[3]

In Sweden the agricultural population decreased by more than one third, from 2.7 to 1.7 million people, between 1910 and 1950, whereas the nonagricultural population rose by nearly 90 percent, from 2.8 to 5.3 millions, in the same period. This redistribution partly took the form of urbanization of areas formerly rural, and was also reflected in the well known locational redistribution of population: from rural to urban areas. Thus while Sweden's total population grew at a slow rate, cities and towns, generally speaking, grew much more rapidly.[4]

Stockholm, the largest city in Sweden and also the capital, more than doubled her population (including suburbs) in the period mentioned. In the 1940's alone, the number of inhabitants in the Stockholm area rose by more than 200 000, bringing the total up to nearly one million in 1950.

In planning for the future of the Stockholm area, the need for knowledge of the tendencies in the city's development has been apparent, since many measures taken by the authorities have tended to affect, and even bind, future development within the area. This applies, for instance, to public investment made to adapt the systems of communications and other public utilities to the continued growth of population within the area, and to the rebuilding which is now in progress in central parts of the city.

The City of Stockholm has long been sponsoring such research work as would contribute to available knowledge regarding the structure and development of the

[1] For a recent contribution to this line of thought, see Svennilson, I., (1954) Growth and stagnation in the European economy.

[2] Cf. Simon, H., (1957) Models of man, ch. 12. Also published in Econometrica (1947), vol. 15, pp. 31—42.

[3] Some research workers have attempted to quantify the presumed relationship between the (secular) rise in real national income, as given by estimates in use, and the shift away from agriculture to other occupations. See, e. g., Kuznets, S., (1946) National income. A summary of findings, pp. 45—49; Lundberg, E., (1953) Konjunkturer och ekonomisk politik (Business cycles and economic policy) pp. 53—56; and Kendrick, J. W., (1954) National productivity and its long-term projection, pp. 93—96 (In: Long-range economic projection, Studies in income and wealth, vol. 16).

[4] Ahlberg, G., (1956) Population trends and urbanization in Sweden 1911—1950, pp. 16—19. For a more detailed account, see Ahlberg, G., (1953) Befolkningsutvecklingen och urbaniseringen i Sverige 1911—50, chs. 1, 7 and 8.

area. Early contributions of this kind were made by AHLMANN, EKSTEDT, JONSSON and WILLIAM-OLSSON (1934), JONASSON (1934), WILLIAM-OLSSON (1937 and 1941) and others. With one or two exceptions, their main emphasis was upon geographic and demographic aspects. A statistical analysis of population trends was carried out by AHLBERG (1953).

In the latter half of the 1940's the City began to sponsor research work at the Stockholm School of Economics: a research team was formed by professor Folke Kristensson, then Director of the Business Research Institute at the School, for the explicit purpose of studying economic problems pertinent to the Stockholm area. The studies so far conducted by the team fall into two main categories. One has dealt with the study of specific problems judged to be of immediate relevance to city authorities. HÖLCKE (1952) and GUSTAFSSON (1952) thus studied problems pertinent to the port of Stockholm and ADLER (1958) studied the marketing o perishable foodstuffs in the Stockholm area. The other category of studies has been confined to problems of relevance in a long-range perspective. The work to be reported on here is the first to be published in this latter series.

The purpose of the present study is mainly exploratory. It is founded upon a belief that many tools and concepts developed in economic theory, and hitherto applied almost exclusively to the study of *national* economies, may be fruitfully applied also in the study of the economies of metropolitan areas and other large cities. A logical consequence of the lack of such applications is that the organized body of economic data pertaining to metropolitan areas, etc., is extremely limited. The present investigation of the Stockholm area aims to make a contribution in this field of metropolitan area research. It will explore the possibilities of application, and adaptation, of the theoretical scheme used by LEONTIEF (1941; 1951; 1953) in his studies in the structure of the American economy.[1] It will also attempt to apply concepts used in national accounting, as developed by FRISCH (1943; 1955), AUKRUST, BJERVE and FRISCH (1948), STONE (1951; 1955), STONE and UTTING (1953), OHLSSON (1953), AUKRUST (1955) and RUGGLES and RUGGLES (1956).

The present application of these tools and concepts represents an attempt to uncover relationships, by means of which some light may be thrown on the very functioning of a metropolitan economy. Seen from a different point of view, this study aims to *comprehend* a great mass of phenomena and events in such a way that one of the outcomes of the study will consist of an organized set of economic data, pertaining to the Stockholm area.

Again, seen from a practical point of view, it is my hope that the theoretical framework to be provided here may help to throw some light on the future developmental possibilities of the economy of the Stockholm area, and, further, that the findings to be presented here may be of some interest to city planners.

In the past city planners have usually adhered to the so-called base theory[2] in

[1] As is well known, Leontief's framework was firmly rooted in classical economic theory. For an exposition of the historical background, see, for instance: Balderston, J., (1954) Models of general economic equilibrium (In: Economic activity analysis, edited by O. Morgenstern).

[2] See, for instance, Forbat, F., (1953) Untersuchungen über den »Lokalisierungsmultiplikator», pp. 97—101 (Raumforschung und Raumordnung, vol. 11); Andrews, R. B., (1953) Mechanics of the urban economic base, pp. 161—167 (Land Economics, vol. 29); and Alexander, J. W., (1954) The basic-nonbasic concept of urban economic functions, pp. 246—261 (Economic Geography, vol. 30).

assessing the developmental possibilities of a city. According to this theory, the economic base of a community or region consists of those industries which mainly produce goods or services for the *export market*, that is to say, the market outside the confines of the community or region concerned. Such industries are termed »basic»; all remaining industries, which produce for the local market, are termed »nonbasic».[1] Denoting the employment of basic industries by »B», the employment of nonbasic industries by »N», and total employment by »T», we have the following equation:

$T = B + N$, or $T - N = B$, which may be rewritten as $T\left(1 - \frac{N}{T}\right) = B$, from which we get: $T = \frac{B}{1 - \frac{N}{T}}$.

Of course, the relationship expressed here still holds by definition. But in addition, now, the base theory assumes that $\frac{N}{T}$ is a constant, that is to say, it assumes that a constant proportion of total employment is absorbed by nonbasic industries. In this way a simple theory is obtained for determining the total employment of the city or region concerned.[2] If the assumption holds, the problem of estimating the total employment of the city in the future would be reduced to that of estimating the future employment of its basic activities.[3]

While recognizing that the base theory might in many instances serve as a shortcut in analysing the structure of urban areas, I felt, when preparing the present study, that its framework was too narrow. Indeed, it is a tremendous simplification to maintain that the export base is *the* determinant of employment or income in a metropolitan area. A city may very well continue to grow, even if its exports do not increase. Changes in productivity, changes in consumption patterns, private investment activity and government activity in the city, may all very well imply further growth. Also, by the establishment of industries for the production of goods and services which used to be imported, a city may conceivably get an impetus to further growth. Further, one may conceive of various forms of capital movement which tend to stimulate the development of a city.

This list of »factors» which would tend to upset the constancy of the ratio of basic to nonbasic employment, could be greatly extended. The real trouble is of course not to list such factors, but to find out, in specific terms and for specific cases, how their interplay or interaction would change the ratio concerned. A framework that

[1] For some other terms used to denote the same concepts, see Ch. IV, p. 61, where, also, further references are given.

[2] The form of the multiplier here described is well known from Keynesian analysis, where the corresponding assumption of constancy refers to »the marginal propensity to consume».

[3] Cf., here, Hildebrand, G. H., and Mace, A., (1950) The employment multiplier in an expanding industrial market: Los Angeles County, 1940—47, pp. 241—249 (The Review of Economics and Statistics, vol. 32, no. 3). H. and M. fitted a straight regression line to two time series of employment figures — basic employment and nonbasic employment — for some years in the 1940's. As pointed out by the authors, however, their attempt was rather a poor test of the constancy of the ratio, over time, partly because they did not consider any time lags between the two series. It would have been preferable also to study the monthly changes and not, as they did, total employment figures.

would conceptualize such interaction is, however, not provided by the base theory.[1]

I shall carry this discussion regarding the base theory a little further in Ch. IV, but to some readers it may appear that I have already paid too much attention to that particular theory. However, in the last twenty years there has been such a heavy reliance on the base theory among city planners and research workers in this field that it rather seems necessary to give some rationales for not applying it in the present context.

In the search for a wider framework we might instead turn attention to general location theory. By viewing Stockholm as a nodal point of transports and as a big center of consumption, or, more generally, by analysing the whole complex of transfer costs, the location of the factors of production, and all the other considerations brought to bear in location theory, we might be able to probe rather deeply into the functioning and growth of the Stockholm economy. A fruitful starting-point might be to draw upon THÜNEN's famous theory of agricultural location. For concentric zones around Stockholm we should then probe into the interdependence between the areal »rings» and the Stockholm area, and thus we might be able to indicate among other things the intensity of the urban field of the Stockholm area.[2] Lösch's conception of price waves and their spread in space might also be applied in such a context.[3]

Further, by drawing upon the findings of WEBER, OHLIN, PALANDER, LÖSCH, HOOVER and others, we might be able to analyse different industries with regard to their locational patterns, and particularly with reference to their possible economies of (further) local concentration.

There were two main hindrances to such an approach here. One was the lack of the necessary empirical data. The other was the seemingly overwhelming difficulties of achieving anything but a *verbal* analysis in a limited study of the factors involved. However, on a more limited scale, the mentioned classics of location theory provided a useful frame of reference for the study of the spatial arrangements of certain activities *within* the Stockholm area; that study will be reported on in Ch. VI. Furthermore, in attempts to forecast the future of the Stockholm economy on the basis of present results — a problem that will be considered in Ch. V — we shall find that location theory is an indispensable tool.

[1] As already indicated, however, there may be many instances, in which the base theory gives sufficient information for planning purposes, e. g. for relatively small and simply structured cities or other areas. For a very interesting application, see Rasmussen, W., and Lomholt, J. K., (1954) Beretning om Fredriksværk undersøgelsen (Report on the Fredriksværk investigation). This study was concerned with the little Danish town of Fredriksværk, where a steel rolling mill was established in 1942. The investigation covered the period 1943—49 and, methodologically, it drew upon the pioneering work of Barfod, B., (1938) Lokaløkonomiske virkninger af en storindustriel virksomhed (also published in English: Local economic effects of a large-scale industrial undertaking).

[2] Cf., for instance, Tuominen, O., (1949) Das Einflussgebiet der Stadt Turku im System der Einflussgebiete SW-Finnlands, and Vining, R., (1953) Delimitation of economic areas: statistical conceptions in the study of the spatial structure of an economic system, pp. 52—64 (Journal of the American Statistical Association, vol. 48). See also: Kant, E., (1951) Omlandsforskning och sector analys, pp. 19—49 (Umland studies and sector analysis; in: Tätorter och omland) and Forbat, F., (1956) Die Bedeutung der umlandbestimmenden Faktoren für die Planung, pp. 71—79 (Raumforschung und Raumordnung, vol. 14).

[3] Lösch, A., (1940) Die räumliche Ordnung der Wirtschaft, pp. 176—182.

In choosing an approach to the study of the Stockholm economy, I have been strongly influenced by the writings of FRISCH, from whom I quote the following programmatic words: »We want to bring into the analysis a spectrum of statistically or in some other way numerically defined factors that are too great in number and too interwoven in their effects to make it possible to handle them by verbal reasoning or partial types of analysis.»[1] The present investigation should be looked upon as a modest attempt to work in this spirit.

Anyone who is familiar with LEONTIEF's systems will recognize that the conceptual framework requires very large amounts of empirical data for its implementation. It appeared at the outset of the present study, however, that enough relevant statistical material, pertaining to the Stockholm area, was available or could be made available to justify an application.

It seems that the researcher's decision-making influence can be traced not only in the choice of basic approach but all along the line in a research undertaking. He has to decide which specific concepts or variables he is going to consider pertinent. He has to choose a scientific level: he may attempt to explore what relations, if any, exist between the variables, or he may at the outset formulate hypotheses which specify what interactions are to be found among the variables. Furthermore, he has to choose methods of observation, classification and measurement, criteria for testing, and rules for generalization.[2]

In this report, I shall try to indicate to the reader on what points I have made a specific choice or decision, to the exclusion of other possible alternatives.

We shall set out here to analyse and describe the structure of the Stockholm economy in terms of flows of goods and services and of (financial) receipts. These economic flows can be conceived as forming a system, through which all the industries or, more generally, sectors of the economy, are linked to each other. The way in which such flows will be described and analysed, will also give some indication of the interdependence between Stockholm and the rest of the world. The treatment will indicate the extent to which the economic flows concerned are dispersed from Stockholm to the Rest of Sweden and Foreign Countries, and the extent to which such flows are absorbed by Stockholm from the Rest of Sweden and Foreign Countries. This will, among other things, render possible a balance of payments analysis for the Stockholm area.[3]

Chs. II—V report on that investigation into the economic flows *within* Stockholm as well as *between* Stockholm and the rest of the world. The chapter on empirical findings (ch. IV) has to focus all attention on the year 1950, the only period for which data could be obtained. The investigation is integrated with a study of the spatial distribution of the industries or sectors within the Stockholm area. *Ch. VI* gives an interim report on that work. It deals with the land use patterns of retail trade and certain other service industries, in the densely populated central

[1] Frisch, R., (1956) Main features of the Oslo median model, p. 1.
[2] Cf., Westerlund, G., (1952) Group leadership, a field experiment, pp. 51—67.
[3] Cf. Oskaloosa vs. the U. S., pp. 55—62, 125—132 (Fortune, april 1938).

districts of Stockholm. Statistical procedures are used for the testing of hypotheses regarding the spatial associations.

In this report *Stockholm* will be identified as the geographical area that has been known since 1949 as Greater Stockholm. Besides the corporate city of Stockholm, with 800 000 inhabitants in 1958, the definition includes 28 other administrative communities forming a suburban zone which had 300 000 inhabitants in 1958. The area is specified in Appendix 1, which gives an areal delineation on a map, together with a list of the municipalities included. This definition seemed to be of greatest interest to the sponsors of the work. Also, the area thus defined has in the last few years been the unit for the gathering of data of relevance in the present context. With regard to future research, it might have been preferable to identify Stockholm in a more neutral way, independent of the community border lines that happened to prevail in 1950.[1] Some attempts in that direction will be reported in Ch. VI.

[1] Cf. Hägerstrand, T., (1955) Statistiska primäruppgifter, flygkartering och »data processing»-maskiner (Census returns, air photographs and data-processing machines), p. 254: »Chronologically seen we use astronomical units of time independent of social or biological 'natural' periods. Why not base the chorological accounts on analogous neutral space-units? Gradually, as the new Swedish land-use map to the scale 1 : 10 000 and founded on air photographs, is published, it will be in principle possible to localize each statistical primary data with the help of coordinates.» (In: The Swedish Geographical Yearbook, vol. 31).

CHAPTER II

Conceptual Framework

»It is the faith of all science that an unlimited number of phenomena can be comprehended in terms of a limited number of concepts or ideal constructs. Without this faith no science could ever have any motivation. To deny this faith is to affirm the primary chaos of nature and the consequent futility of scientific effort. The constructs in terms of which natural phenomena are comprehended are man-made inventions. To discover a scientific law is merely to discover that a man-made scheme serves to unify, and thereby to simplify, comprehension of a certain class of natural phenomena. A scientific law is not to be thought of as having an independent existence which some scientist is fortunate to stumble upon. A scientific law is not a part of nature. It is only a way of comprehending nature.«

This well known statement of L .L. THURSTONE[1] may serve as a convenient starting-point for the present chapter. The unifying scheme, in terms of which phenomena will be conceived in this report, is closely related to what is best known as a LEONTIEF system, namely that of the open static variant.

The appearance of Leontief's first studies in »The structure of American economy»[2] has been followed by a large number of works in the same area of research,[3] and any attempt here at a general exposition of the field would take us outside our frame of reference. May it suffice to give a few words of orientation to readers entirely unfamiliar with the literature in question.

Writing about Gulliver's voyage to Lilliput, Swift does not convey much information on economic conditions there. However, let us assume for the sake of illustration that the country was characterized by a high degree of specialization and division of labor between different economic activities, such as handicrafts or trading establishments. If Gulliver, by some caprice, one day moved a number of the activities away from Lilliput, say to the Island of Blefuscu,[4] he might have brought the economy of Lilliput into complete disorder. Some activities would have lost their customers, and others their suppliers — maybe to such an extent that they would have closed down, which in turn would have affected many other activities, households included, giving rise to still wider repercussions throughout the economy.

[1] Thurstone, L. L., (1947) Multiple factor analysis, p. 51.

[2] Leontief, W., (1941) The structure of American economy. Its main ideas were presented by Leontief some ten years earlier before the National Bureau of Economic Research.

[3] The bibliography on Interindustry economic studies (1955) by Riley, V., and Allen, R. L., contains some 1 200 titles. Among the works not included there, is an important one by Frisch wherein matrices are used as an analytical device. See Frisch, R., (1934) Circulation planning: Proposa for a national organization of a commodity and service exchange, Econometrica, vol. 2, nos. 3 and 4.

[4] Blefuscu was, as the reader will remember, the other great empire in that part of the world.

Conceptualization in terms of such interdependence between different economic activities is a characteristic of the Leontief systems. The economy is viewed as a system consisting of flows of goods and services. These flows link together all the different parts of the economy, that is the individual activities or, usually, classes of activities, referred to as »industries» or »sectors». The intersectoral flows are quantified, over a period of time, and presented in a two-way table showing from whom and to whom deliveries take place.[1] Since the flows could be looked upon as inputs to, and outputs from, the different industries or sectors, such a table is often referred to as an input-output table. To illustrate, coal is one of the »inputs» of the steel industry, whose »output», in turn, consists of steel. Usually, but not necessarily, it is assumed that the amount of each of the inputs flowing into any sector is strictly proportional to the amount of output from that sector: if the output of steel from the steel industry is doubled, the necessary inputs of iron ore, coal, etc., are also assumed to double.

The assumption that all production functions or, strictly speaking, input functions are linear and homogeneous, has given rise to much controversy. We shall see later that even the construction of the basic table, referred to above, does imply some rather heavy assumptions about the properties of the data used. On p. 11, when the basic concepts have been introduced, we shall return to this question of the high level of measurement assumed, and to the other and more controverted assumptions. The assumptions involved can then be exposed more simply and clearly.[2]

To begin with, the Leontief systems were applied only in the study of national economies: the industries or sectors were classified on a national level, the industries in foreign countries being lumped together and treated as a separate class. Recently, however, systems employing cross-classifications of industries and *areas* (regions) have been developed, chiefly by LEONTIEF,[3] ISARD,[4] and MOSES.[5] Besides the condition of linear and homogeneous input functions, mentioned above, these interregional systems impose a condition of stable trading relations, as between industries in different regions. An empirical implementation of such a system, specifying three regions each containing 11 industries, has been carried out for the United States by Moses,[6] but apart from that work the paucity of data on (inter)regional phenomena seems to have severely hampered practical applications of

[1] For a practical illustration, see the folded table at the end of the book.

[2] Short introductions to this field of economic analysis are given, i. al., by:
Christ, C., (1952) A review of input-output analysis, pp. 137—182 (In: Input-output analysis: An appraisal);
Dorfman, R., (1954) The nature and significance of input-output, pp. 121—133 (The Review of Economics and Statistics, vol. 36);
Eckstein, O., (1954) The input-output system — its nature and uses, pp. 43—78 (In: Economic Activity Analysis);
Shephard, R. W., (1952) A survey of input-output research (presented at the Conference on Research in Income and Wealth, in N. Y., 1952).
Scandinavian readers are referred to Bjerve, P. J., (1954) Kryssløpsforsking i Statistisk Sentralbyrå, pp. 3—14 (In: Statistisk Tidskrift, vol. 3); and Rasmussen, P. N., (1954) Om input-output analysen, pp. 19—35 (Nationaløkonomisk Tidsskrift, vol. 92).

[3] Leontief, W., (1953) Studies in the structure of the American economy, pp. 93—115.

[4] Isard, W., (1951) Interregional and regional input-output analysis: A model of a space-economy, pp. 318—328 (The Review of Economics and Statistics, vol. 33).

[5] Moses, L. N., (1955) Interregional analysis, pp. 163—226 (In: Report on Research for 1954, Harvard Economic Research Project).

[6] Moses, L. N., (1955) op. cit. (also in: The American Economic Review, vol. 45, pp. 803—832).

full-scale interregional systems. Instead, the empirical work done on that level has, generally speaking, been of a simpler character. It has focused attention on one particular region of a country, treating all »the rest of the world» summarily.[1] In principle, an interregional system of this simple type has identically the same construction as a national system, the only difference being that the »region» is substituted for the »nation». The present study of Stockholm proper and its surrounding area is of this kind. It gives a fairly detailed account of flows to and from sectors *within* Stockholm,[2] but due to the severe shortage of data, the two other areas incorporated into the study, namely the Rest of Sweden and Foreign Countries, are given only a highly summarized treatment.[3]

BASIC CONCEPTS

Sectors

We shall here conceive of the economic activity in society as being related to specifiable acting entities or units. Manufacturing establishments, retail stores and households may serve as examples of these acting units. For the time being at least, a study that would consider all such units in their individuality is not manageable. We shall therefore group the units into classes; the criteria of classification will be dealt with in Ch. III.[4] Each such class will henceforth be referred to as a »sector». Thus a particular sector might consist of all households, or a specified set of households. Another sector might consist of all retail stores, or a specified set of retail stores, etc. It is assumed that this classification of the units of economic activity will be carried out in such a way that the sectors form disjoint and exhaustive subsets of the universal set of units of economic activity.

[1] See, e.g. Freutel, G., (1952) The eighth district balance of trade, pp. 70—78 (Monthly Review, vol. 34); Isard, W., and Kuenne, R. E., (1953) The impact of steel upon the Greater New York-Philadelphia industrial region, pp. 289—301 (The Review of Economics and Statistics, vol. 35) and comments by Moses, L. N., (1955) Location theory, input-output, and economic development: an appraisal, pp. 308—312 (The Review of Economics and Statistics, vol. 37); Moore, F. T., and Petersen, J. W., (1955) Regional analysis: An interindustry model of Utah, pp. 368—383 (The Review of Economics and Statistics, vol. 37); Moore, F. T., (1955) Regional economic reaction paths, pp. 133—153 (The American Economic Review, vol. 45, Papers and Proceedings); and A regional interindustry study of Maryland (Studies in Business and Economics, vol. 8, no. 2, 1954).

[2] As indicated in Ch. I, »Stockholm» means »Greater Stockholm» in this report.

[3] The only empirical intersectoral-flow study focusing on a city and its immediate environment that I have discovered was concerned with West-Berlin and that was rather narrow in scope (see Krengel, R., 1953, Volkswirtschaftliche Input-Output-Rechnung, Sozialprodukt, Beschäftigung und Produktivität in West-Berlin, Deutsches Institut für Wirtschaftsforschung, Sonderhefte, Neue Folge nr. 24, Reihe A). However, I have been informed by Professor Leontief that studies are being carried out for Washington, D. C., and St. Louis.

[4] Cf. Haavelmo, T., (1954) A study in the theory of economic evolution, p. 16: »In order to give meaning to aggregate economic variables one would usually require that the group (of people, households, firms etc.) to which the aggregates apply should in some sense consist of 'economically similar' units. The importance of this requirement depends to some extent, however, upon the nature of the theory one has in mind, that is, whether one has a theory where the economic decisions and actions are ascribed to single individuals and other small, 'natural' decision units, or whether the behavioristic elements of the theory are meant to apply directly to larger groups *as such*.»

The particular set of sectors chosen for the present study will be related to empirical data in the next chapter. For the sake of clarity and brevity, the sectors are here denoted by numbers, i. e. 1, 2, 3,.....n.

Intersectoral flows

Assume that over any period of time[1] we can record all the deliveries or flows of goods and/or services that take place within and between the sectors defined above — or, rather, between the acting units that constitute the sectors. Let such flows be classified according to sectors of origin and destination. Denote flows by x and use footscripts for sectors, the first figure indicating the sector that makes deliveries and the second figure indicating the sector that takes deliveries. We may then write the set of all possible flows as (x_{11}), (x_{12}), (x_{13}).....(x_{1n}), (x_{21}), ...(x_{nn}). Here (x_{ij}) contains all flows from sector (i) to sector (j).

The set of flows, defined above, will be referred to henceforth as the »intersectoral flows».[2]

We shall find it useful also to give the set (x_{11}), ...(x_{nn}) an alternative interpretation. It will be postulated here that to any flows of goods and/or services there correspond specific counterflows of money or other financial obligations, that is to say, we shall postulate that to each *real* flow there corresponds a *financial* flow in the opposite direction.[3] This corresponding set of financial flows will be denoted by the same set of symbols. Thus, the subset (x_{ij}) will be interpreted *either* as the real flows from sector (i) to sector (j), *or* as the financial flows from sector (j) to sector (i). However, we do not postulate equivalence, in the logical sense, between the two sets. The set of intersectoral flows will be given empirical content in the next chapter, and we shall find there that some of the subsets cannot meaningfully be interpreted as real flows, but only as financial flows.

DEFINITIONAL RELATIONS

We define a set (x_i), $i = 1, 2, 3,.....n$, such that $(x_{i1}) + (x_{i2}) + ...+ (x_{in}) = (x_i)$.

[1] For instance a day, a month or a year.

[2] Even subsets of the type (x_{ii}), i. e., strictly speaking, intrasectoral flows, will be included.

[3] Gifts (so-called real transfers) and barter trade will be accounted for through imputed transactions, or entirely neglected (see Ch. III and App. 2).

I have drawn here upon works by Frisch, Aukrust, and Bjerve. See Frisch, R., (1943) Ökosirksystemet, p. 120, (Ekonomisk Tidskrift, vol. 45); Aukrust, O., Bjerve, P. J., and Frisch, R., (1948) A system of concepts describing the economic circulation and production process, pp. 8—17; and Aukrust, O., (1955) Nasjonalregnskap (National accounts), pp. 94—99.

Cf. also Aukrust, O., (1949) On the theory of social accounting (Review of Economic Studies, vol. 16, no. 3) and Stone, R., and Utting, J. E. G., (1953) The relationship between input-output analysis and national accounting (In: Input-output relations: proceedings of a conference on interindustrial relations held at Driebergen, Holland, pp. 195—229).

For a thorough discussion of the concepts involved (real transactions, financial transactions, transfers, imputed transactions etc.), see Ohlsson, I., (1953) On national accounting, pp. 11—15. Ohlsson also gives a review of the Norwegian Økosirk-system that is of interest in this context, pp. 51—58

In a more explicit form the set of equalities that now appears may be written as follows:

$$
\begin{aligned}
(x_{11}) + (x_{12}) + \ldots\ldots + (x_{1n}) &= (x_1) \\
(x_{21}) + (x_{22}) + \ldots\ldots + (x_{2n}) &= (x_2) \\
\cdot \quad\quad \cdot \quad\quad\quad\quad \cdot \quad\quad \cdot & \\
\cdot \quad\quad \cdot \quad\quad\quad\quad \cdot \quad\quad \cdot & \\
\cdot \quad\quad \cdot \quad\quad\quad\quad \cdot \quad\quad \cdot & \\
(x_{n1}) + (x_{n2}) + \ldots\ldots + (x_{nn}) &= (x_n)
\end{aligned}
$$

Each equality states a simple balance requirement. On the right side we have the total real outflows from any given sector. On the left we have the distribution over receiving sectors of the very same flows. Or, in the alternative interpretation, on the right side we have the financial flows into a sector, and on the left we have the distribution with regard to sources of these financial flows. We have balance in the sense that any *flow out* from a sector must necessarily *flow in* somewhere, and vice versa.

Thus, we have conceptualized a system of interdependence between the sectors, the intersectoral flows forming the connecting links.

STRUCTURAL RELATIONS

So far only primitive terms[1] and a set of definitional relations, based upon the primitive terms, have been introduced. The problem of connecting these primitive terms with observable properties of events or phenomena belongs to the next chapter. Simply to *define* relations between logical classes as previously done, however, is to make only a beginning towards comprehension of the observable properties of the events or phenomena concerned. The definitional relations need to be supplemented by *structural* relations[2] — in economics usually behavioristic or technical in nature.

[1] See Hempel, C. G., (1952) Fundamentals of concept formation in empirical science, p. 15: »... the vocabulary of a theory falls into two classes: the *defined terms*, i. e., those which are introduced by definition in terms of other expressions of the vocabulary, and the so-called *primitive terms*, or *primitives*, by means of which all other terms of the theoretical vocabulary are ultimately defined.» Cf., also, Zetterberg, H. L., (1954) On theory and verification in sociology, p. 16: ... »We will list a series of primitive terms or basic concepts. These are definitions which we, strictly speaking, will introduce as undefined. However, by circumlocations and examples, we may convey what we intend them to mean. There is nothing mystically 'fundamental' or 'basic' about these concepts — they only represent an assumption of an agreement that we may use certain words in certain ways.»

[2] Cf., Leontief, W., (1952) Some basic problems of structural analysis, p. 5 (The Review of Economics and Statistics, vol. 34, no. 1): »First, there are the balance requirements: the combined inputs of each commodity or service must equal its total output. Second, there are the structural characteristics of all the individual sectors of the economy. These imply the existence of definite relationships between the quantities of all the outputs absorbed by any one particular industry and the level of its total output.»

The above terminology also agrees with that used by Frisch, who distinguishes between »(1) definitional (accounting) relations possibly with the sub-species 'parametrically transformed accounting relations' and (2) structural relations which fall in the two sub-species behaviouristic and technical.» (Quoted from a letter, in which Frisch commented upon a preliminary version of this chapter.)

Above, we conceptualized flows of the general form x_{ij}, where i and j could be any sectors in the range 1, 2,.....n. Now we partition the set of all sectors into two subsets, Π and Ω, one containing m sectors and the other containing $(n - m)$ sectors. We shall refer to the m sectors belonging to the subset Π as *endogenous* sectors or *production* sectors, and to the $(n - m)$ sectors belonging to the subset Ω as *exogenous* sectors or *final demand* sectors.

Among the m sectors in the subset Π will be included all branches of the manufacturing industry, distributive trades and other service industries.

Now, letting $\varkappa$ and λ represent endogenous sectors, the Leontief systems are usually built on the assumption that the structural relations are of the simple form

$$\text{(i)} \qquad x_{\varkappa\lambda} = a_{\varkappa\lambda} x_\lambda \quad (\varkappa, \lambda = 1, 2, \ldots\ldots m)$$

where $a_{\varkappa\lambda}$ $(\varkappa, \lambda = 1, 2, \ldots\ldots m)$ are constants. Each constant, or »technical coefficient»,[1] $a_{\varkappa\lambda}$, can be interpreted as the *average* amount of product of sector $\varkappa$ that is absorbed by sector λ per unit of its output — the average (weighted) being calculated over any specific period of time on the basis of data pertaining to all the acting units that constitute the absorbing sector.

Just to give a concrete example, the assumption implies that the amount of paper, print, etc., necessary to »manufacture» this book would have been about the same if the book were printed, for instance, five years hence and even if, let us say, twice as many books were printed. Empirical investigations over short spans of time do not seem to have contradicted the assumption,[2] but strictly speaking they have been inconclusive in so far as they have not given any ex ante rules about the size of tolerable deviations; they have been couched in non-probabilistic terms. When more data become available, more complex relationships can easily be incorporated into the system, if thereby a closer approximation to reality can be achieved.[3] For instance, *marginal* coefficients may be used instead of the *total* coefficients and, further, the structural relations may be formulated in stochastic terms.

Taking the structural relations assumed into account, we can rewrite the system of definitional relations given on p. 10, above. Inserting from (i) we get

$$\text{(ii)} \qquad a_{\varkappa\lambda} x_\lambda + x_{\varkappa\Omega} = x_\varkappa \quad (\varkappa, \lambda = 1, 2, \ldots\ldots m)$$

where $x_{\varkappa\Omega}$ denotes the real flows from sector $\varkappa$ to the $(n - m)$ sectors in the subset Ω.

[1] Cf., e. g., Ohlin, B., (1933) Interregional and international trade, p. 554.

[2] See, e. g., Cameron, B., (1952) The production function in Leontief models, pp. 62—69 (The Review of Economic Studies, vol. 20).

[3] Discussion of this problem can be found in, for example, Leontief, W., (1952) Some basic problems of empirical input-output analysis, pp. 18—19 (In: Input-output analysis: an appraisal); Evans, W. D., and Hoffenberg, M., (1952) The nature and uses of interindustry-relations data and methods, pp. 64—68 (In: the same source); Dorfman, R., (1954) The nature and significance of input-output, p. 126 (The Review of Economics and Statistics, vol. 36); and Frisch, R., (1954) Krysløpsanalyse, pp. 5—9.

Expanding, we can write this system of linear equations as

$$
\begin{array}{lllll}
x_1 - a_{11}x_1 - a_{12}x_2 - a_{13}x_3 - \ldots\ldots - a_{1m}x_m = x_{1\Omega} \\
x_2 - a_{21}x_1 - a_{22}x_2 - a_{23}x_3 - \ldots\ldots - a_{2m}x_m = x_{2\Omega} \\
x_3 - a_{31}x_1 - a_{32}x_2 - a_{33}x_3 - \ldots\ldots - a_{3m}x_m = x_{3\Omega} \\
\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
x_m - a_{m1}x_1 - a_{m2}x_2 - a_{m3}x_3 - \ldots\ldots - a_{mm}x_m = x_{m\Omega}
\end{array}
\qquad \text{(iii)}
$$

This system is composed of the square matrix of (I — a) coefficients, the vector of $x_\varkappa$ variables, and the vector of $x_{\varkappa\Omega}$ variables. It is an »open» system as it now stands, in the sense that we have more variables than independent equations. In principle, we could reduce successively the number of degrees of freedom in the system by introducing more hypothetical relations—behavioristic relations, for instance—which would aim at including among the endogenous sectors some or all of the sectors in the subset Ω, to which belong the household and government sectors, the investment sectors, and the sectors outside the Stockholm area (the rest of Sweden and foreign countries). For these sectors, however, the assumption of strict proportionalities, used above, seems untenable. As applied to the sector of all households, for instance, the assumption states that the relative share of total income spent on food, clothing, housing, motoring, etc., should be independent of the level of income. Instead, the knowledge available »suggests that non-linearity, non-proportionality, and the influence of other variables will have to be taken into account».[1] Similar considerations apply to the other sectors in the subset. However, a theoretical system that would incorporate such more complex relationships cannot at present be connected to empirical data, simply because there are no data available to this study for the estimation of the parameters involved. So we shall take the much more modest step of *predetermining* the values of the $x_{\varkappa\Omega}$ variables.[2] Then the system (iii) can be solved for the vector $(x_1, x_2, \ldots\ldots x_m)$. We rewrite the system as

$$(I - a)\, x = y, \qquad \text{(iv)}$$

where y is the vector $(x_{1\Omega}, x_{2\Omega}, \ldots\ldots x_{m\Omega})$. Premultiplying on both sides by $(I - a)^{-1}$ we get, for non-singular[3] matrices (I — a),

$$x = (I - a)^{-1}y \quad \text{or} \quad x = Ay, \text{ where } (I - a)^{-1} = A.^4 \qquad \text{(v)}$$

[1] Gilboy, E., (1954) Consumption and input-output analysis, p. 404 (In: The structural interdependence of the economy). See, also, the chapters by Sevaldson, P., and Stone, R., in the same publication.

[2] With few exceptions this has, up to now, been the customary procedure in studies of intersectoral flow relationships.

[3] The mathematical properties of Leontief matrices are treated in several papers included in: Morgenstern, O., (ed.) Economic activity analysis (publ. 1954).

[4] The denotations used here are further explicated on pp. 18—19.

That is, we can find the values of the variables $x_1, x_2, \ldots . x_m$ in terms of the coefficients $(A_{\varkappa\lambda})$, $\varkappa, \lambda = 1, 2 \ldots m$, and the independently determined variables $x_{1\Omega}, x_{2\Omega}, x_{3\Omega}, \ldots . x_{m\Omega}$. We get

$$\text{(vi)} \quad x_\varkappa = A_{\varkappa 1}x_{1\Omega} + A_{\varkappa 2}x_{2\Omega} + A_{\varkappa 3}x_{3\Omega} + \ldots . + A_{\varkappa m}x_{m\Omega} \quad (\varkappa = 1, 2, \ldots . m)$$

To the extent that the independent variables can be determined directly through the decisions of policy-makers, the influence thereof upon the magnitudes $(x_\varkappa)$, $\varkappa = 1, 2, \ldots . m$, can be traced via the coefficients $(A_{\varkappa\lambda})$, $\varkappa, \lambda = 1, 2, \ldots . m$.[1]

In the following pages we shall refer to the vector $(x_{\varkappa\Omega})$, $\varkappa = 1, 2, \ldots . m$, as the final demand vector and to the sectors in the subset Ω as the final demand sectors. Since these sectors are outside the system of structural relations, we shall also refer to them as exogenous sectors and, correspondingly, to the production sectors as endogenous sectors. No attempt will be made in this report to include investment demand among the endogenous sectors.

It is clear that in many instances uses of the very simple assumption about fixed input coefficients introduced above can provide only a first approximation to reality. As stated by LEONTIEF, »practical necessity, rather than theoretical convenience, is responsible for the dominant position assigned to this limiting assumption . . .»[2] In the present case, we shall estimate the coefficients related to one period (the year 1950) and apply them in order to make a »conditional forecast» to another period (the year 1955). That is to say, the only achievement that we can claim is to indicate the levels of economic activity, etc., which would be *consistent* with such an assumption of invariant structural relations. The purposes of that application are to provide a basis for comparisons and to illustrate a procedure of forecasting. No more application of the assumption will be carried out within the framework of the investigation to be reported here. Instead, the emphasis of the present report lies upon an analysis and description of the state of the Stockholm economy in the year 1950. The theoretical framework will now be adapted to fit the needs of such an analysis and description.

LEVEL OF MEASUREMENT

For purposes of the analysis and description to follow, we shall make the assumption here that the observations considered relevant to the present study are amenable to numerical analysis. In fact, we have already used an implicit assumption that data should be amenable to numerical operations, when we introduced the assumption of structural relations above. Such elementary operations as addition and division, used above, require that the principle of what FRISCH called »centralized descrip-

[1] However, this statement must not be misinterpreted as saying that the independent variables are »cause» variables and the dependent variables are »effect» variables. The distinction between independent and dependent variables, as here used, is a purely mathematical one.

[2] Leontief, W., (1952; publ. 1955) Some basic problems of empirical input-output analysis (In: Input-output analysis: an appraisal, p. 18.)

tion» should be fulfilled.[1] Symbolically, we account for this assumption here by omitting brackets in the definitional relations:

$$x_{i1} + x_{i2} + \ldots\ldots + x_{in} = x_i, \qquad i = 1, 2, \ldots\ldots n,$$

or, for short,

$$(1) \qquad \sum_{j=1}^{n} x_{ij} = x_i, \qquad i = 1, 2, \ldots\ldots n.$$

Regarding this fundamental question of the level of measurement to be imposed in the present investigation,[2] we shall now also assume explicitly that certain matrix operations can be meaningfully performed on the numbers assigned to (or derived from) observations. Stated more precisely, we shall assume that by some method we can assign numbers to observations and that this method is isomorphic to some abstract (mathematical) system that can be operated upon according to the rules of simple matrix theory.[3] In accounting for this assumption I shall now draw upon works by FRISCH.[4]

We partition as before the set of all sectors into two subsets, Π and Ω, one containing m sectors and the other containing $(n - m)$ sectors. Let R and C represent two exogenous sectors, and let $\mu, \nu, \ldots\ldots \varkappa, \lambda$, represent endogenous sectors.

Conceive, then, of a real flow $x_{R\vartheta\lambda}$ to be interpreted here as the part of the flow from sector R which is used up by sector ϑ in the production of goods and services for delivery to sector λ. We generalize this conception through the real flow

$$(2) \qquad x_{R\mu\nu\ldots\ldots\eta\vartheta\lambda},$$

to be interpreted here as the part of the flow $x_{R\mu\nu\ldots\ldots\eta\vartheta}$ which is used up by sector ϑ in the production of goods and/or services for delivery to sector λ. In turn, $x_{R\mu\nu\ldots\eta\vartheta}$ can be interpreted as the part of the flow $x_{R\mu\nu\ldots\eta}$ which is used up by sector η in the production of goods and/or services for delivery to sector ϑ, and so on.

[1] See, e. g., Frisch, R., (1943) Ökosirk-Systemet, p. 121 (Ekonomisk Tidskrift, vol. 45). Cf., also Aukrust, O., (1955) Nasjonalregnskap, pp. 111—112: According to the principle of centralized description, »... all doubtful and conventional questions on evaluations, classifications, time element etc., are decided centrally, for all sectors, within a general and consistent framework». According to the principle of decentralized description, »... the conventional practices of the individual units in the economy are accepted, and no efforts are made to force them into a system of consistency».
This problem will be treated in the next chapter, where reference is also made to Burdett, D. K., (1954) Social accounting in relation to economic theory (The Economic Journal, vol. 64, pp. 679—697).

[2] Cf., Coombs, C. H., (1953) Theory and methods of social measurement, p. 485 (In: Research methods in the behavioral sciences): »... the process of measurement consists in part of selecting a level of measurement, an abstract system, into which the data are to be mapped». ... »The axiomatic basis of the level of measurement selected constitutes a theory about the behavior in question in that the axioms specify the relationships that are to hold in the data and the properties of the relationship.»

[3] Introductory texts on the theory of matrices and determinants, sufficient for the understanding of this book, can be found in the following works among others:
Dwyer, P. S., (1951) Linear computations;
Kemeny, J. G., Snell, J. L., and Thompson, G. L., (1956) Introduction to finite mathematics;
Klein, L. R., (1953) A textbook of econometrics;
Thurstone, L. L., (1947) Multiple-factor analysis;
A more advanced work is Beaumont, R. A., and Ball, R. W., (1954) Introduction to modern algebra and matrix theory.

[4] See Frisch, R., (1952) Reperkusjonsanalytiske problemer ... (Lectures on problems of repercussion analysis, summarized and edited by L. Johansen) and Frisch, R., (1954) Krysløpsanalyse (Lectures on interflow analysis, summarized and edited by N. Bakke, O. Bredal and H. J. Hylin).

Although flows of the type (2) are conceivable, they are hard to observe and measure. However, through the fundamental assumptions of factorability (Frisch's term) a reformulation of such expressions into operational terms is facilitated. The factorability assumptions state that all the outputs from any given sector should have identically the same relative composition of inputs, regardless of which the receiving sectors are, and regardless, also, of the length of the chain of sectors that only indirectly, via other sectors, receive the outputs in question. More specifically, we assume that the following relation holds for any $\lambda = 1, 2, \ldots . m$:

$$\frac{x_{R\mu\nu \ldots \eta\vartheta\lambda}}{x_{\mu\nu \ldots \eta\vartheta\lambda}} = \frac{x_{R\mu\nu \ldots \vartheta\lambda}}{x_{\mu\nu \ldots \eta\vartheta}} = \frac{x_{R\mu\nu \ldots \eta}}{x_{\mu\nu \ldots \eta}} \tag{3}$$

Through successive deletions of sector symbols, we get:

$$\frac{x_{R\mu\nu \ldots \eta\vartheta\lambda}}{x_{\mu\nu \ldots \eta\vartheta\lambda}} = \frac{x_{R\mu}}{x_{\mu}} \tag{4}$$

By successively reducing flows of the forms $x_{\mu\nu \ldots \eta\vartheta\lambda}$, $x_{\nu \ldots \eta\vartheta\lambda}$, etc., we can factorize completely from relation (4), to get

$$\frac{x_{R\mu\nu \ldots \eta\vartheta\lambda}}{x_{\lambda}} = \frac{x_{R\mu}}{x_{\mu}} \cdot \frac{x_{\mu\nu}}{x_{\nu}} \cdot \ldots \cdot \frac{x_{\vartheta\lambda}}{x_{\lambda}} \tag{5}$$

Writing $\frac{x_{R\mu}}{x_{\mu}} = a_{R\mu}$, $\frac{x_{\mu\nu}}{x_{\nu}} = a_{\mu\nu}$, $\ldots . \frac{x_{\vartheta\lambda}}{x_{\lambda}} = a_{\vartheta\lambda}$, this reduces to

$$x_{R\mu\nu \ldots \eta\vartheta\lambda} = a_{R\mu}\, a_{\mu\nu} \ldots a_{\vartheta\lambda}\, x_{\lambda} \tag{6}$$

That is to say, by assuming complete factorability we are able to express flows of the type $x_{R\mu\nu \ldots \eta\vartheta\lambda}$ in terms which generally speaking are much easier to observe and measure. As such, flows like $x_{R\mu\nu \ldots \eta\vartheta\lambda}$ may seem of little interest. However, such flows form part of a concept which we shall find very useful in the analysis of empirical data, namely the following one:

$$x_{R \mid \lambda} \tag{7}$$

For present purposes, we shall interpret (7) as the part of x_R which is incorporated in x_λ, regardless of the route it followed to get there. For example, if x_R represented the total flow of imports from the Rest of the World into the area studied, and λ represented some sector manufacturing electrical equipment, then, according to definitions given before, $x_{R\lambda}$ would represent the amounts of imports *directly* absorbed by this equipment manufacturing sector, whereas $x_{R \mid \lambda}$ would in addition include all those *indirect* imports that would be incorporated in the raw materials, semi-manufactured products, etc., needed to manufacture the electrical equipment in question.[1]

Similarly, we shall here interpret the related concept

$$x_{R \mid \alpha\lambda} \tag{8}$$

[1] Cf., Leontief, W., (1951) The structure of American economy, 1919—1939, pp. 159—162 and pp. 178—188.

as the part of x_R which is incorporated in the deliveries made from sector α to sector λ, regardless of the route it followed to get to sector α.

We define the interrelation between expressions (7) and (8) as follows:

$$x_{R\,|\,\lambda} = x_{R\lambda} + \sum_{\alpha=1}^{m} x_{R\,|\,\alpha\lambda} \tag{9}$$

That is to say, the part of x_R incorporated in x_λ consists of, first, the flow, if any, which goes directly from R to λ ($x_{R\lambda}$) and, second, the flows which, originating in R, arrive by all possible ways at sector α for delivery to sector λ. As stated before, α can represent any sector in the range 1, 2,.....m. By summing for $\alpha = 1, 2 \ldots m$, we exhaust all the possible ways by which a flow can pass from sector R to sector λ, *via* one or more sectors.[1] This latter criterion is fulfilled by, for example, the flows $x_{R\alpha\lambda}$ and $x_{R\mu\nu\ldots\vartheta\alpha\lambda}$, that is, generally speaking flows of the form given in expression (2) above.

In analogy with (9), we can write

$$x_{R\,|\,\alpha\lambda} = x_{R\alpha\lambda} + \sum_{\vartheta=1}^{m} x_{R\,|\,\vartheta\alpha\lambda} \quad \text{and} \tag{10}$$

$$x_{R\,|\,\alpha} = x_{R\alpha} + \sum_{\vartheta=1}^{m} x_{R\,|\,\vartheta\alpha} \tag{11}$$

As indicated, the second term on the right hand side of (10) will contain flows of the general form $x_{R\mu\nu\ldots\vartheta\alpha\lambda}$, whereas the corresponding term in (11) will contain flows of the form $x_{R\mu\nu\ldots\vartheta\alpha}$. Applying the assumptions of factorability, these two magnitudes can be written as follows, analogous to (6):

$$x_{R\mu\nu\ldots\vartheta\alpha\lambda} = a_{R\mu}\, a_{\mu\nu} \ldots a_{\vartheta\alpha}\, a_{\alpha\lambda}\, x_\lambda \quad \text{and} \tag{12}$$

$$x_{R\mu\nu\ldots\vartheta\alpha} = a_{R\mu}\, a_{\mu\nu} \ldots a_{\vartheta\alpha}\, x_\alpha \tag{13}$$

Dividing (12) by (13) we get

$$\frac{x_{R\mu\nu\ldots\vartheta\alpha\lambda}}{x_{R\mu\nu\ldots\vartheta\alpha}} = \frac{x_{\alpha\lambda}}{x_\alpha} \tag{14}$$

Similarly, by dividing the first term on the right hand side of (10) by the corresponding term in (11), we get

$$\frac{x_{R\alpha\lambda}}{x_{R\alpha}} = \frac{x_{\alpha\lambda}}{x_\alpha} \tag{15}$$

Since the right hand side of (10) contains the same number of flows as the right hand side of (11) and since the same relationship, as illustrated in (14) and (15), holds for each pair of corresponding flows, it is readily found that

$$\frac{x_{R\,|\,\alpha\lambda}}{x_{R\,|\,\alpha}} = \frac{x_{\alpha\lambda}}{x_\alpha} \tag{16}$$

[1] As a special case we have $\alpha = \lambda$, which gives flows of the forms $x_{R\lambda\lambda}$ and $x_{R\ldots\lambda\lambda}$. We shall consider such flows as distinct from $x_{R\lambda}$, in order to avoid double-counting.

From (9) and (16), we find that

$$x_{R\,|\,\lambda} = x_{R\lambda} + \sum_{\alpha=1}^{m} \frac{x_{R\,|\,\alpha}}{x_\alpha} x_{\alpha\lambda} \tag{17}$$

Dividing both sides by x_λ and putting, as before, $\frac{x_{R\lambda}}{x_\lambda} = a_{R\lambda}$, etc., we get, for any $x_\lambda \neq 0$,

$$\frac{x_{R\,|\,\lambda}}{x_\lambda} = a_{R\lambda} + \sum_{\alpha=1}^{m} a_{\alpha\lambda} \frac{x_{R\,|\,\alpha}}{x_\alpha} \tag{18}$$

Letting λ vary from 1 to m, we can rewrite (18) as a system of linear equations, which after slight rearrangement appears as follows:

$$\begin{aligned}
&(1 - a_{11}) \frac{x_{R\,|\,1}}{x_1} - a_{21} \frac{x_{R\,|\,2}}{x_2} - a_{31} \frac{x_{R\,|\,3}}{x_3} - \cdots\cdots - a_{m1} \frac{x_{R\,|\,m}}{x_m} = a_{R1} \\
&- a_{12} \frac{x_{R\,|\,1}}{x_1} + (1 - a_{22}) \frac{x_{R\,|\,2}}{x_2} - a_{32} \frac{x_{R\,|\,3}}{x_3} - \cdots\cdots - a_{m2} \frac{x_{R\,|\,m}}{x_m} = a_{R2} \\
&\qquad\vdots \qquad\qquad\qquad \vdots \qquad\qquad \vdots \qquad\qquad\qquad \vdots \\
&- a_{1m} \frac{x_{R\,|\,1}}{x_1} - a_{2m} \frac{x_{R\,|\,2}}{x_2} - a_{3m} \frac{x_{R\,|\,3}}{x_3} - \cdots\cdots + (1 - a_{mm}) \frac{x_{R\,|\,m}}{x_m} = a_{Rm}
\end{aligned} \tag{19}$$

In the more compact matrix notation this system can be written as

$$(I - a')\, X = b, \tag{20}$$

where I is the identity matrix,

$$I = \begin{bmatrix} 1 & 0 & 0 & 0 & \cdots\cdots & 0 \\ 0 & 1 & 0 & 0 & \cdots\cdots & 0 \\ 0 & 0 & 1 & 0 & \cdots\cdots & 0 \\ 0 & 0 & 0 & 1 & \cdots\cdots & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ 0 & 0 & 0 & 0 & \cdots\cdots & 1 \end{bmatrix}$$

a' is the transpose of $a = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \cdots\cdots & a_{1m} \\ a_{21} & a_{22} & a_{23} & \cdots\cdots & a_{2m} \\ a_{31} & a_{32} & a_{33} & \cdots\cdots & a_{3m} \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ a_{m1} & a_{m2} & a_{m3} & \cdots\cdots & a_{mm} \end{bmatrix}$

$$\text{X is a vector } \left(\frac{x_{R\,|\,1}}{x_1}, \frac{x_{R\,|\,2}}{x_2}, \frac{x_{R\,|\,3}}{x_3}, \ldots\ldots \frac{x_{R\,|\,m}}{x_m}\right) \text{ and}$$

$$\text{b is a vector } (a_{R1}, a_{R2}, a_{R3} \ldots\ldots a_{Rm}).$$

For any non-singular matrix $(I - a)$, premultiplication of both sides in (20) by $(I - a')^{-1}$ gives

$$X = (I - a')^{-1} b \text{ or } X' = b\,(I - a)^{-1}, \tag{21}$$

where $(I - a')^{-1}$ is the inverse of $(I - a')$. Putting $(I - a)^{-1} =$

$$= A = \begin{bmatrix} A_{11} & A_{12} & \ldots\ldots & A_{1m} \\ A_{21} & A_{22} & \ldots\ldots & A_{2m} \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ A_{m1} & A_{m2} & \ldots\ldots & A_{mm} \end{bmatrix} \tag{22}$$

we can now write

$$\frac{x_{R\,|\,\lambda}}{x_\lambda} = a_{R1} A_{1\lambda} + a_{R2} A_{2\lambda} + \ldots\ldots + a_{Rm} A_{m\lambda} \text{ or} \tag{23}$$

$$x_{R\,|\,\lambda} = (a_{R1} A_{1\lambda} + a_{R2} A_{2\lambda} + \ldots\ldots + a_{Rm} A_{m\lambda})\, x_\lambda \quad (\lambda = 1, 2, \ldots\ldots m)$$

In the chain of derivations above, R represented an exogenous sector. By a similar train of reasoning we can also arrive at estimates of, for instance, $x_{\varkappa\,|\,\lambda}$, where $\varkappa$ represents an endogenous sector ($\varkappa = 1, 2, \ldots\ldots m$). We find that

$$x_{\varkappa\,|\,\lambda} = A_{\varkappa\lambda}\, x_\lambda \tag{24}$$

Thus the part of $x_\varkappa$ which, working its way through the industrial system, is absorbed by sector λ, can be estimated as the coefficient $A_{\varkappa\lambda}$ times the total amount flowing from sector λ (x_λ). We may therefore interpret the coefficient $A_{\varkappa\lambda}$ as the average amount of *direct-plus-indirect* supply from sector $\varkappa$ that is needed per unit of output from sector λ.

Using the same general procedure and extending the factorability assumptions to hold for the deliveries to the exogenous sectors, we can also derive formulas for estimating $x_{R\,|\,\lambda C}$ and $x_{\varkappa\,|\,\lambda C}$, where C represents an (arbitrarily chosen) exogenous sector. We find, in analogy with (23),

$$x_{R\,|\,\lambda C} = x_{\lambda C} \sum_{\alpha=1}^{m} a_{R\alpha} A_{\alpha\lambda} \tag{25}$$

and, in analogy with (24),

$$x_{\varkappa\,|\,\lambda C} = A_{\varkappa\lambda}\, x_{\lambda C} \tag{26}$$

By summing for $\lambda = 1, 2, \ldots\ldots m$ in (26), we get

$$\sum_{\lambda=1}^{m} x_{\varkappa\,|\,\lambda C} = \sum_{\lambda=1}^{m} A_{\varkappa\lambda}\, x_{\lambda C} = x_{\varkappa\,|\,C} \tag{27}$$

The interpretations that can be given to (25), (26) and (27) should be fairly obvious from what has been said above; (27), for instance, can be interpreted as the part of $x_\varkappa$ which is incorporated in the deliveries to sector C from all the m endogenous sectors, that is to say it includes the direct as well as all indirect supplies from sector $\varkappa$. Since the expression (27) exhausts all the possible routes (within the theoretical system given) by which a flow can pass from sector $\varkappa$ to sector C, it can also be written $x_{\varkappa \mid C}$.

Thus, by means of the factorability assumptions, we have expressed the rather complex magnitudes $x_{R \mid \lambda}$, $x_{\varkappa \mid \lambda C}$, etc., in terms that are easily derivable, once the definitional relations given in (1) above are connected with empirical data. The question of how far the empirical data concerned fulfil the factorability assumptions, will be taken up in the next chapter. It should be clear to the reader, however, that here we have required the data to permit the valid use of operations at a high level of measurement. We have assumed that such operations as addition, division, vector multiplication, and matrix inversion, can be meaningfully performed.

The results derived from the factorability assumptions can be used as instruments in the analysis of data pertaining to a specific period of time. In Ch. IV we shall try our luck on several applications of the factorability assumptions. In Ch. V one application will be made of the more comprehensive assumption of invariant structural relations. Incidentally, the assumption of invariant structural relations presupposses the assumptions of factorability, as can in fact be found from the preceding analysis.

CHAPTER III

Connecting Theoretical Concepts with Empirical Data

In science, one is generally aware of the complexity of the term »observation». The problem of the interaction between the observer and the observed has attracted much attention,[1] and wide variations in the meaning of the term observation in different scientific situations have been exposed.[2] MORGENSTERN, writing on the problem of accuracy in the field of economics, makes a distinction between *observations,* as being »deliberately designed», and *data,* as being »merely obtained».[3] If one applies this distinction to the present study, it will be found that this is a study dealing with data. In fact, most of the phenomena and events of interest here, were first recorded by business enterprises, government bodies and other entities, in various forms of accounts, later collected by data-gathering agencies, and only afterwards treated by the researcher. In the procedure of relating the theoretical concepts to the empirical data, in the following pages, I shall now and then remind the reader of this circumstance and point out some of the possible consequences. I shall refrain from using the term observation and speak instead about *data* when referring to »that which is measured».

SOME GENERAL MATTERS OF FLOW CLASSIFICATION AND MEASUREMENT

In the previous chapter we conceived of the economy as a special system of real and financial flows. The meaning to be attached to »flows» was only indicated, by circumventing examples. Now, I shall try to convey a more precise meaning of the concept, as used here, by exposing the operations from which the measures of flows in this study have been generated. Thus, our task is now to connect the conceptual system with empirical data. First, I shall consider some general matters that bear upon the classification and measurement of all flows in the present study. On p. 32,

[1] See, e. g., Sebba, G., (1953) The development of the concepts of mechanism and model in physical science and economic thought, pp. 259—268, and the comments on Sebba's paper by Carl Christ, pp. 272—274 (The American Economic Review, Papers and Proceedings, vol. 43).

[2] See, e. g., Lenzen, V. F., (1955) Procedures of empirical science, pp. 281—338 (In: International Encyclopedia of Unified Science, vol. I).

[3] Morgenstern, O., (1950) On the accuracy of economic observations, p. 32.

after the sector classification has been presented, some special questions of flow classification and measurement will be dealt with, such as the treatment of flows referring to distributive trades and to foreign trade. A more detailed description of the classifications and measurements is given in Appendix 2. The present chapter is concluded by a discussion of the main shortcomings and limitations of the data available.

The timing of flows

A set of definitional relationships was introduced on p. 10 in Ch. II. The accounting identities upon which these relationships rest, may in principle appear rather evident.[1] However, when it comes to fitting available empirical data into such definitional relations, it turns out that the matter is not quite so simple.[2]

One of the characteristics of the type of economy that we are studying here is the fact that it is composed of a large number of different decision-units. Differences in the decision-making, as between different units, manifest themselves also in the field of accounting. For instance, not all enterprises use the same rules for *dating* flows. (Normally, available records of flows will refer to some definite period of time.) Consequently, if all enterprises were to map data on exactly the same set of flows according to time periods, it is very unlikely indeed that they would all come out with the same order. Clearly, then, when we combine micro-data, i.e., data from individual establishments or other acting units, into macro-data, we must be careful to see that data on the macro-level are not inconsistent with each other.[3]

Some enterprises, particularly small ones, date flow transactions only when they pay, or are paid, for them. Other enterprises, particularly larger ones, assign several dates to flow transactions. For instance, a manufacturing company may keep records of the daily output of products, i.e., a date is assigned to real flows when they emerge from the production process. Also, a date may be assigned to real flows, when an invoice is issued and/or when the physical delivery takes place. Finally, the date of actual and/or stipulated payment for any particular flows may be recorded. Similarly, a company that purchases raw materials, etc., may record the flows of such goods on the basis of 1) the dates at which the goods are put into a production process or are used up in some other way, i.e., become »costs»; 2) the dates of

[1] Cf., Leontief, W., (1951) The structure of American economy, 1919—1939, p. 12: »It follows from the obvious nature of economic transactions that each revenue item ... of an enterprise or household must reappear as an outlay item in the account of some other enterprise or household.»

[2] For some supporting examples, see Sillén, O., (1943) Studier i svensk företagsekonomi (Studies in Swedish business administration), pp. 208—215.

[3] Cf., Frisch, R., (1943) Ökosirk-Systemet, p. 121 (Ekonomisk Tidskrift, vol. 45) and, also, Burdett, D. K., (1954) Social accounting in relation to economic theory, p. 685 (The Economic Journal, vol. 64): »Different bodies keep their accounts in different ways, and if social accounting did not go beyond plain description, it would be impossible to form a consistent set of accounts for the transactions of all bodies together. It is necessary to formulate a standard accounting system. This means that all units of economic behavior are treated not only as though each had a set of accounts of the same kind, but also as though each followed the same rules for recording transactions in them. This is as much a fiction as those to be found in pure economic theory. It might be termed the fiction of the 'accounting man' as opposed to that of the 'economic man'.»

receipt of invoice and/or physical receipt of the goods, i.e., when an »expenditure» is incurred; and 3) the dates of actual and/or stipulated payment.[1]

To summarize, some enterprises consider only one aspect of the timing of flows, namely dates of actual payment, in their accounting, whereas others consider several aspects of the timing of flows, including dates of actual payment. A practical conclusion from this, with regard to the fact that we are here restricted to the use of data which are already available, might seem to be that we should select such data for study as are recorded on a cash-payment basis, in order to achieve consistency on the macro-level. However, to select data on that basis might give a completely misleading picture of the functioning of the economy from one point of view that is of particular interest in this study, namely with regard to the productive activity of the various parts of the economy. From that point of view, also, it would be misleading to study the real flows and their financial counterparts as selected on the basis of the dates of issuance and receipt of invoice.[2] Such data would overestimate the amount of productive activity in times of inventory decrease and underestimate it in times of inventory increase.

The procedure here followed has been to try as far as possible to measure flows on an *accrual* basis. Real flows have been interpreted, on the dispersing (or output) side, as the *production* of goods and services that has accrued during a specific period of time, and on the absorbing (or input) side, as the *consumption,* or other usage, of goods and services that has accrued during the same period of time. Financial flows have been interpreted as *receipts* accrued during a specific period of time — specified with regard to sources on the one side, and on the other side with regard to allocations.

From what has been said follows that transactions in real objects which have been neither produced nor consumed during some specific period chosen for study, will not be covered by this investigation. An example is the sale or purchase of some real estate or of a house which was built before the beginning of the period of study and which will last till long after the end of the period. Similarly, transactions in such financial objects as bonds or debentures, are excluded.

Thus events which, from the point of view of both the seller and the buyer, may be referred to as *capital* transactions are excluded from study here.

Relating flows to establishments

To relate the flows to periods of time in some consistent way, is one step toward their measurement. Another step is to relate the flows to some identifiable units of economic activity, which can be interpreted as absorbing and/or dispersing the flows in question.

By »units of economic activity» or »acting units» we shall here understand those

[1] In Swedish, the following terms correspond to these three aspects of the timing of flows: 1) kostnad, 2) utgift, and 3) utbetalning. Cf., ter Vehn, A., (1945) Mekanförbundets normalkontoplan. pp. 36—46.

[2] Or, on the basis of the dates of delivery and receipt of goods.

entities which in official censuses are referred to as »establishments».[1] The concept will be interpreted sufficiently widely to incorporate households.

From the point of view of the validity of the assumption of structurally invariant relationships introduced earlier, it might be argued that a still finer unit should be chosen: a kind of operating unit, that is, which would account for the not uncommon fact that mixed activities — such as spinning and weaving or manufacturing and wholesaling — are carried on within the same establishment. However, in this study the choice of the establishment as unit was dictated by the data obtainable. The main sources — for instance, the 1951 Census of Production, Distribution and Services — used the establishment as their basic reporting unit.

Measuring flows in monetary units

Like all other empirical studies in this field, the present one has had to adopt the monetary yardstick as a measure of flows. That the financial flows, the receipts, have been measured here in monetary units, need perhaps not be commented upon. But, clearly, we might think of measuring the real flows in quantity units: the flows of steel in tons, the flows of electric power in kilowatts, the flows of labor in man-hours or man-years, and so on. However, as is well known, one soon runs into great trouble in any attempt to measure along such lines, for one thing because of the heterogeneity of the commodities produced, for example, by establishments in engineering industries. Also, as regards many service-producing establishments such as those engaged in distributive trading, there is at present no other measure available of current output or production than the receipts which are obtained in return for the output.

It turns out that the receipts, expressed in monetary units, are the only common denominator available for all those real flows which are paid for, that is, which occur in pairs with financial counterflows. To each such pair of flows one number is assigned in the present study. Being expressed in some monetary unit this number is to be interpreted here as the amount of real flows, going in one direction, and as the amount of financial flows (receipts), going in the opposite direction.[2]

[1] Cf., Studies in methods: Industrial censuses and related enquiries, vol. 1, p. 62 (publ. by the Statistical Office of the U. N., in 1953, as series F, no. 4): ». . . the establishment is a combination of resources and activities that are directed toward the output of one or more major but similar products or services (i. e., falling within the same primary class in the industrial classification scheme), carried on at a singular location under one control. Resources and activities that contribute indirectly as well as directly to output should be included. In other words, the establishment encompass auxiliary units, such as offices, warehouses, machine shops and power plants, as well as the units that directly produce the goods and services sold. All governments have utilized this definition for the establishment, and it has been recommended by the League of Nations, the Statistical Commission and the Inter-American Statistical Institute.»

[2] Cf., Leontief, W., (1953) Studies in the structure of the American economy, pp. 8—9, where the interest is focused upon the real flows: »All figures . . . are shown in dollars. They might as well have been given in physical units appropriate for the description of the outputs of the individual sectors of the economy — tons of coal, bushels of wheat, ton miles of transportation, man-hours of work, and so on. As a matter of fact, the dollar figures entered in each particular row can be interpreted in this sense provided one defines the physical units in which they have been measured as 'the amount (i. e. number of tons, yards, ton miles, or hours) of the particular product purchasable for one dollar at the prevailing 1947 prices'.»

In principle, one could *impute* counterflows, so that all data when arranged in tabular form could be interpreted in this dual way, as representing real flows in one direction and financial flows in the opposite direction. Then data would be selected regarding any real and financial flows, provided that they referred to establishments in the society considered and to some specific period of time chosen for study, but regardless of whether the flows were interrelated or not. However, in some cases one would be very hard put to it to give a meaningful interpretation of the imputed counterflows. Take, for instance, such government transfers to households as family allowances. To impute real counterflows to such financial flows, one would have to imagine that households yielded some services to the government in return. Similarly, taxes paid by business enterprises would have to be conceived of as payments for some government services rendered.

To clarify the position taken here in this matter, let us consider the different types of flows that can occur. In the literature of the subject such flows as have corresponding counterflows, are referred to as requited[1] or combined[2] flows. Unilateral flows are referred to as unrequited[1] or independent[2] flows. If A sends some commodity to B, which B has to pay for, it is a requited flow, but if A presents the commodity to B as a gift, it is an unrequited flow. Using a two-way classification, we distinguish five types of flow transactions: two types of unrequited flows, namely real ones (i.e., gifts in kind) and financial ones (i.e., financial transfers) and three types of requited flows, namely real flows with real counterflows (i.e., barter trade), real flows with financial counterflows (e.g., sales of goods and services) and financial flows with financial counterflows (e.g., sales of bonds).

As has already been indicated, flows of the last-mentioned type, i.e., requited flows which consist of two financial flows, will be excluded from study here. Barter trade is in principle accounted for simply through two imputed flows, one in each direction. In that way, we are left with only one type of requited flows, namely those which are composed of real flows in one direction and financial flows in the opposite direction. To simplify further the arrangement and, also, the interpretation of data, gifts in kind are either neglected here — that applies, for instance, to gifts between households — or accounted for through imputed financial flows — that applies, for instance, to aid to foreign countries. Thus, all real flows are treated here as requited flows. The remaining type of unrequited flows, namely the financial ones, were, however, considered too important in the Swedish economy to be neglected in the present investigation.[3] They are explicitly accounted for. When data on unrequited financial flows are arranged in tabular form, they are denoted by such titles as »Transfers from national government», »Direct taxes», and »Dividends, interest and other transfer payments», so that there should be no doubt about their interpretation as unrequited flows.

[1] Frisch, R., (1955) From national accounts to macro-economic decision models (In: Income and Wealth, series IV, p. 20). I owe the distinctions made here to Frisch.

[2] Ohlsson, I., (1953) On national accounting, p. 13.

[3] On the other hand, as touched upon above, it was considered too artificial to impute real counterflows to such financial flows.

THE SECTOR CLASSIFICATION — WITH REFERENCE TO THE INTERSECTORAL FLOW DATUM TABLE

Principles guiding the classification of establishments into sectors

Clearly, data regarding the flows absorbed by and dispersed from any particular establishment during a period of time are aggregates, generally speaking.[1] A step towards further aggregation is taken when the establishments are grouped into sectors, as indicated in the conceptual framework, pp. 9—10. In this study the grouping has been guided, mainly, by the following principles:

A) The classification into production sectors and final demand sectors should be made sufficiently detailed for expository purposes. Through the resulting arrangement of data in tabular form a detailed net of flow relations between the sectors should be exposed — both with regard to relationships *within* the Stockholm area and with regard to relationships *between* the Stockholm area and the rest of the world. In particular, the arrangement of data should be such as to render it possible to estimate the city product or income (analogous to the national product or income), the city balance of current payments (analogous to the national balance of current payments), the shares in the city income accrued to the various manufacturing and service industries, and similar magnitudes.[2]

B) The production sectors should as far as possible be defined in such a way that the resulting structural coefficients will remain independent of changes in any element(s) of the final demand vector. This principle corresponds to the following statement by LEONTIEF[3]: »According to the abstract theoretical scheme, all production enterprises should be segregated into several homogeneous industrial groups, homogeneity being defined in terms of a) identity of products and b) qualitative and quantitative similarity of the cost structure of the firms within each group.»[4]

C) In order to make the explaining power of the theoretical system as great as possible, the set of endogenous (production) sectors should be given the largest possible scope. This principle has particularly guided the treatment of government authorities within the framework of the present study. Public schools and hospitals and similar government-owned establishments have been included among the endogenous sectors, leaving as far as possible only government administration in the set of exogenous sectors.[5]

[1] Balderston, J. B., and Whitin, T. M., (1954) Aggregation in the input-output model, p. 80 (In: Economic activity analysis, edited by O. Morgenstern): »In economics, the most basic units in *micro*, as well as *macro*, theory are aggregates. For example, the firm is a highly aggregated unit, the family is an aggregate and management is an aggregate. From the standpoint of aggregation, the difference between micro and macro economics is one of degree rather than of kind.»

[2] Cf., Aukrust, O., (1955) Nasjonalregnskap (National accounting), p. 44.

[3] Leontief, W., (1951) The structure of American economy, 1919—1939, p. 20.

[4] Cf., also, Holzman, M., (1953) Problems of classification and aggregation, pp. 326 and 336 (In: Studies in the structure of the American economy).

[5] On the other hand, due to the limitations of the data available, investment activity and households are included among the exogenous sectors in this study.

Of these three principles, the first and the third have the character of rather general signposts, whereas the second is formulated with special regard to the theoretical assumptions stated in the preceding chapter. Concerning this latter, let me state at once that it has not been possible here to carry out a formal analysis of the relevant properties of all establishments[1] as a basis for the classification into sectors. Lack of data and lack of time have precluded any such analysis, except on a limited scale.[2] By and large, I have had to depend upon the classifications used for census purposes.

The main categories of sectors

Five main groups of sectors are distinguished here and referred to by the following titles:

i) Production Sectors,
ii) Industries in the Rest of Sweden,
iii) Foreign Countries,
iv) Government Authorities, and
v) Households

Each of these groups will be commented upon briefly, in the following pages.

Altogether, 62 production sectors have been specified. They are all composed of establishments located within the Stockholm area. The names given to these 62 sectors are used as headings in the Intersectoral Flow Datum Table (nos. 1—62) that will be found inside the back cover of this report. A specification of the contents of each sector will be found in Appendix 2, where reference is made to the corresponding group numbers of the International Standard Industrial Classification of all Economic Activities (»ISIC»).[3] May it suffice here to say that each row, in the range 1—62, shows the destination of the total production from the sector named on the left — or, interpreted in the other way, the receipts of the sector, distributed with regard to sources. Each corresponding column shows the allocations of the receipts.

The classification of establishments manufacturing certain metal products and foodstuffs—a special investigation

The 1951 Census of Production, Distribution and Services, one of our main sources, classified altogether 475 groups of establishments — basing the work, generally, on the ISIC pattern.[3] Such groups have been combined here to form most of

[1] The Stockholm area had some 50 000 establishments in 1951, exclusive of households but including farms.
[2] See below.
[3] Cf., Studies in Methods: Industrial censuses and related enquiries, series F, no. 4, (1953), p. 55: »The International Standard Industrial Classification is designed for classification of establishments according to their main activity (e. g., type of products made, services rendered, or raw materials and processes used in work), determined for establishments that engage in diverse types of work by the activity that accounts for the highest proportion of receipts.»

the 62 production sectors. However, in order to classify establishments which manufacture certain metal products and foodstuffs, another and more formal technique was applied; available knowledge suggested that such establishments, as classified by the Census, manufactured a variety of products and, also, used many different processes. Consequently, it was thought that the Census groups formed from these establishments were rather heterogeneous when considered from the special point of view relevant here, namely with regard to their cost structures. I thought it worth while to investigate a little, whether the presumed heterogeneity could be reduced by applying another principle of classification: one that distinguished small and large establishments. As criterion of size I used the number of people gainfully employed per establishment. Data on sales per man-year were used to indicate variability within the different groups of establishments selected. The arithmetic means and the standard deviations of the quotients of sales per man-year were estimated for each group. Also, to allow for differences in the arithmetic means between the groups of establishments, coefficients of variation were calculated. Part of the study was based on samples.[1]

The investigation covered three groups of establishments, two groups from engineering industries and one group from food manufacturing industries.[2] As regards the first two groups of establishments, subgroups which consisted of establishments having more than 200 people gainfully employed each, showed a markedly lower dispersion than the respective groups of all establishments, the dispersion being measured in terms of standard deviations of the quotients of sales per man-year. Since the large establishments had somewhat higher sales per man-year than the smaller ones, the differences in the corresponding coefficients of variation were still larger. A trial with two other subgroups, each consisting of all establishments having more than 50 people gainfully employed, gave less convincing results. The figures arrived at are found on p. 29.

On the basis of these results the first group, i), was divided into the following two sectors, numbers referring to the Intersectoral Flow Datum Table:

16. Manufacture of electrical equipment, n. e. c.: establishments with more than 200 employees each,
17. Manufacture of electrical equipment, n. e. c.: establishments with not more than 200 employees each.

[1] Each sample contained data from some 80 establishments. Every *k*th establishment was selected, after a random start. As far as I was aware, this procedure should have been equivalent to a simple random sample.

[2] In terms of the branch classification used in the Swedish Census of Production, Distribution and Services, taken in 1951, the three groups had the following content, respectively: i) »manufacture of electrical machines», »manufacture of radios», »manufacture of electrical appliances, not elsewhere classified» (nos. 38—40); ii) »manufacture of paraffin stoves», »manufacture of caps and stoppers», »manufacture of lamp and light fittings», »manufacture of bicycles», »manufacture of transport equipment, n. e. c.», »manufacture of machines and engines», »machine shops, n. e. c.» (nos. 19—21, 28—29, 34—35); iii) »manufacture of bakery products», »refining of sugar», »manufacture of dairy products», »other slaughter-houses and slaughtering», »manufacture and preserving of meat products», »processing, canning and preserving of fish», »other canning and preserving», »manufacture of margarine», »coffee roasting», »manufacture of vinegar, mustard, soya, etc.», and »food industry, n. e. c.» (nos. 106—108, 111, 115, 118, 119, 121/122, 123/124, 125, 127, 131, 132).

Group i): *Manufacture of electrical machines and appliances*

Subgroups	arithmetic mean $\bar{x}$	standard deviation σ	coefficient of variation v
	sales per man-year (in thousands of Sw. Cr.)		
All establishments, sample	18	16,9	92
Establ. with more than 50 employees	21	8,9	42
» » » » 200 »	22	7,7	35

Group ii): *Manufacture of engines and turbines; machine shops, not elsewhere classified, etc.*

Supgroups	arithmetic mean $\bar{x}$	standard deviation σ	coefficient of variation v
	sales per man-year (in thousands of Sw. Cr.)		
All establishments, sample	20	22,3	112
Establ. with more than 50 employees	32	33,0	103
» » » » 200 »	28	13,4	48

The arithmetic mean, $\bar{x}$, is calculated as $\frac{\Sigma X}{N}$, where ΣX is the sum of the quotients of sales per man-year and N is the number of establishments selected.

The standard deviation, σ, is for the samples calculated as $\sqrt{\frac{\Sigma(\bar{x}-X)^2}{N-1}}$ and for the sub-populations as $\sqrt{\frac{\Sigma(\bar{x}-X)^2}{N}}$.

The coefficient of variation, v, is calculated as $\frac{100\sigma}{\bar{x}}$.

The second group, ii), was divided into:

20. Manufacture of engines and turbines, etc., n. e. c.: establishments with more than 200 employees each,
21. Manufacture of engines and turbines, etc., n. e. c.: establishments with not more than 200 employees each.

As regards the group of establishments manufacturing foodstuffs the results were not considered sufficiently conclusive to warrant a corresponding division. Instead, it was found preferable to reduce the over-all dispersion by making a separate sector of a subgroup consisting of all establishments manufacturing dairy products. Also, the coefficient of variation was much lower for this subgroup than for the rest of the total group. This particular subgroup of dairies weighed heavily in terms of total sales of the group, making up for nearly 40 per cent.

Besides being limited in scope, the attempts reported on above suffer from several shortcomings, as can easily be recognized. Other subgroups might have been investigated by using other class limits or other criteria of size. Also other properties of the establishments than sales per man-year, might conceivably have been analysed.[1] However, as was mentioned, lack of data and time made such analyses impracticable. The endeavours here made should be looked upon as modest attempts to improve upon the classifications given in the census; improve, that is, for our present purpose.

Further comments on the sector classification chosen

The reader who is used to American input-output tables will find that in another respect, too, the present sector classification does not seem to be quite orthodox. No less than 14 of the 62 production sectors represent wholesale and retail trade.[2] This should not appear surprising, however, when it is remembered that the present study focuses upon a large city which is also a trading center.

Due to the severe limitations of data, industries in the Rest of Sweden have been lumped together under two headings only, namely Agriculture and all Other Industries (nos. 63 and 64 in the Intersectoral Flow Datum Table). These two sectors have been included among the final-demand categories; to treat them as endogenous sectors might have given rise to erroneous results because of their aggregated character.[3]

Each one of the 64 sectors now commented upon is represented by a row and a corresponding column in the Intersectoral Flow Datum Table. This strict correspondence between rows and columns is not maintained in the rest of the table. Thus, Foreign Countries, which come next in the table, are represented by six rows and one column (nos. 65—70). The rows specify under six headings Sweden's imports of goods and services and some other transactions which also result in financial flows, such as dividends, *to* Foreign Countries. The column specifies Sweden's exports of goods and services to Foreign Countries and some other transactions which also result in financial flows, such as dividends, *from* Foreign Countries. The greater specification on the import side was made in order to provide some more detailed information on the import structure and, also, to make it easier to detect errors and mistakes in the table.

Three government sectors are separated in this study, namely a) the City of Stockholm, i.e. the local authority, b) All Other Municipal Authorities in the country and c) National Government. The Stockholm area comprises 28 municipalities in addition to the city of Stockholm. In order to keep all the establishments which are comprised within the Stockholm area separate from establishments in the rest of Sweden, a special sector should have been formed from the local authorities

[1] For instance, one might have analysed whole vectors of structural coefficients, for each establishment.

[2] Even the American table from 1947 that distinguishes 200 sectors, gives only two trade sectors.

[3] However, in one of the applications, dealt with in ch. V, there was no other choice open than to treat the two industries in the rest of Sweden as endogenous sectors.

of these 28 municipalities. But the data available did not permit such a separation; the sector All Other Municipal Authorities in Sweden therefore includes a small fraction consisting of establishments within the Stockholm area, i.e., the 28 municipal authorities referred to. It may be mentioned that in 1950, the period of study, some 25 % of the total population of the Stockholm area lived within the 28 municipalities in question. Their relative importance was even less when measured in terms of the working population: some 15 % of the gainfully employed population of the Stockholm area worked within the municipalities mentioned. Due to data limitations, also, it turned out that those establishments of the national government sector which were situated in the Stockholm area could not be separated.

The City of Stockholm is represented in the table by two rows (nos. 75—76), one showing local taxes accrued and the other showing all other income accrued to the City, and two columns (nos. 75—76 and 82), one showing goods and services used[2] for administration purposes, mainly, and the other showing the allocations of financial transfers from the City.

All Other Municipal Authorities in Sweden are represented by one row (no. 77), showing their aggregated receipts, and two columns (nos. 77 and 83), one showing the goods and services used[1] by these authorities and the other showing the allocations of the financial transfers from them.

National Government Administration, including defence, is represented in the basic table by three rows and two columns. The rows (nos. 78—80) specify the receipts under three headings, namely direct taxes, indirect taxes and income from property and entrepreneurship — all three kinds of receipts being measured as far as possible on an accrual basis. One of the two columns (also numbered 78—80) shows the goods and services used by the national government administration, distributed with regard to their sources. The other column (no. 81) shows the allocations of the financial transfers from the national government.

Households are separated into two sectors, Households in Stockholm and Households in the Rest of Sweden, each being represented in the basic table by two rows and one column. The first row (nos. 84 and 86, respectively) shows wages and salaries, and the second (nos. 85 and 87, respectively) shows dividends, interest and other transfer payments to the household sector concerned. The column (indicated by the same numbers) shows the way in which households allocated their receipts, for consumption.

The flows of products used for capital formation are registered separately in the Intersectoral Flow Datum Table. However, for data reasons, the destinations of such flows are specified only on a simple geographical basis. Column no. 71 registers the Gross Capital Formation, inventories excluded, within the Stockholm area, whereas the corresponding entries for the rest of the country are found in column no. 72. Inventory Increase is registered in column no. 73. Inventory Decrease, on the other hand, is registered in row no. 73. Corresponding to the registrations of capital formation are the Depreciation entries registered in the row numbered 71—

[1] Purchases on investment account are not included here; they are registered in a separate column, cf., p. 34.

72. Data on Retained Profits of the 62 production sectors in Stockholm and the two industries in the rest of Sweden are registered along row no. 74 — and, correspondingly, any net losses or deficits incurred by the same sectors are registered in column no. 74.

The items registered in the columns and rows nos. 71—74 are referred to in the basic table as Balance Items. By inserting these items, an identity is established between the sum in any row and the sum in the corresponding column, for each one of the 64 sectors mentioned. The rows and columns balance completely.

SOME SPECIAL MATTERS OF FLOW CLASSIFICATION AND MEASUREMENT

Supplementary measures

As already mentioned, the data of the basic table are measured in monetary units. A supplementary measure will be used for two types of flows, namely flows of *labor* and *space (rental services)*. In the table the flows of labor are measured in terms of wages and salaries, and the flows of rental services are measured in terms of rent. These two kinds of flows are considered by the sponsors of this study to be of special interest and of strategic importance, from the point of view of planning for the future of the Stockholm area. From that point of view the crucial questions are not of the type »how much will wages, salaries and rents amount to, in order to be consistent with such and such exogenous conditions?» — but rather »how large supplies of manpower and of building space will be needed in order to be consistent with such and such exogenous conditions?». The answers to this latter type of question will throw more light, it is considered, on the adequacy or feasibility of the exogenous conditions stated. To provide some information expressed in physical units, the basic table will be supplemented by a small table of data on total requirements of man-years and floor space, during or close to the basic period of study; these data will be arranged so that the monetary units, used in the basic table, can easily be converted into physical units of man-years and floor space.

Taxes on an accrual basis

The timing of flows in such a way that the data will be consistent on the macro-level, has been a serious problem in the stage of implementation, among others with respect to the *Government* sectors. Most of the primary statistics available in Sweden regarding the direct taxes received by government sectors are based on a cash-payment system.[1] On the other hand, at least the larger business enterprises record the allocations for taxes on an accrual basis, in their income (or production) statements.

[1] This state of affairs has been critized from a more general point of view than here in: Hansen, B., (1955) Finanspolitikens ekonomiska teori, p. 72 (The economic theory of fiscal policy).

With the system of taxation prevalent in Sweden, it would be a mere coincidence if the aggregated amounts of direct taxes recorded on the receiving (i.e., government) side were identical to the corresponding amounts recorded on the delivering or allocating (i.e., business) side. Since the principle adopted here is to record data on an accrual basis, the government data on taxes were recalculated. It was found that the amount of taxes *accrued* to the government sectors were some 500 miljon Sw. Cr. *higher* than the amount of taxes *received in cash,* during the period of study.[1]

Producer's values

In assigning numbers to the flows, I have used producer's values as a yardstick, instead of purchaser's values. Thus in this respect I have followed the practice of EVANS and HOFFENBERG and others, who have given convincing reasons for using producer's values.[2] A consequence of this choice is that *Indirect Taxes* have been carried directly to the government sectors concerned, from the sectors that use the products taxed. Also, such a treatment of the indirect taxes renders the financial-flow-interpretation quite clear-cut: the indirect taxes are receipts flowing to the government sectors and not to the sectors that produce the goods or services being taxed.

Another consequence of using producer's values is that the flows of services rendered by the *Trade and Transportation sectors* (nos. 7, 8, 11, 12, 37—52) are charged to the sectors for which the commodities are destined — and not to the sectors of origin. As regards distributive trades, I have followed the customary procedure of allocating the flows of commodities directly from the originating sectors to the sectors of destination, and not via wholesale and retail trade.[3] The sectors of distributive trades are treated as *producers of service,* including, for instance, the service of keeping assortments of goods available in stock. As usual, the value of the services concerned is defined as realized gross margins. In one respect, however, the present treatment of the trade sectors differs from what has been customary in the past. In all the applications I have seen, the services rendered to retail trade by wholesale trade are *not* charged to retail trade but to households. This seems to be a

[1] In Swedish national-accounting practice, the cash-payment basis is used for registration of direct taxes, whereas the general orientation is accrual. Thus, the figures arrived at here will differ by some 500 million Cr. from those found in Swedish national accounts studies. Cf., in this context, the discussion in: Ohlsson, I., (1953). On national accounting, pp. 168—171.

[2] See, Evans, W. D., and Hoffenberg, M., (1952) The interindustry relations study for 1947, pp. 103—104 (The Review of Economics and Statistics, vol. 34, no. 2). Also: Modlin, C. P., and Rosenbluth, G., (1954) The treatment of foreign and domestic trade and transportation charges in the Leontief input-output table, pp. 169—173 (In: Economic activity analysis, edited by O. Morgenstern).

[3] See, for instance, Barna, T., (1952) The interdependence of the British economy, p. 47 (Journal of the Royal Statistical Society, Series A, vol. 115, part I); and Evans, W. D., and Hoffenberg, M., (1952) op. cit., pp. 103—104. I quote from the last-mentioned source, p. 104: »If output of the trade sectors were defined to cover total sales, it would mean that a great variety of commodities would flow into trade as inputs and then be charged out in some averaged aggregate form to consuming sectors. This procedure would eliminate the direct link between producers and users (the exposing of) which is a main purpose of the tabulations, and would substitute instead a heteregeneous trading structure.»

misleading procedure.[1] In the present study, such services are treated as inputs to the retail trade sectors. Transportation services are treated in the same way.

The flows of services rendered by the *Banking and Insurance* sector (no. 53) are defined as having identically the same value as the total operating costs incurred by the sector, inclusive of dividends but exclusive of claims and similar capital transactions. The distribution of the services over receiving sectors had to be made in a rather arbitrary manner; it will be commented upon below, on p. 44.

Rental services

The delimitation of the sector named *Lessors of Real Property* (no. 54) is made on a functional basis, thus being an exception to the general principle of delimiting the sectors on an establishment basis. This exception has been made in order not to let ownership relations bias the cost structures. The flows referred to this sector include all rental services, and all costs incurred in supplying rental services, regardless of ownership relations.[2] Thus, the row which represents the sector in the basic table, registers not only factual rental payments but also imputed rentals for home owners, for industries using their own factory and office buildings, etc.

Imports

Imports from Foreign Countries (rows 65—70) to the Stockholm area are charged directly to consuming sectors, i.e., no distinction is made between competitive and noncompetitive imports.[3] Flows of products (»imports») from *the Rest of Sweden* (rows 63—64) are treated similarly. In making this decision I have been guided by the penetrating analysis of Modlin and Rosenbluth.[4] Also, for obvious reasons, most of the imports from »the rest of the world» to the Stockholm area are of the noncompetitive type, so that a division of imports into the two categories would have modified the arrangement of data only slightly.

Capital formation

Apart from inventory changes, the concept of *Gross Domestic Capital Formation* (columns 71—72) is defined here so as to correspond as closely as possible to the current international standard usage of the term.[5] The definition employed is nar-

[1] To illustrate, it implies that if, for instance, retailers began to by-pass wholesalers and to purchase commodities direct from manufacturers, their total costs, *as registered in the table*, would increase rather sharply. The tasks formerly carried out by the wholesalers would not then be eliminated, but would be transferred to the retailers. Whether the corresponding cost elements would be higher or lower than before, cannot be stated generally, but, the retailers would certainly incur costs.

[2] However, as regards buildings used by the government sectors, it was not possible to separate costs comparable to those found for all other sectors. The corresponding cost elements are therefore included in other items in the columns of the government sectors, such as Imports of Fuels, Depreciations, and Wages and Salaries.

[3] Cf., Leontief, W., (1951) The structure of American economy, p. 164, and Evans, W. D., and Hoffenberg, M., op. cit., p. 109.

[4] Modlin, C. P., and Rosenbluth, G., op. cit., pp. 129—173.

[5] See, for instance, Concepts and definitions of capital formation (Memorandum from the U. N. Economic and Social Council, prepared by the Secretary-General, 11 November 1952).

rower than that used in Swedish national accounts studies, where »all sorts of maintenance and small repairs» are included and where, further, »military expenditures on capital goods such as buildings or guns are treated as investment expenditures.»[1]

Private consumption

The columns which represent *Households* (nos. 84—87) comprise all the items conventionally referred to as private consumption, i.e., broadly speaking, all expenditures made by private individuals and families. The value of residential construction is not included in private consumption, but carried to Gross Domestic Capital Formation. As usual,[2] no value has been imputed to such household activities as the work of housewives; only paid domestic services have been registered in the basic table. The value of household consumption in kind has been estimated and, also, inserted in the table.

Depreciations

The decrease in the economic value of dwellings, non-residential buildings, and construction and works, due to physical deterioration — wear and tear — and obsolescence, have been estimated roughly and charged to the sector Lessors of real property (column 54) as an item of *Depreciations* (row 71—72).[3] The value of the existing building stock in the Stockholm area, as estimated for taxation purposes, amounted to some seven billion Sw. Cr. in 1950. This amount has been multiplied by a percentage figure of 2.5, in order to obtain an estimate of the depreciation allowances concerned. To view the estimate thus arrived at in its proper perspective, it may be useful to indicate an alternative procedure which would have yielded about the same results. Allowing for the influence of two long-run factors, both working in the same direction, namely the rise in prices and the expansion in building activity in the Stockholm area, the *original* value of the building stock, as measured in terms of the prices in effect when the buildings were erected, would probably be found to lie between ten and eleven billion Sw. Cr. If this value were then multiplied by 1.67, which would have been equivalent to an assumption that the average economic life of the building stock amounted to 60 years,[4] the result obtained would agree fairly well with that found through the procedure actually used here.[5]

Depletion allowances which represent the exhaustion of wasting resources, such as quarries, are estimated and charged as depreciation items to the sectors concerned

[1] National accounts studies: Sweden (1953), published by the OEEC, p. 13.

[2] See, e. g., Ohlsson, I., (1953) On national accounting, pp. 194—195, and Stone, R., (1956) Quantity and price indexes in national accounts, pp. 28—30.

[3] Depreciation of buildings used for government administration purposes are charged to the government columns concerned (nos. 75—80).

[4] Cf., Bildmark, K., (1954) Underhållskostnader för hyresfastigheter i Stockholm, pp. 167—173 (Maintenance costs for apartment houses in Stockholm).

[5] It turned out that no reliable measure could be made regarding the *cost of replacing* the decrease in the economic value of the dwellings, non-residential buildings, etc., that occurred in the year 1950 — a measure which would otherwise have been preferred.

— in this study to the sectors Manufacture of non-metallic mineral products in Stockholm (no. 24) and All other industries in the Rest of Sweden (no. 64).

The depreciation of other kinds of capital goods, such as transportation equipment, machinery and instruments,[1] is estimated on the basis of the actual accounting allowances made by enterprises. Such charges are obviously dependent upon accounting conventions and tax regulations, and frequently they do not reflect the value of the wear and tear and obsolescence that has occurred.[2]

It is perhaps superfluous to remind the reader that this problem of measuring fixed capital consumption is an extremely difficult one, particularly on the macroeconomic level. The estimates made here are admittedly very rough and can certainly be improved when more data become available regarding the productive capacity, the average economic life, etc., of different capital assets. With regard to the shortcomings of the items of depreciation inserted in the basic table — *as measures of capital consumption* — it might have been preferable to combine them, in the registration, with Undistributed Net Profits (row no. 74) to form a set of more aggregative financial items of retained income.

Here I have given only such information on the principles of classification and measurement adopted, as was considered indispensable for a general understanding of the form and content of the datum table. For further particulars regarding the classification and measurement of specific sectors and flows, the reader is referred to Appendix 2.

LIMITATIONS AND SHORTCOMINGS OF THE INTERSECTORAL FLOW DATUM TABLE

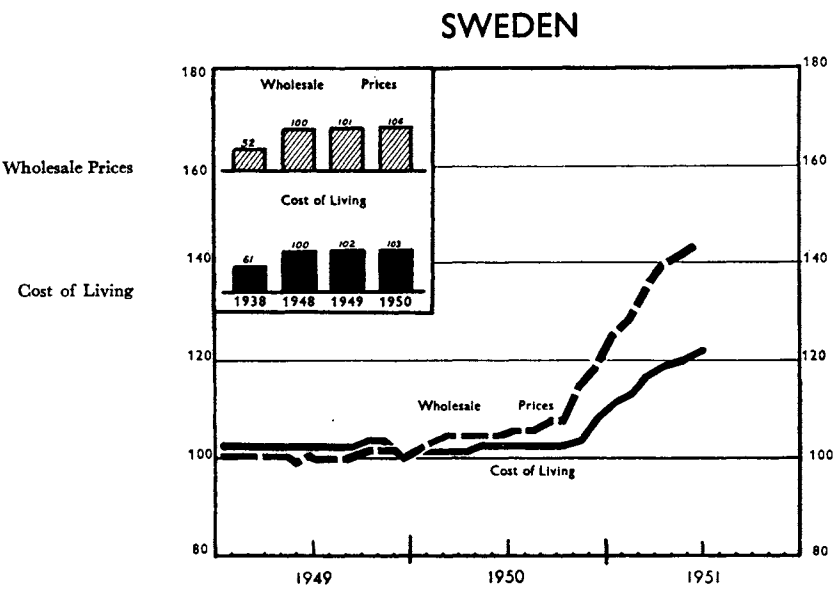
Gradually, we have approached the concrete figures inserted in the Intersectoral Flow Datum Table. So far, little has been said about the limitations and shortcomings of the table. A host of questions emerge, when we now take up this important theme for discussion. To which specific period of time does the table refer? How reliable are the data? How far are the data consistent, in the sense of fulfilling the definitional relations? Can one combine items in the table — by rules isomorphic to the arithmetical laws of addition and subtraction — so that the resulting aggregates or residuals can be meaningfully interpreted? Do the data fulfil the assumptions of factorability, so that they can be operated upon by rules analogous to the

[1] As indicated above, motor cars, refrigerators, etc., purchased by households, are registered as private consumption. This is in accordance with customary procedures.

[2] Some studies by Västhagen are of interest in this context. He investigated the income tax returns of some 200 large manufacturing and shipping companies in Sweden, during the period 1938—1951. As a standard for comparisons, he constructed a (fictitious) depreciation plan based on estimates of current replacement cost. This plan was then compared to the actual depreciation charges made to current income, according to available data. On the average, it was found that the actual depreciation for the whole period 1938—1951 was somewhat higher than the fictitious depreciation. See Västhagen, N., (1956) Free depreciation 1938—1951. An English summary of: Västhagen, N., (1953 and 1956) De fria avskrivningarna 1938—1951, Part I and II.

matrix-algebraic operations specified in the previous chapter? Can the set of structural relationships derivable from the table be applied to other time periods, as well?[1]

Chart showing wholesale prices and cost of living in Sweden, 1949—1951
(1948 = 100)



Source: OEEC General Statistical Bulletin, Nov. 1951, p. 10

The time period studied

The year 1950 was chosen as the basic period for study. It turned out when the study was being planned that the most extensive and detailed information on flows could be obtained for that year. This fact should be borne in mind when information is derived from the Intersectoral Flow Datum Table. In a sense, the table is based on a sample consisting of one unit only, the year 1950. Consequently, information derived from the table is tied to conditions prevailing at that time.

The full-employment situation on the Swedish labor market in 1950 and adjacent years, is indicated by the following set of figures, which show the unemployment in trade unions, measured as a percentage of the total registered.

[1] For pedagogical reasons, I have slightly reversed the order of discussing these questions in the following pages.

	Sweden as a whole	Stockholm
1938	10,9	?
1939	9,2	7,5
1947	2,8	3,0
1948	2,8	3,1
1949	2,7	2,2
1950	2,2	1,5
1951	1,8	1,2
1952	2,4	1,8
1953	2,8	3,0

Sources: OEEC General Statistical Bulletin, Nov. 1951 and 1954; Statistisk Årsbok för Stockholms Stad, 1951 and 1955 (Statistical Yearbook of Stockholm).

Except for certain raw material prices, there was only a moderate price rise in Sweden after the outbreak of hostilities in Korea in June 1950. The sharp rise in prices did not take place until 1951. The development of prices, for Sweden as a whole, is indicated by the chart on p. 37.

For further information regarding economic conditions in Sweden in 1950, and their relative position in time, the reader is referred to the Reports from the Swedish Konjunkturinstitut, from one of which I shall here quote only the following sentence: »The volume of gross national product rose by about 5 per cent per annum over the period 1947—1950, a rate of progress which is considerably above that of the inter-war period.»[1]

Additivity and factorability

In a preceding section, we found that consistent timing, »periodising», of all flows would be a prerequisite[2] for the fulfilment of the definitional relations. I used as an illustration the accounting of direct taxes. It has not been possible in the present study, to check that this requirement is fulfilled in all cases in the table. In principle, it might seem easy to make such a check: by adding all the estimates of the individual items (nos. 1—87), along any row in the table, the sum should coincide with the corresponding Grand Total item in column 88. For all the production sectors, this column shows the total value of production[3] for the sector concerned, the value being measured in terms of total receipts, adjusted for (the producer's value of) any increase in inventories in 1950. However, if the two sums did not coincide, the difference might be ascribed to many other kinds of error as well. Thus we do not have one particular source of error, but several, and the different types of error cannot at present be isolated.

Throughout, I have followed the procedure of taking the Grand Total data for granted, and of reconciling individual items along the rows, so that they are consistent with the corresponding Grand Total item. Since it is likely that the receipts

[1] Konjunkturläget våren 1952 (The economic outlook in the spring of 1952), vol. A: 21, p. 179

[2] Strictly speaking, this prerequisite is not mathematically necessary, since there may be compensating effects involved.

[3] As mentioned, indirect taxes are excluded.

data obtained from small handicrafts and similar establishments are on a cash basis, the procedure used has given rise to a possible source of error in the table, although, in all likelihood, a small one.[1]

When confronting the theoretical assumptions of factorability and additivity, introduced in the previous chapter, with data, we find that we must impose upon data the requirement of being consistently *priced*. Let me illustrate this by an example. Take the sector Electricity, Gas and Water Services (no. 34). According to the table, this sector obtained one million Sw. Cr. in receipts from Beverage Industries and Tobacco Manufactures (column 2, row 34) and the same amount of receipts from the sector Motion Pictures and Other Amusement (column 56, row 34). Now, does this mean that the amount of electricity, gas and water services rendered to Beverage Industries and Tobacco Manufactures *exactly balances* the amount of such services rendered to Motion Pictures and Other Amusements? In other words, if we add the numbers designating the amounts of services rendered to these two sectors, can we conclude that half of the resulting sum is interpretable as absorbed by Beverage Industries and Tobacco Manufactures and the other half as absorbed by Motion Pictures and Other Amusements? As can be seen, these questions boil down to the fundamental question whether the items along any row in the table are additive, when interpreted as real flows. If they are additive, then we should be able to give an operational interpretation to the sum arrived at.[2] In the example cited such an interpretation is possible, provided that the two flows concerned are *priced* in identically the same way. That is, we must require that some *average price* for the electricity, gas and water services rendered in the period of study, was applicable to both the buying sectors. This would not be the case, if there had been price changes in 1950 and if, also, one sector happened to buy most of the services concerned when prices were relatively low, whereas the other sector happened to buy most of the services when prices were relatively high. Neither would it be the case, if prices were differentiated as between the two buying sectors, such that one of them was charged a higher price, say, per kilowatt of electric power, than the other.

In order that prices should be consistent in the sense indicated above, I have tried to avail myself, as far as possible, of information regarding the *quantities* absorbed by the sectors; to form cost items, the quantities have then been evaluated in terms of the average prices of the commodities, prevailing in 1950. However, this procedure has only been possible for the raw materials, semi-manufactured products and fuels consumed by manufacturing industries. Moreover, the available data of

[1] In this connection, it might be worth mentioning that the National Government (current) expenditure, as obtained from official accounts, relates to budgetary years, lasting from July 1st to June 30th. In the present study, I have added the expenditure of the two periods 1949/50 and 1950/51, and divided the sums by two. This procedure has occasionally been used by the Konjunkturinstitut.

[2] Cf., Hempel, C. G., (1952) Fundamentals of concept formation in empirical science, p. 75: »The distinction of additive and nonadditive quantities refers to the existence or nonexistence, for a given quantitative concept, of an operational interpretation for the numerical addition of the s-values of two different objects (s is a function which assigns to every element x, within a specified domain of application, exactly one real-number value, $s(x)$). In this sense, length is called an additive quantity because the sum of two numerical length-values can be represented as the length of the interval obtained by joining two intervals of the given length end to end in a straight line; temperature is said to be nonadditive because there is no operation on two bodies of given temperatures which will produce an object whose temperature equals the sum of the latter.»

this type refer to Sweden as a whole, which means that national averages have been applied to industries in the Stockholm area.

Thus, there may be inconsistencies in the table with regard to the pricing of flows. Besides affecting the real-flow interpretation of data, this possibility casts some doubt, also, on the intended applications of the factorability assumptions. As the reader will remember (Ch. II, p. 16), the assumptions of factorability imply that the real flows (outputs) from a sector should have the same cost structure (the same relative composition of inputs), regardless of which sector directly, or indirectly via other sectors, absorbs the flows. As pointed out by Frisch, these assumptions are not so far-reaching as to require »atomistic» factorability, implying that however small a unit of product that was analysed we should still find that it was built up of the same cost structure as all other units.[1] But since the flows are expressed in values, the factorability assumptions do require that the same set of prices applies to all buying sectors. It is not known whether, and if so to what extent, different prices actually were charged to different sectors in 1950. As indicated above, it has been possible to cope with this problem on a limited scale only, through the use of average prices.

The practical outcome of these considerations seems to be that one must stress the *approximate* character of the results derived from applications of the factorability assumptions in this study. The degree of approximation cannot at present be appreciated, since no precise, numerical, limits can be assigned to the results. We are faced with the not uncommon situation of having a powerful theoretical apparatus that cannot be completely sustained by available data.

The table as a basis for estimates of structural relations

Through applying the factorability assumptions we can derive more information than that explicitly given in the Intersectoral Flow Datum Table, but, clearly, this derived information will also pertain to the year 1950, the period of study. However, if one employs a table of this kind as one basis for estimating the structural relations that link together the production sectors, then one usually has a different purpose in mind, namely to make forecasts. Thus, one intends to apply the set of structural relations to a period of time other than that or those from which it was derived.[2] The simplest and crudest form of such application is of course the one in which it is assumed that the structural relations have been invariant in the meantime. In the present study I shall use this assumption of invariant structural relations in one

[1] It goes without saying that the homogeneity of flows is also conditioned by the sector classification used. This question has been dealt with before (see p. 26).

[2] Such conditional forecasts need not of course refer to *future* periods of time. Some very interesting applications were recently reported by Adams and Stewart (University of Cambridge), who used a matrix of coefficients for 1935 to estimate the production levels in the years 1924, 1930, 1933 and 1934. See Adams, A. A., and Stewart, I. G., (1956) Input-output analysis: An application, pp. 442—454 (The Economic Journal, vol. 66).

application only, namely in order to calculate, for the year 1955, the production levels of the 62 endogenous sectors which would be consistent with the structural coefficients pertaining to the year 1950. The structural coefficients, the $a_{\varkappa\lambda}$'s of the preceding chapter, are calculated by dividing the entries in the 62 columns representing the production sectors, by the corresponding column totals (registered along row 88).[1]

Considered as a problem of statistical estimation, such a simple procedure is fraught with serious weaknesses, as has been emphasized by several authors.[2] To quote one of them,[3] »it could be argued that this (using data for one year) ... implies estimating the characteristics of a population by way of taking one sample-point only.» ... »One of the consequences is that no measure of variability is available in relation to the model. It follows that for this very reason it can be argued, as indeed it has been argued, that whatever the model tells, it will receive credit by the path of events. Assume for instance that the model — as it very often happens — is directly applied to predict the total output that will conform with a bill of goods estimated from outside information. Assume further that afterwards a comparison is made beween the prediction and the actual development with due regard to changes in prices. Now, if the prediction is judged to be 'good' the model will be praised for its ability to produce forecasts. In case, however, 'large' discrepancies appear between the 'prediction' and the actual course of events the model may likewise be praised, in this case because it has supplied an index for the changes in the 'productivity' of the economy considered. It appears clearly that this interpretation is only possible because the model in its present form from the point of view of statistical inference is most deficient. Statistically speaking there are no degrees of freedom.»

The three writers cited, SHEPHARD, KLEIN and RASMUSSEN, suggest a stochastic formulation of the theory, and I shall return to this question in Ch. V, after having made the simple application to the year 1955. Here, it has been my purpose to expose the limitations inherent in the Intersectoral Flow Datum Table as the *only* basis for estimates of structural relations.

The accuracy of the data

In the above section, I have been unable to give an answer in *precise* terms to the pertinent question as to what extent available data are amenable to the numerical operations outlined in the previous chapter, i.e., to what extent the theoretical assumptions have been fulfilled. Unfortunately I shall have to answer the question

[1] I made the mistake, in the calculations, of not correcting the Grand Total items for decreases in inventories. However, it so happened that this mistake did not appreciably affect the coefficients. (In two cases, the resulting error amounted to one tenth of a percent, in all other cases it was even smaller).

[2] See for instance, Shephard, R. W., (1952) A survey of input-output research, pp. 10—29; Klein, L. R., (1953) A textbook of econometrics, pp. 205—210; and Rasmussen, P. N., (1956) Studies in inter-sectoral relations, pp. 46—47 and pp. 129—130.

[3] Rasmussen, P. N., op. cit., pp. 46—47.

regarding the accuracy of the available data in almost the same fashion. For several reasons it has not been possible to evaluate, by a formal analysis, the reliability of the individual items in the basic table.

It would obviously be possible to obtain the data of the table, the individual entries, in several different ways. One procedure would be to analyse the structure of the receipts (the sales) of each sector. Another procedure would be to analyse the cost structure, or input structure, of each sector. Thirdly, one could arrive at the data through a combination of both these types of structural analysis, which would seem to open up possibilities for independent cross-checks of the entries, and, other things being equal, would thus be preferable. This last-mentioned procedure was also the one I tried to use in the present study. But it turned out that, for many sectors, the necessary information on the individual items could only be obtained in *either* of the two first-mentioned ways, not through a combination of both. For instance, the entries along the row representing Wages and Salaries accrued to Households in Stockholm (row 84) could only be obtained as *cost* items of the individual sectors;[1] only for the sum of all wages, salaries, dividends and other receipts accrued to Households in Stockholm (rows 84 and 85) was a cross-check possible.[2] As regards the production sectors (rows 1—62), I first estimated the amounts of total receipts that were obtained from the different sectors of final demand, basing the work on, among other things, a special investigation of the manufacturing industry and wholesale trade in the Stockholm area. But in estimating the distribution of the remainder of total receipts accrued to each production sector, I had to depend by and large upon analyses of cost structures.

Thus, in analysing the structure of receipts I had as a preliminary measure to use a special column for unallocated items. Similarly, in analysing the structure of costs I had to use a special row for unallocated items to begin with, and the two types of analysis gave complementary information, rather than cross-check possibilities. Many adjustments were then made, in a series of iterative steps, in order to render the data consistent with each other, in the sense that the definitional relations should be fulfilled and, for the production sectors, that the sum of the entries in any column should coincide with the sum of the entries in the corresponding row.[3]

It goes without saying that I was hampered in the work by the simple fact that this was the first intersectoral flow study to be carried out in Sweden (not to mention that it focused upon a small geographic region within the country). A great deal of the available data had originally been gathered for quite different purposes and, as already illustrated, had to be adapted for present needs. A very large number of different sources were used in the course of the work, and it was felt that the data thus obtained varied considerably in quality. However, in general, there were no numerical measures available regarding the accuracy of the data.[1] In one case the

[1] Most of these items were derived from the 1951 Census of Production, Distribution and Services. For further particulars, see Appendix 2.

[2] The two sums differed by about 1.5 percent. The difference was successively reduced by adjustments of the items considered to be most in doubt, so that in the end it amounted to 0.6 percent.

[3] As already indicated, this balancing principle is not maintained here as regards the final demand sectors, for which I used independent estimates of the differences between the sums of corresponding rows and columns.

need for numerical knowledge of the accuracy involved was considered particularly vital, namely for the 1951 Census of Production, Distribution and Services which was a major source of the present study. The Census provided data also for other investigations at the Business Research Institute, so it was considered worthwhile to try to obtain some knowledge of its accuracy, in spite of the rather heavy costs involved. In order to study the two types of error that were found to be most easily accessible in an investigation *ex post,* namely errors in coverage and errors in classification, we selected a sample of establishments in Stockholm, using small areas chosen at random as sampling units. On the basis of this study, we estimated the undercoverage of the Census to be between one and two percent, measured in terms of total employment in the Stockholm area in September 1951. We also found that a few percent of all establishments in Stockholm had probably been classified erroneously. In a mimeographed paper (in Swedish) that can be obtained upon request, I have given a more detailed report on this study.

Since we used the Census in the construction of the basic table as, among other things, a basis for estimates of the total production of each sector in 1950, the conclusion to be drawn here from the results cited above, seems to be that *on the average the Grand Totals (column 88 and row 88) of the table are biased downwards.* Consequently, all individual entries in the table are also biased downwards, on the average. There is one more possible reason for such a downward bias in the table. In the above-mentioned investigation we were not able to measure the inaccuracy due to response errors. In the official Census Report, however, there is some indication that the data on sales obtained from the reporting units, did coincide with the data on sales reported for taxation purposes.[2] The practical conclusion of this circumstance for us, seems to be that *if* the data on sales in 1950 reported to government authorities for taxation purposes, did underestimate »factual» sales, then the table has a further downward bias. If it at all exists, this bias is not likely to be evenly distributed; probably, underestimates of this kind are limited to sectors which to a large extent consist of small establishments, such as Laundries, Barber and Beauty Shops (sector no. 57), Repair of Motor Vehicles, Cycles and Electrical Appliances (sector no. 22) and Other Food Manufacturing (sector no. 5).

[1] Needless to say, this problem of the accuracy of economic data worried national accountant. and other economists long before I took up this study. See, as regards Sweden, e. g., Lundberg, Es, (1950) Den ekonomiska expansionens stabilitet (The stability of the economic expansion), pp. 199—202 (Ekonomisk Tidskrift, vol. 52) and Ohlsson, I., (1953) On national accounting, pp. 249—251. Describing the practices of the Konjunkturinstitut, in this respect, Ohlsson writes: ». . . various types of warning signals have been used in presenting the Institute's estimates, such as italicized residual items, and uncertainty factors ($\pm$ x, $\pm$ y, etc.) which are intended to show how errors in certain specially unreliable items are transmitted throughout the system.» ». . . the Institute has tried in some reports to present reliability figures. These are of a purely subjective character, and are based on similar attempts made earlier in Eire, and by S. Kuznets. Their purpose is to show the degree of reliability which the persons making the estimates themselves place on the results. They deal not so much perhaps with the absolute reliability of various items, but rather with the relative reliability of the items in relation to one another. They also aim to show that, even if the errors for individual items have been estimated as being very large, it is conceivable that the total items will not be too unreliable, if the errors are not correlated.» (Ohlsson, I., op. cit., pp. 249—250). Cf., in this context also: Aukrust, O., (1955) Nasjonalregnskap (National accounting) pp. 71—73.

[2] 1951 års företagsräkning (The 1951 Census of Production, Distribution and Services, published in 1955) p. 25.

Ideally, one might conceive of the formulation of two basic tables, one of them being similar to the one presented in this study, and the other being of exactly the same size and containing estimates of the errors, let us say standard errors or some other type of bounds, of the entries in the first. Nothing of the kind could be established in this study, as was mentioned above.

Maybe the reader is now struck by the idea that such an error table could be produced by letting several people independently estimate the entries of the basic table. One could then take averages of their estimates of the individual entries and form a basic table from the averages. By making some simplifying assumption regarding the distribution of the estimates, around the averages, one could construct a kind of error table. Lack of time and money precluded such attempts in this study.

How then should the reader be warned against consuming and digesting inaccurate data presented in this study? I have chosen the simple procedure of putting into brackets the figures which I have felt, while working with the data, are particularly uncertain. The rows and columns most heavily burdened by brackets are the following:

a) *Rows 47—53,* representing transportation, communication services and banking and insurance. The present treatment of the sector Ocean Transport (row 49) is particularly unsatisfactory, since its receipts are registered as if obtained from only three sources, namely Foreign Countries (column 65—70), Households in Stockholm (column 84—85) and Households in the Rest of Sweden (column 86—87). This is a consequence of the fact that Swedish exports are registered on a *fob* basis and Swedish imports on a *cif* basis; I have not been able to isolate the value of »cost, insurance and freight» from the import values. Thus, the entries along rows 65—69, which represent imports of goods from Foreign Countries, *may* include items which, in accordance with the principles elsewhere used in the table, should have been separated and registered along row 49. This applies also to the Banking and Insurance sector (row 53): to the extent that the Banking and Insurance sector rendered services connected with the importation of goods, the corresponding costs should have been separated from the values registered along rows 65—69 and carried to the row 53.

b) *Rows 63—64,* representing goods and services produced by industries in the Rest of Sweden. As a preliminary, the entries in these rows were calculated as residuals formed, in principle, by subtracting the sums of all other entries in each column from the corresponding Grand Total (row 88). For instance, in column 9, representing the (cost) allocations of the sector Manufacture of Wearing Apparel, the Grand Total is 133,0 million Sw. Cr. By adding all the entries in this column except for the item in row 64, a sum of 93,0 million Cr. is arrived at. Thus, the item in row 64 is estimated as 133,0 — 93,0 = 40,0 million Sw. Cr. Each residual was then checked with regard to its plausibility.[1] But in many cases my knowledge of what should be regarded as »plausible» was too limited to be of much help, so considerable uncertainty must, generally speaking, be attached to the entries in the rows 63—64.[2]

c) *Row 73 and column 73,* representing Inventory Decrease and Inventory Increase. In one or two cases, such as for Beverage Industries and Tobacco Manufactures (sector no. 2), estimates could be based directly upon data pertaining to establishments in the Stockholm

[1] See, Aukrust, O., (1955) Nasjonalregnskap (National accounts) p. 72: »We check that the picture given by the figures, does not contradict what we consider to be well-founded a priori knowledge — of a theoretical or empirical kind — about economic relations or economic development.»

[2] Obviously, we always had the possible check that each residual must be non-negative, but in the present study this check had little applicability.

area; in some cases it had to be assumed that the net increase or decrease of inventories of the products concerned bore the same ratio to national net increase or decrease as the 1950 output of the sector concerned bore to national output. In other cases, again, it had to be assumed that no change in inventories took place. Generally speaking, data on changes in inventories represent one of the weakest links in all available Swedish statistics.[1] However, the evidence that does exist, indicates that no large changes in the volume of inventories took place in 1950. This indication was also supported at the stage of data arrangement, as in many cases the data available regarding intersectoral flows could not have been reconciled with any data on large changes in inventories.

d) *Rows 86—87,* representing Households in the Rest of Sweden. Those entries which indicate the amount of wages, salaries, dividends, etc., allocated from the production sectors (in Stockholm) to Households in the Rest of Sweden are nothing but guesses, but it is known for sure that the amounts are small, so that the *absolute* errors involved should not worry us unduly.

e) *Column 54,* representing all costs incurred from using (and/or owning) real property. The uncertainty of these data is due to the fact that they are based, mainly, on a small (nonrandom) sample of the profit and loss statements of large housing companies and similar associations.

f) *Columns 59—60,* representing the costs of medical, educational, etc., services. The entries for wages and salaries (row 84) are uncertain.

g) *Columns 63—64,* representing the allocations made by Agriculture and All Other Industries in the Rest of Sweden. The entries in rows 63—87 are particularly uncertain. The depreciation item referring to All Other Industries (column 64, row 71—72) is presumably the most doubtful of all, since it was calculated as a residual. It is likely to have been overestimated, possibly by as much as ten percent.

h) *Columns 71—72,* representing Gross Domestic Capital Formation (exclusive of inventories). The uncertainty inherent in these estimates is mainly due to the well known difficulty of obtaining a clear-cut distinction between expenditure for fixed capital formation purposes and expenditure for repair and maintenance purposes.

i) *Column 77,* representing the current expenditure (except for subsidies, etc.) incurred by all other Swedish municipal authorities than the City of Stockholm. Here, again, the depreciation entry (row 71—72) is extremely doubtful; the same judgment applies to the entry for intrasectoral flows (row 77), i.e., the current transactions between different bodies of municipal government (other than the City of Stockholm). My only basis for these two estimates was the corresponding information for the City of Stockholm, admittedly a very weak basis for a generalization to all other municipal authorities.

j) *Columns 78—80,* representing the current expenditure (except for subsidies, and other transfer payments) incurred by the national government administration. Due to the shortcomings of available data, this column suffers from a special kind of inconsistent treatment. Expenditure incurred by the national government to finance medical, educational and similar activities within the Stockholm area, is registered in the table as a Transfer (column 81) to the sectors concerned. However, I have not been able to treat the government financing of such activities in the Rest of Sweden similarly. Instead, that expenditure is included among the entries in column 78—80.

In the official accounts of the national government, fixed capital assets are depreciated much faster than is the custom in business accounting. This would be of no concern, in the long run, provided that the annual amount of investment were invariant. The last-mentioned condition, however, is not fulfilled: public investments have expanded considerably. Consequently I made a special estimate for the table,[2] but the figure arrived at and inserted in the table does seem low.

[1] Cf., Lindahl, O., Sveriges nationalprodukt 1861—1951 (The gross domestic product of Sweden 1861—1951), pp. 28 and 32.

[2] The following rough methods were used. On buildings, I calculated the depreciation as three percent of the original cost; on other capital assets, ten percent was taken as the corresponding figure.

k) *Columns 84—87,* representing private consumption, in Stockholm and in the Rest of Sweden. Here, as elsewhere, I have drawn upon estimates made by the Konjunkturinstitut, but such data (naturally) refer to Sweden as a whole. I estimated the differences in consumption patterns prevailing in 1950, as between Stockholm and the Rest of Sweden, on the basis of consumers surveys made by the Social Board.[1] These investigations, however, referred to the year 1952, and they did not specify Households in Stockholm, but only households in the three largest cities of Sweden (Stockholm, Gothenburg and Malmö). No attempt was made to correct for the possible bias due to these two conditions. As weights in the estimates, I used the number of adults *or* the number of adults plus half the number of children, in the Stockholm area vs. the Rest of Sweden, the choice between the two weights being dependent upon the type of commodity or service concerned. Consequently, due to the rough methods used, the estimates of the household columns are uncertain.

In principle, the savings of households are obtained by adding the Grand Totals (column 88) of *rows* 84—85 and subtracting the Grand Total (row 88) of *column* 84—85, for Households in Stockholm, and by adding the Grand Totals (column 88) of *rows* 86—87 and subtracting the Grand Total of *column* 86—87, for Households in the Rest of Sweden. By carrying out these simple calculations, we find that Households in Stockholm saved some 28 million Sw. Cr., in 1950, whereas Households in the Rest of Sweden saved some 160 million Sw. Cr. Now the first-mentioned item, for Stockholm, was obtained in exactly that way, as a residual, but for the Rest of Sweden I had to make an independent estimate of the savings and subtract that estimate from the Grand Total of receipts accrued (column 88, rows 86—87) in order to estimate the Grand Total of column 86—87, i.e., total private consumption in the Rest of Sweden. Thus the Grand Total of column 86—87 was not computed by adding the entries 1—87, in the column, but through an independent estimate of the total savings. In turn, to get this estimate of the savings, I simply assumed that Households in the Rest of Sweden saved one percent of disposable income, i.e., their total receipts after deduction of personal income taxes. It is likely that this assumption *underestimates* the savings.[2] That is indeed indicated by quite another entry in the table, namely the Depreciations (row 71—72) of the Other Industries in the Rest of Sweden (column 64): that entry is probably overestimated, as stated above. It so happens, through the iterative steps taken before arriving at the »final»entries of the table, that an error in the estimate of the household savings (for the Rest of Sweden) is reflected in the way mentioned.

Finally, it should be mentioned here that, in order to simplify the data problems involved, I neglected to treat transactions in second-hand goods specifically. This problem may be of some importance with regard to scrap. To the extent that scrap, used as raw material by the production sectors in Stockholm, is imported to Stockholm from the Rest of Sweden or from abroad, it is included in the entries of the columns concerned. But it is not included when sold between (or within) the production sectors in Stockholm, or when sold from the production sectors to the rest of the world.

Computational errors

As mentioned before, the entries in the Intersectoral Flow Datum Table are measured in millions of Swedish Crowns, in the current prices for the year 1950. One

[1] Levnadskostnaderna år 1952 (Family expenditure in 1952).

[2] However, the figure arrived at cannot be compared directly with estimates of the Konjunkturinstitut, because the Konjunkturinstitut also included in the personal savings the difference between the personal income taxes *accrued* and the personal income taxes *paid* in 1950, and that difference was considerable, as indicated before (see p. 33).

decimal place is carried in the table. Considering that some 90 percent of all entries are estimated at less than ten million crowns, the precision of the table may seem rather poor: some 90 percent of all figures are given zero, one, or, at most, two digits. However, even that level of precision may be questioned in many cases, as indicated in the previous section.[1] The problem then arises as to whether it is in fact possible to operate numerically at all on the data in the table, without running a heavy risk of getting lost in cumulative errors. In particular, this problem seems to apply to the matrix-algebraic operations outlined in the previous chapter, since they involve a very large number of numerical computations.

To be specific, we can formulate the problem thus. We assume that we know the margins of error in each element of a matrix consisting of the structural coefficients calculated from a datum table. Further, we have given a final demand vector about which we also know the margins of error associated with each element. The question, then, is this: *What limits, if any, can we set on the errors in the elements of the vector of calculated production levels?* Investigations of the mathematical properties of so-called Leontief-matrices, i.e., the type of matrices dealt with here, have shown that relatively narrow limits can be set on the errors in question, due to the special properties of such matrices.[2] DWYER and WAUGH have derived very simple formulas for the cases where uniform absolute or percentage errors can be assigned to a matrix of structural coefficients.[3] They have also derived formulas for the more general case, where unequal limits are set on the errors. EVANS has gone one step further and considered also the influence of errors in the elements of the final demand vector.[4] One of his conclusions runs as follows: »With reasonable care in the construction of base tables, especially with regard to the autonomous (i.e., final demand) and total activity vectors, interindustry estimates can be made with confidence that errors in structural matrices are not only noncumulative but rather compensating in effect.»[5]

So far, three types of error, in a wide sense, have been considered, namely 1) errors due to shortcomings of the theoretical assumptions, 2) errors in the basic data, i.e., inaccuracies, and 3) computational errors due to inaccurate data. One more type of computational error will be dealt with here, namely errors due to rounding off, in the inversion process.[6] CHRIST and EVANS, among others, have studied in the

[1] On the other hand, to work on a still lower level of precision would have made it more difficult to check if the data of the table were consistent, and would have implied a heavy sacrifice of information, particularly regarding the many items with a value less than one million.

[2] The Leontief matrices belong to a class of matrices characterized by, among other things, the property that all elements of the inverses have the same sign. Each element of the inverse of a Leontief matrix is positive or zero. See, e. g., Woodbury, M. A., (1954) Properties of Leontief-type input-output matrices, pp. 341—363 (In: Economic activity analysis, edited by O. Morgenstern).

[3] Dwyer, P. S., and Waugh, F. V., (1953) On errors in matrix inversion pp. 289—319 (Journal of the American Statistical Association vol. 48). I quote from p. 301: »Thus, if the maximum inherent error associated with any element of a Leontief matrix is 5 per cent of that element, the maximum discrepancy associated with any element of the inverse is 0,05/0,95 times that element of the inverse.»

[4] Evans, W. D., (1954) The effect of structural matrix errors on interindustry relations estimates, pp. 461—480 (Econometrica, vol. 22).

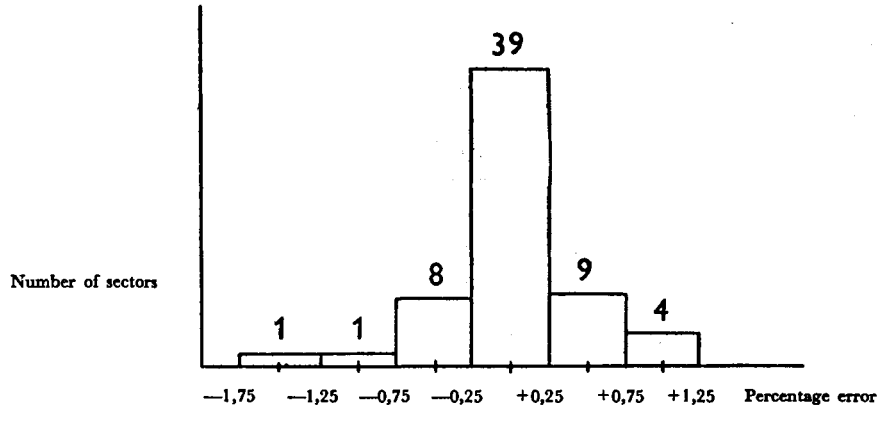
[5] Evans, W. D., op. cit., p. 479. See, also, Christ, C., (1955) A review of input-output analysis, pp. 150—158 (In: Input-output analysis: An appraisal).

[6] Errors arising from the application of approximate formulas, such as the use of truncated infinite series, is of no relevance in this particular study. Such errors are treated by Morgenstern and Christ, both drawing upon a paper by von Neuman and Goldstine. See, Morgenstern, O., (1950) On the accuracy of economic observations, pp. 40—42, and Christ, C., op. cit., pp. 147—150.

papers cited the possible errors due to rounding off, and they have both found that such errors are negligible in input-output or intersectoral flow analyses. The following results of the present study may serve to illustrate this point.[1]

The inverse of the matrix (I—a), where *I* stands for the identity matrix and *a* stands for the matrix of structural coefficients, was computed on BESK, the binary electronic sequential computer of the Swedish Board for Computing Machinery.[2] Each element of the inverse thus computed was carried to five decimal places. To check the computations, the final demand vector of 1950, the basic period of study, was premultiplied by the inverse, to give the vector of production levels in 1950. If no rounding off errors had occurred, the elements of this vector should agree completely with the corresponding 62 elements of the column of Grand Totals (column 88) in the basic table. Any deviations would serve as a measure of the errors due to rounding off.

Chart showing the distribution of the errors due to rounding off, found in checking the inverse computed on the basis of data in the Intersectoral Flow Datum Table.



The distribution of the errors that occurred will appear from the chart above. It is found that nine elements out of ten had a percentage error below 0,75 percent, in either direction. In the course of the checking procedure, we detected some mistakes that had been committed in the premultiplication work which had been carried out on ordinary desk machines. We also detected some small mistakes that had been committed in calculating the structural coefficients and the elements of the final demand vector. All these mistakes were corrected before the above diagram was drawn.

[1] Cf., also, Frisch, R., (1956) Main features of the Oslo Median Model, pp. 24—26.
[2] The inverse is reproduced as Appendix 4.

CHAPTER IV

Some Findings on the Structure of the Stockholm Economy

This chapter aims to contribute to our knowledge of the economic structure of the Stockholm area. The analysis and description that follow are based upon the Intersectoral Flow Datum Table and upon supplementary information regarding the size of the working population and the amount of floor space utilized. The assumptions of factorability which were introduced in Ch. II, will be applied in the course of the work. Although the factorability assumptions will enable us to dig a little deeper than has perhaps ever been done in an economic study of a city, it should be clear that all conclusions will relate to the period to which the basic data refer, and only to that period. Thus, the application of the factorability assumptions gives no prediction, but, bringing more light on the economic structure of the area in a recent period, it may help in providing a basis for judging the future possibilities of the Stockholm area.

One application will be made, also, of the more restrictive assumption of invariant structural relations. Here again, however, the purpose is not to attempt a prediction proper, but rather to provide some basis for comparisons and to indicate the way in which the theoretical apparatus *could* be applied for purposes of prediction, if more data were available on tendencies in the development of structural relations and of final demand categories, such as household consumption, exports and government activity.

From the point of view of city planning, knowledge of the spatial distribution of establishments over the Stockholm area is vital. I shall devote Ch. VI to that subject; until then I shall ignore the spatial aspect and simply think of Stockholm as a point.

Various cross-sectional comparisons will be made in the following pages. For instance, I shall expose the way in which the working population of Stockholm was distributed in the period of study, the way in which the various sectors contributed to the city product or income and the way in which the city balance of current payments was composed. Thus, I shall consider several aspects of the economic structure of the Stockholm area, but it goes without saying that in a limited study it is not possible to exhaust all the possibilities of analysis and description that may seem relevant. It is hoped that the present work may serve as a basis for further study.

Table 4.1. *The size and distribution of the working population in the Stockholm area, in 1950/51.*

Sector No.	Employment (number of persons)	Sector No.	Employment (number of persons)
1. Agriculture and fishing	(8 800)	34. Electricity, gas and water services	5 100
2. Beverage industries and tobacco manufactures	2 950	35. Building construction	32 800
3. Manufacture of cocoa and chocolate	1 650	36. Construction other than building	14 700
4. Manufacture of dairy products	1 350	37. Wholesale trade: hardware, lumber, constr. materials	8 650
5. Other food manufacturing: consumers' goods	8 650	38. Wholesale trade: fuels	3 000
6. Other food manufacturing: industrial goods	800	39. Wholesale trade: shop and office fittings	1 500
7. Wholesale trade: food products	5 100	40. Wholesale trade: machinery, equipm., and supplies	4 200
8. Retail trade: food products (including beverages)	15 850	41. Wholesale trade: pulp, paper and paper products	2 650
9. Manufacture of wearing apparel	5 750	42. Wholesale trade: other kinds of business	11 450
10. Other textile manufacturing	6 000	43. Retail trade: motor vehicles	1 950
11. Wholesale trade: apparel and dry goods	4 200	44. Retail trade: other consumers' durables	6 750
12. Retail trade: apparel and dry goods	10 450	45. Retail trade: department stores and variety stores	6 000
13. Manufacture of tinware, castings and forgings	6 350	46. Retail trade: all other stores (including tobacco)	10 550
14. Manufacture of insulated wire and cable	3 050	47. Railway transport	7 000
15. Manufacture of electrical lamps	1 500	48. Urban and suburban tramway and omnibus operators	6 900
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	12 700	49. Ocean transport, involving foreign countries	7 650
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	5 250	50. Other transport activities	13 450
18. Ship building and repairing	2 950	51. Services incidental to transport (including storage)	3 500
19. Manuf. of automobiles and automobile bodies	1 150	52. Communication services	10 500
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	9 300	53. Banking and insurance	19 200
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	7 950	54. Lessors of real property	(12 000)
22. Repair of motor vehicles and electric appliances	8 950	55. Drinking and eating places; hotels, etc.	13 550
23. Other metal manufacturing	6 900	56. Motion pictures and other amusements	3 350
24. Manufacture of non-metallic mineral products	4 000	57. Laundries; barber and beauty shops	9 350
25. Manufacture of articles of paper and paperboard	1 150	58. Business services (including legal services)	9 350
26. Manufacture of wood, cork, paper and paperboard	3 250	59. Medical and other health services	(15 000)
27. Printing and publishing	10 900	60. Educational services; religious activities, etc.	(16 000)
28. Bookbinding, photographing, etc.	9 850	61. Labor and political org., trade assoc., etc.	(4 800)
29. Manufacture of leather, rubber and fur products	3 700	62. Other economic activities in Stockholm	4 800
30. Manufacture of dyes, paints and varnishes	1 450	Total for the production sectors	*443 700*
31. Manufacture of perfumes and washing compounds	1 750	Government administration	(40 000)
32. Manuf. of plastic materials and plastic products	1 250	Domestic services	(14 000)
33. Manuf. of other chemicals and chemical products	3 100	Total working population	497 700

Notes. Classification according to sectors (defined in Appendix 2). — Units: The number of persons gainfully employed. Part-time employees (including family members working part-time) have been counted as half persons. — Uncertain figures are shown in brackets. — In the procedure of summing it has been assumed that the errors are uncorrelated.

FINDINGS BASED ON THE ASSUMPTION OF ADDITIVITY

In deriving information from the basic table, I shall first apply only the relatively simple assumption that the individual entries are additive; thereafter the more powerful assumptions of factorability will be applied.

Manpower usage

In 1950 the Stockholm area had nearly 990 000 inhabitants, about half of whom were gainfully employed. In terms of the sector classification used in this study, the distribution of the working population can be seen in *Table 4.1.*

The figures for production sectors 1, 59, 60 and 61, and for government employees and domestic workers refer to the end of 1950, whereas the figures for all other sectors refer to September 1951. The first-mentioned figures are based on the 1950 Census of Population, whereas all other figures in the table are based on the 1951 Census of Production, Distribution and Services. The data that are relatively most uncertain in the table are shown in brackets. I have tried to estimate the uncertainty involved, and assuming that the individual errors are not appreciably correlated, I have found that the error in the estimate of the total number of gainfully employed (full-time workers), *497 700,* should be less than one percent.[1]

A more condensed version of the same basic data is provided by *Table 4.2.,* where a special column indicates which sectors have been lumped together.

As appears from Table 4.2., the manufacturing industries in the Stockholm area employed altogether some 37.5 percent of the total working population in 1950/51. This was somewhat lower than the corresponding percentage figure for Sweden as a whole. Considering urban occupations only — that is, excluding agriculture — one would find that Stockholm had a much lower fraction of its working population engaged in manufacturing industries than the nation as a whole.

It is interesting, also, to compare the above figure with the corresponding percentage figures for the largest American cities.[2] One finds, as expected, that Chicago, Philadelphia, Detroit, Pittsburgh and Cleveland had a notably higher proportion of their working population engaged in manufacturing industries than Stockholm. On the other hand, Washington, D.C., had a much lower percentage than Stockholm. Although less pronounced, Los Angeles, San Francisco and Boston also had lower figures. New York, St. Louis and Baltimore had about the same proportion of manufacturing industries, in terms of employment, as Stockholm.

Among the different types of manufacturing industry in the Stockholm area, the metal and engineering industry employed the largest number of people, namely

[1] For details of computation, see Appendix 3.

[2] I have drawn, here, upon Alexandersson, G., (1956) The industrial structure of American cities. His data refer to urbanized areas and to the year 1950. The American data are not exactly comparable to those of the present study, because of 1) a slightly different definition of manufacturing industry, 2) a slightly different way of delimiting the city area and 3) the fact that the American data are apparently not adjusted for part-time employees. But no exactness is necessary for the illustrative comparisons here made.

Table 4.2. *The size and distribution of the working population in the Stockholm area, in 1950/51. Summary of table 4.1.*

	Sectors included (numbers refer to Appendix 2)	Employment (number of persons)	Percentage distribution
I. Metal and engineering industry	13—23	66 050	13,3
II. Printing and publishing, bookbinding etc.	27—28	20 750	4,2
III. Food processing	2—6	15 400	3,1
IV. All other manufacturing, incl. construction	9—10, 24—26, 29—36	84 000	16,9
V. Wholesale trade	7, 11, 37—42	40 750	8,2
VI. Retail trade	8, 12, 43—46	51 550	10,4
VII. Transportation and communication services	47—52	49 000	9,8
VIII. Business and personal services, incl. banking and insurance, rental and amusements	53—58	66 800	13,4
IX. Medical and educational, etc., services	59—60	31 000	6,2
X. Agriculture and all other production sectors	1, 61—62	18 400	3,7
I—X. Total for the production sectors	1—62	443 700	89,2
XI. National and municipal government administration	75—80	(40 000)	8,0
XII. Domestic services	84—85	(14 000)	2,8
I—XII. Total working population		497 700	100,0

some 66 000 persons (Table 4.2.). The largest individual sector belonging to that industry was no. 16, Manufacture of Electrical Equipment, consisting of establishments with more than 200 employees each, as can be seen from a comparison between Table 4.1. and Table 4.2. Five of the 12 American cities mentioned had a smaller fraction of employment in the metal and engineering industry than Stockholm, namely New York, Los Angeles, Boston, San Francisco and Washington, D.C.

The printing industry employed some four percent of the working population in the Stockholm area. The corresponding percentage was lower in the 12 largest American cities, except for Washington, D.C., which had about the same proportion of its employment in the printing industry as Stockholm.

In the residual group of manufacturing industries, in Table 4.2., construction weighed most heavily in terms of employment.

Stockholm is a center for the wholesale trade in Sweden. This is indicated by the fact that more than eight percent of the total working population in the Stockholm area were employed in the wholesale trade. As a comparison it may be mentioned that none of the large American cities showed a higher corresponding figure than about five and a half percent (New York and San Francisco). However, such a comparison should be seen in the light of the fact that foreign trade weighs much more heavily in the Swedish, and the Stockholm, economy than in the U.S. economy — and to a large extent the wholesale trade is customarily engaged in foreign trade.

On the other hand the retail trade had a weaker relative position, measured in terms of total employment, in Stockholm than in any of the 12 largest American

cities.[1] Even so, the retail trade accounted for more than ten percent of the total working population in the Stockholm area.

Transportation and communication services answered for the same fraction of those gainfully employed in Stockholm as retail trade. The corresponding percentage figures for most of the large American cities were the same. Only Los Angeles, Detroit and Washington, D.C., showed notably lower figures.

Of the remaining occupational groups, as specified in Table 4.2., Business and personal services, including banking and insurance and amusements, employed the largest number of people and outweighed even the metal and engineering industry. As regards the large American cities, used for comparison, only New York and Los Angeles showed higher percentage figures for this group.

As expected, only Washington, D.C., had a larger fraction of its working population employed in government administration than Stockholm.

So far, considerable space has been devoted to describing the size and composition of employment in the Stockholm area. To make such a description may seem to be a reasonable step from the point of view of city planning. It has often been found in the past[2] that there is a clear and relatively stable connection between the size of the total population in an area and the size and composition of employment in the area. Consequently, such data on employment may provide *a* basis, among several, for predicting the size of the future population total. However, we shall find later on that the very same data can be *rearranged* through the use of the factorability assumptions, so that more light may be thrown on the developmental possibilities of the Stockholm economy.

Again, from a *social* point of view, the simple employment data may be a valid measure of the structure of a city. However, a much wider applicability has traditionally been ascribed to such data. They have been widely used as measures of the *economic* or industrial structure of a city, without any attention whatsoever being paid to the question of their validity for such purposes.[3]

In the following pages I shall compare the employment pattern, as given in Tables 4.1. and 4.2., with various other measures of the economic structure which seem to have at least as high validity as the employment data. It would be unjust, however, not to mention here that many workers in this field have had access to no other types of data than those regarding employment. In fact, the comparisons with American data given above were only possible in terms of the employment distribution.

[1] The differences would be reduced but would still exist, if the American data were adjusted for the influence of the number of part-time employees.
Even on the national level did the corresponding differences exist: the United States had a somewhat higher proportion of its working population employed in the retail trade than Sweden.

[2] See, e. g., Forbat, F., (1953) Untersuchungen über den »Lokalisierungsmultiplikator» (Raumforschung und Raumordnung, vol. 11, pp. 97—101).

[3] See, for instance, Alexandersson, G., op. cit., p. 22: »Figures on employment have been used throughout this study, not as a substitute for something better, but as a direct measure of how people earn their living». But, surely, if one is interested in the way people earn their living, *income* data should have higher validity than employment data, since income can be expected to vary between different industries.

Table 4.3. *The size and distribution of wages and salaries in the Stockholm area in 1950. A summary of row 84, Intersectoral Flow Datum Table.*

	Amount of wages and salaries (mill. of Sw. Cr.)	Distribution of wages and salaries %	Distribution of the working population (from table 4.2) %
I. Metal and engineering industry	495	12,4	13,3
II. Printing and publishing, etc.	169	4,2	4,2
III. Food processing	109	2,7	3,1
IV. All other manufacturing, etc.	691	17,2	16,9
V. Wholesale trade	407	10,1	8,2
VI. Retail trade	335	8,4	10,4
VII. Transportation and communication	380	9,5	9,8
VIII. Business and personal services, etc.	565	14,1	13,4
IX. Medical and educational services	300	7,5	6,2
X. Agriculture and all other production	122	3,1	3,7
I—X. Total for the production sectors	3 573	89,2	89,2
XI. National and municipal government administration	373	9,3	8,0
XII. Domestic services	61	1,5	2,8
I—XII. Total working population	4 007	100,0	100,0

Notes. The grouping is in accordance with that used in Table 4.2.
Wages and salaries accrued to Households in Stockholm in return for work performed outside the Stockholm area, 5,5 mill. Cr. (columns 64—70), are excluded here.

Distribution of wages and salaries

Using the distribution of employment as a yardstick in exposing the economic structure of the Stockholm area, as was done above, means that the existing heterogeneity of the labor force with respect to, say, training, education and hardness of work, is not taken into account. A simple method of evalution is to substitute the distribution of wages and salaries for the distribution of the manpower resources. This means that the *number* of people gainfully employed in different industries are weighted by the prevailing average rates of wages and salaries.

A detailed picture of the size and composition of total wages and salaries in the Stockholm area in 1950, is given in *row 84* of the Intersectoral Flow Datum Table. One finds, for instance, that the sum of wages and salaries amounted to just over four billion Sw. Cr. (column 88). A summary of row 84 is provided in *Table 4.3.*, above. As a comparison, the corresponding distribution of employment is inserted (taken from Table 4.2.).

As we can see, 12.4 percent of the total amount of wages and salaries in the Stockholm area accrued in the Metal and engineering industry. That fraction was somewhat lower than the fraction of the working population employed in the same industry, as appears from a comparison between the corresponding entries in the two columns giving percentage data. In those two columns, the largest relative deviations are found for Wholesale trade, Retail trade and Domestic services. The

Table 4.4. *Sources of personal income, in 1950. Stockholm vs. the Rest of Sweden.*

	Stockholm		The Rest of Sweden
	mill. of Sw. Cr.	%	%
Wages and Salaries[1]	4 007	84,5	82,5
Dividends and Interest, etc.	372	7,8	(8,5)
Transfers from Government[2]	294	6,2	8,5
Income from other areas of the country and from abroad	(68)	(1,5)	(0,5)
Total Personal Income	4 742	100,0	100,0
Less: Personal Taxes	737	15,5	14,0
Disposable Income	4 005	84,5	86,0

Notes. As elsewhere uncertain estimates are denoted through the use of brackets.
[1] Estimated salaries of proprietors are included.
[2] Includes interest on the public debt.

deviations are found to be very small for the three groups Printing and publishing, All other manufacturing and Transportation and communication services.

Sources of personal income

Above, we used the data on wages and salaries as an indicator of the industrial structure of the Stockholm area. Clearly these data can also be interpreted as exposing the sources of household returns, that is, personal income. To get a complete picture of those sources, we must, however, add the other types of income accruing to households, such as dividends and interest. Through a combination of the data in rows 84 and 85 in the basic table, we find the composition of personal income presented above *(Table 4.4.)*.

The table demonstrates how dominant wages and salaries were as a source of personal income. Out of the total personal income accrued in the Stockholm area in 1950, 84.5 percent consisted of wages and salaries. The comparison with the Rest of Sweden shows, among other things, that the transfers from national and municipal government, comprising people's pensions, etc., answered for a relatively smaller share of personal income in Stockholm than in the Rest of Sweden. On the other hand, personal income in Stockholm was charged with relatively higher income taxes than personal income in the Rest of Sweden, so that a smaller proportion of personal income remained as disposable income in Stockholm than in the Rest of Sweden.

Gross factor returns (gross city income), by industrial origin

The concepts personal income and disposable income, as used above, are familiar to any student of national accounting. We might apply several other concepts, also from that field, in describing the economic structure of the Stockholm area. For

instance, analogous to the gross national product, the *gross city product* could be formed and in analogy with national income we could form *city income,* and so on. By analysing such aggregates according to their industrial origin, we should find additional measures of the economic structure of the Stockholm area. The analyses would provide a more comprehensive picture than any of the measures applied so far, since in addition to household returns they would include all other returns accruing to the factors of production. As an illustration, I have here chosen to estimate and analyse one particular aggregate of this type which can appropriately be referred to as »*gross factor returns*». It comprises all the receipts accruing to the factors of production in the Stockholm area in return for their services. It excludes indirect taxes and the current surplus of government enterprises, since it would be misleading to consider such items as payments to the factors of production in the Stockholm area. The concept is denoted »gross», because it includes depreciation, that is the allowances made for capital consumption. By thus defining the factor returns on a »gross» level, I have tried to account for differences in the extent to which industries use machinery, buildings and other capital goods.

The industrial breakdown of the gross factor returns for the Stockholm area in the year 1950 is presented in *Table 4.5.*

We can interpret this table as indicating how the gross city income of Stockholm accrued with regard to its industrial origin. Among other results, the table brings out that the industrial structure of the Stockholm area was highly differentiated.[1]

As can be seen, the largest factor returns were obtained by the group Business and personal services, including banking and insurance, rental and amusements. Altogether, the service industries (nos. V—IX, in the Table) accounted for some 53 percent of the total city income.

If the ten individual sectors with the largest factor returns are ranked in order of size and a similar ranking is made for the ten sectors that employed the largest number of people, one finds the following orders:

According to size of gross factor returns: 54, 35, 53, 36, 60, 49, 59, 42, 50, 16
» » » » employment: 35, 53, 60, 8, 59, 36, 55, 50, 16, 54

Thus, no sector kept the same rank in both instances, and four sectors appeared only in one of the two rankings.[2]

The total gross factor returns in Stockholm amounted to nearly *5 400* million Sw. Cr. (bottom row in Table 4.5.). It can be estimated[3] that this represented about 20 percent of the gross factor returns for the nation as a whole, whereas Stockholm had less than *15* percent of the total population in the country.[4]

For obvious reasons, the structure formed by the total values of production of the different sectors or industries is of minor interest in the present context. The reader

[1] Cf., here, Washington, D. C., where government administration alone employed about 32 percent of the working population in 1950 (Alexandersson, G., op. cit., p. 134).

[2] If the ten sectors that employed the largest number of people are arranged in order of size of gross factor returns, one finds that Spearman's rank correlation coefficient (ρ) gives a relatively low value (+ 0,19).

[3] By means of other data in the Intersectoral Flow Datum Table.

[4] It should be remembered, however, that these data do not allow for any existing differences in prices between Stockholm and the rest of the country.

Table 4.5. *Size and distribution of gross factor returns, by industrial origin, in the Stockholm area, 1950.*

	Gross factor returns (mill. of Sw. Cr.)[a]	Distribution of gross factor returns %	Distribution of the working population %	Distribution of wages and salaries %
I. Metal and engineering industry	660	12,4	13,3	12,4
II. Printing and publishing, etc. ..	205	3,9	4,2	4,2
III. Food processing	152	2,8	3,1	2,7
IV. All other manufacturing, etc. ..	864	16,2	16,9	17,2
V. Wholesale trade	526	9,9	8,2	10,1
VI. Retail trade	400	7,5	10,4	8,4
VII. Transportation and communication, etc.	567	10,7	9,8	9,5
VIII. Business and personal services, etc.	1 021	19,2	13,4	14,1
IX. Medical and educational services	305	5,7	6,2	7,5
X. Agriculture and all other production	133	2,5	3,7	3,1
I—X. Total for the production sectors	4 833	90,8	89,2	89,2
XI. National and municipal government administration	(420)	(7,9)	8,0	9,3
XII. Domestic services	69 [b]	1,3	2,8	1,5
I—XII. Total working population	5 322	100,0	100,0	100,0
XIII. Returns accruing to households from the Rest of the world ...	(68)			
I—XIII. Total gross factor returns	5 390			

Notes. The grouping is in accordance with that used in Table 4.2.

[a] The following rows in the Intersectoral Flow Datum Table have been incorporated: 71—72, 74, 75, 76 (excl. entries in columns 34 and 35), 77, 78, 84 and 85 (excl. entries in columns 78—83).

[b] Here is included an estimated income from the consumption of food in kind.

who, with some other purpose in mind, is interested in that structure, can obtain the necessary information direct from the Intersectoral Flow Datum Table (column 88, rows 1—62).

Utilization of urban space

In planning for the future, the city planner's interest is often focused on questions of land use.[1] How much additional space, supplied by buildings, will be needed by the different types of users of space? What kinds and qualities of space will be needed? Where and when will it be needed? These seem to be some of the pertinent questions.[2]

As a basis for an approach to such questions, it seems vital to possess some knowledge about the present situation. Regrettably, however, the knowledge avail-

[1] See, e. g., Rannells, J., (1956) The core of the city.

[2] Cf., Rannells, J., op. cit., pp. 42—44.

Table 4.6. *Amount of floor space utilized by different sectors in the Stockholm area, in 1950.*

Sector No.	Employment (number of persons)	Amount of floor space used (thousands of square metres)	Sector No.	Employment (number of persons)	Amount of floor space used (thousands of square metres)
1. Agriculture and fishing	(8 800)	(180)	34. Electricity, gas and water services	5 100	200
2. Beverage industries and tobacco manufactures	2 950	200	35. Building construction	32 800	250
3. Manufacture of cocoa and chocolate	1 650	50	36. Construction other than building	14 700	150
4. Manufacture of dairy products	1 350	40	37. Wholesale trade: hardware, lumber, constr. materials	8 650	300
5. Other food manufacturing: consumers' goods	8 650	400	38. Wholesale trade: fuels	3 000	100
6. Other food manufacturing: industrial goods	800	40	39. Wholesale trade: shop and office fittings	1 500	60
7. Wholesale trade: food products	5 100	200	40. Wholesale trade: machinery, equipm., and supplies	4 200	120
8. Retail trade: food products (including beverages)	15 850	450	41. Wholesale trade: pulp, paper and paper products	2 650	100
9. Manufacture of wearing apparel	5 750	70	42. Wholesale trade: other kinds of business	11 450	400
10. Other textile manufacturing	6 000	90	43. Retail trade: motor vehicles	1 950	60
11. Wholesale trade: apparel and dry goods	4 200	100	44. Retail trade: other consumers' durables	6 750	250
12. Retail trade: apparel and dry goods	10 450	300	45. Retail trade: department stores and variety stores	6 000	180
13. Manufacture of tinware, castings and forgings	6 350	150	46. Retail trade: all other stores (including tobacco)	10 550	300
14. Manufacture of insulated wire and cable	3 050	60	47. Railway transport	7 000	200
15. Manufacture of electrical lamps	1 500	30	48. Urban and suburban tramway and omnibus operators	6 900	150
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	12 700	250	49. Ocean transport, involving foreign countries	7 650	20
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	5 250	100	50. Other transport activities	13 450	400
18. Ship building and repairing	2 950	60	51. Services incidental to transport (including storage)	3 500	180
19. Manuf. of automobiles and automobile bodies	1 150	60	52. Communication services	10 500	250
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	9 300	280	53. Banking and insurance	19 200	400
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	7 950	220	54. Lessors of real property	(12 000)	30
22. Repair of motor vehicles and electric appliances	8 950	200	55. Drinking and eating places; hotels, etc.	13 550	(470)
23. Other metal manufacturing	6 900	150	56. Motion pictures and other amusements	3 350	(280)
24. Manufacture of non-metallic mineral products	4 000	100	57. Laundries; barber and beauty shops	9 350	200
25. Manufacture of articles of paper and paperboard	1 150	30	58. Business services (including legal services)	9 350	200
26. Manufacture of wood, cork, paper and paperboard	3 250	100	59. Medical and other health services	(15 000)	(700)
27. Printing and publishing	10 900	200	60. Educational services; religious activities, etc.	(16 000)	(1 350)
28. Bookbinding, photographing, etc.	9 850	250	61. Labor and political org., trade assoc., etc.	(4 800)	120
29. Manufacture of leather, rubber and fur products	3 700	100	62. Other economic activities in Stockholm	4 800	70
30. Manufacture of dyes, paints and varnishes	1 450	80	Total for the production sectors	*443 700*	*12 300*
31. Manufacture of perfumes and washing compounds	1 750	80	Government administration		(850)
32. Manuf. of plastic materials and plastic products	1 250	40	Dwellings		19 750
33. Manuf. of other chemicals and chemical products	3 100	150	Total floor space used		32 900

Notes. Classification according to Appendix 2. — The most uncertain figures are shown in brackets. — Employment data for the production sectors are reproduced from Table 4.1. for purposes of comparison. — In the procedure of summing it has been assumed that the errors are uncorrelated.

Table 4.7. *Amount of floor space utilized by different industries in Stockholm, in 1950. Summary of Table 4.6.*

	Amount of floor space used (thousands of square metres)	Percentage distribution	Corresponding distribution of the working population %	Corresponding distribution of gross factor returns %
I. Metal and engineering industry.	1 560	11,9	13,7	12,6
II. Printing and publishing, bookbinding, etc.	450	3,4	4,3	4,0
III. Food processing	730	5,6	3,2	2,8
IV. All other manufacturing, incl. construction	1 440	11,0	17,4	16,4
V. Wholesale trade	1 380	10,5	8,4	10,0
VI. Retail trade	1 540	11,7	10,7	7,6
VII. Transportation and communication services	1 200	9,1	10,1	10,8
VIII. Business and personal services, incl. banking etc.	(1 580)	12,0	13,8	19,5
IX. Medical and educational, etc., services	(2 050)	15,6	6,4	5,8
X. Agriculture and all other production sectors	(370)	2,8	3,8	2,5
I—X. Total for the production sectors	12 300	93,5	91,8	92,0
XI. National and municipal government administration	(850)	6,5	8,2	8,0
I—XI. Total amount of floor space utilized, exclusive of dwellings	13 150	100,0	100,0	100,0
XII. Dwellings	19 750			
I—XII. Total floor space utilized	32 900			

Notes. The grouping is in accordance with that used in Table 4.2.
The most uncertain figures are shown in brackets.
In the procedure of summing it has been assumed that the errors are uncorrelated.

able in this field is very limited. The only relevant variable which I have been able to assess in the present study, refers to *the amount of floor space utilized in the Stockholm area, in 1950.* But even on that level, the information here presented is weak. Very few data on the amount of floor space are directly available, so I have had to go about rather circuitously in the procedure of estimation.[1] The figures arrived at are presented in *Table 4.6.*

As can be seen, the floor space figures in Table 4.6. have been rounded off to the nearest ten thousand square metres. Where I felt that the uncertainty involved

[1] Data on the amount of floor space (less an allowance for walls, staircases, etc.) per gainfully employed person, in different sectors, were taken from a thorough investigation on land use in Malmö, the third largest city in Sweden (A general plan for Malmö, Part II, 1952, 394 p.). As a preliminary, these quotients were then multiplied by the number of gainfully employed persons in different sectors in Stockholm, to give a first approximation on the amount of floor space per sector. Through the use of total rents per sector (in 1950), I then estimated the rent per square metre of floor space in each sector. Somewhat adjusted, these data were then put before an advisory board of the City of Stockholm, who recommended some amendments. Also, where possible, comparisons were made with data from an earlier inquiry in Stockholm (Manufacturing industry and handicrafts in Stockholm, publ. 1938).

was even larger, I tried to estimate margins of error. Except for dwellings, where the precision is greater, at most two digits should be considered reliable. The estimate of the *total* floor space utilized should not be in error by more than one percent, provided that the errors involved are uncorrelated.[1]

A summary of the data of Table 4.6. is given in *Table 4.7.*, where the same grouping as in Tables 4.2., 4.3. and 4.5. has been used. Table 4.7. also indicates the relative distribution of the amount of floor space between different groups of sectors. From the corresponding distributions of the working population and of gross factor returns, which have been given to facilitate comparisons, it can be seen that rather large differences existed between these three indicators of the industrial structure of the Stockholm area. The differences were particularly large for the groups III, IV, VI, VIII and IX.

We find from the tables that the total floor space used in the Stockholm area amounted to some 33 million square metres. Considering that by 1950 the area had nearly one million inhabitants, there were some 33 square metres of building space per individual. About 60 percent of the total represented dwelling space.[2]

Needless to say, the data contained in Tables 4.6. and 4.7. are very crude. They have been combined without any regard to differences in the *quality* of the buildings and with very little regard to differences in the *kind* of building space included (offices, factories, warehouses, etc.). Add to this the unreliability of the individual items as indicated above, and it becomes clear that the information provided by the two tables can be used only with the utmost care. In the following pages, I shall apply these data on floor space for illustration purposes only, that is to say, to illustrate how such data could be fitted into the theoretical framework, provided that they were sufficiently reliable and specified as to quality and kind.

What we have done so far in this chapter, has been to indicate the size and composition of the Stockholm economy in the year 1950, as seen from different aspects. Thus we found, for example, that the gainfully employed population in the area amounted to a total of nearly 500 000 persons and that the total building capacity utilized, as measured in terms of floor space, covered some 33 million square metres (some 355 million sq. ft.). We also found that the city income, as defined here, amounted to some 5 400 million Sw. Cr. in 1950. The composition of these and other related aggregates was analysed, particularly with regard to industrial or sectoral origin.

[1] For details of computation, see Appendix 3.

[2] It is interesting to compare these data with those found in a special survey made in Brisbane, Australia, in 1943. (See Economic News, vol. 13, No. 1, pp. 1—2). By that time Brisbane had some 370 000 inhabitants. The Brisbane survey did not cover dwellings, government buildings and some other types of space. For the groups covered, the square footage of space required per inhabitant amounted to a little more than *60* sq. ft. Expressed in the same unit, the total floor space in the Stockholm area amounted to some *355* sq. ft. per inhabitant. For the groups covered by the Brisbane survey, the figure for Stockholm would be about *110* sq. ft., that is, nearly twice as high as the Brisbane figure. For the retail trade, the two cities used about the same space per inhabitant. For all other groups, the amount of space utilized was much higher per inhabitant in Stockholm, particularly for the wholesale trade, for business and personal services, including banking and insurance, and for medical services.

Short digression on the base theory

Now, in order to estimate or guess the developmental possibilities of the Stockholm area in the future, we may find such data useful as a starting-point. But in any attempts to forecast, it is hardly possible to ignore the *external* relations of the Stockholm area, i.e., the relationships between Stockholm and the Rest of the World. In fact, as has already been touched upon in Ch. I, there is a widespread opinion among city-planners, and also among distinguished research workers in this field,[1] that the only thing that really matters in assessing the future development of a city, is what happens to the so-called export base of the city. Let us pause and examine this view a little more closely.

The view is formalized in the so-called theory of the economic base, or export base. According to this theory, a fundamental difference exists in any city or other region between two types of industries, namely basic and nonbasic industries. The basic industries are those which produce goods or services for an export market, that is, a market outside the confines of the community studied. The nonbasic industries are those which produce for the local market. The same dichotomy has also become familiar under various other names, such as »primary» vs. »secondary»; »city-building» or »city-forming» vs. »city-serving»; »urban growth» vs. »urban service» and »export» vs. »local».

The basic industries are claimed to constitute the very foundation of the city's economic life; they generate the income stream upon which the economic progress of the city is founded. On the other hand, the development of the nonbasic industries, to which the retail trade, the repair services, etc., usually belong, are characterized as being dependent upon the basic industries.

At the stage of application of this theory, a so-called basic-nonbasic ratio is usually calculated, to be applied as a sort of multiplier. In most of the applications reported on,[2] employment data have been used as the unit of measurement. Often, the basic-nonbasic ratio is then interpreted as indicating how many employees are needed in the nonbasic industries for every 100 employees in the basic industries. Various procedures have been used in the calculation of the basic-nonbasic ratio, but a rather common one seems to be to estimate, for each industry, the number of people engaged *beyond* the local needs of the city; this gives an estimate of total basic employment, and through a simple subtraction from total employment, the nonbasic employment is obtained.

In a series of articles, ANDREWS[3] has thoroughly examined various aspects of the

[1] See, for example, Weimer, A. M., and Hoyt, H., (1939) Principles of urban real estate; Jones, J. H., (1944) Industry and planning (in: Creative Demobilization, vol. II, Case studies in national planning); and Alexander, J. W., (1954) The basic-nonbasic concept of urban economic functions, pp. 246—261 (Economic Geography, vol. 30). Cf., also, Lösch, A., (1953) The economics of location, pp. 76—77 (note) and 307—308; Isard, W., Kavesh, R. A., and Kuenne, R. E., (1953) The economic base and structure of the urban metropolitan region, pp. 317—321 (American Sociological Review, vol. 18); and Isard, W., (1956) Location and space-economy, pp. 11 and 49.

[2] See, e. g., Alexander, J. W. (1954) op. cit., and Andrews, R. B., (1953) Mechanics of the urban economic base, pp. 161—167 (Land Economics, vol. 29).

[3] Andrews, R. B., Mechanics of the urban economic base (beginning with the May 1953 issue of Land Economics, and continuing in consecutive issues to the end of 1956).

In one of the articles, Andrews does suggest an approach along the lines tried in the present work. Also, see Moyerman, S., and Harris, B., (1955) The economics of the base study, pp. 88—93 (Journal of the American Institute of Planners, vol. 21).

base theory. He finds that the present theory suffers from many shortcomings, and he qualifies and revises the theory in several respects. However, whereas the simple theory, as sketched above, *quantifies* the important relationship as it sees it, the qualifications and revisions suggested by Andrews are mostly in verbal terms and therefore not so easily incorporated into the theory.

The differences between the base theory and the approach tried here have already been indicated in Ch. I. In this context, let me just state one or two main points. At the heart of the matter there is a philosophical difference. The base theory considers the export base as the (autonomous) *determinant* of the city's total employment, income, etc., whereas the present approach will emphasize a *mutual interdependence* between the city and the rest of the world. Moreover, it is considered here that in order to predict the future employment, income, etc., of a city, it is far from *sufficient* to make some assumption about the future size and composition of the city's exports — let us call it the future position of the export variable — albeit this is a *necessary* assumption. In addition we need some assumptions about future investment activity and government activity in the city and, also, about future patterns of consumtion and technical developments. Thus it is a *set* of (interrelated) variables, whose future positions we need some assumptions or knowledge about, in order to predict the city's economic future; the export variable is just one among these variables.

In the preparatory stage of this study, it appeared to me that the economic life of Stockholm was so differentiated that no fruitful analysis could be made within the relatively narrow framework given by the theory of the economic base. However, it may very well be the case that the base theory gives quite sufficient information, for planning purposes, when it is being applied to a city which is less differentiated, and therefore in most cases smaller, than Stockholm. In any critical appraisal of the theory of the economic base, it should also be observed that it is often meant only as a shortcut, to give some rough idea of the developmental possibilities of an area.

In fact, some of the additional factors or variables mentioned above, are included in a few studies which are, fundamentally, applications of the theory of the economic base, but in most cases such inclusions take the form of verbal reservations.[1]

As indicated above, the base theory usually focuses attention upon the *export* side, while neglecting to consider the *imports*. In the following pages, we shall attempt to analyse both sides of the ledger: an attempt will be made to establish a balance of current payments for the Stockholm area, as well as for each particular production sector of the area.

[1] An early study in this field, by W. William-Olsson, may serve as an example. See William-Olsson, W., (1941) Stockholms framtida utveckling (The future development of Stockholm), particularly pp. 186—188 and 198—203.

William-Olsson's terminology seems preferable to that used by most other writers on the subject. He avoids such value-loaded terms as »basic»-»monbasic», »city forming»-»city serving», etc., and distinguishes instead between »exchange production» and »own production».

A most ardent criticism against the theory of the economic base is delivered by Blumenfelt, who, among other things, points to the »mercantilistic and physiocratic overtones» of the theory. See Blumenfelt, H., (1955) The economic base of the metropolis, pp. 114—132 (Journal of the American Institute of Planners, vol. 21, no. 4).

Table 4.8. *The Stockholm balance of payments, on current account, in 1950. (Millions of Sw. Cr.)*

	Imports from the Rest of the World 1	*Exports* to the Rest of the World 2	Net balance 3
Total for the production sectors	2 873	3 896	+ 1 023
The City of Stockholm	9	1	− 8
Households in Stockholm	610	68	− 542
Imports for capital formation in Stockholm	135	−	− 135
Total	3 627	3 965	+ 338

Notes. Receipts from and disbursements to National Government are excluded in this table.
The *first* column shows the disbursements *from* Stockholm to the Rest of the World (in return for goods and services imported to Stockholm and, to a minor extent, in the form of interest and dividends, etc.).
The *second* column shows the receipts *to* Stockholm from the Rest of the World (in return for goods and services exported from Stockholm and, to a minor extent, in the form of interest and dividends, etc.).
In the *third* column which shows the balance between the first two, a plus sign indicates that Stockholm had a net *inflow* of funds, whereas a minus sign indicates that Stockholm had a net *outflow* of funds.

A balance of current payments — Stockholm vs. the Rest of the World

The Intersectoral Flow Datum Table gives information, for each sector listed, on the size of the receipts obtained from the Rest of Sweden and from abroad — in other words, information on the size of exports, in a wide sense, to the Rest of the World. Also, the table provides information, for each sector listed, on the disbursements (the allocations of receipts) that went to the Rest of Sweden and to abroad — in other words, the table also shows how much each sector imported (imports taken in a wide sense, to include such »invisible items» as the payment of interest and dividends) from the Rest of the World. Thus, the sector Beverage Industries and Tobacco Manufactures in Stockholm (row no. 2, in the table) is found to have exported products to the Rest of the World for nearly 43 million Sw. Cr. (total of entries nos. 64, 65—70 and 86—87, along row no. 2). On the other side of the ledger, we find that the same sector (see *column* no. 2) *imported* commodities (raw materials, etc.) for some 57 millions, in all (total of entries nos. 63, 64 and 65—70, in column no. 2). In *Table 4.8.*, a total is given for the imports and exports of all the 62 production sectors specified in the Intersectoral Flow Datum Table. As can be seen, a sizable export surplus (1 023 millions) is registered for all these sectors together. The city of Stockholm, i.e. the local municipal authorities,[1]

[1] Regrettably, I have not been able to specify the corresponding items referring to municipal authorities in the Stockholm area *other than* the City of Stockholm. However, those items should be negligibly small.

had somewhat larger disbursements *to* the Rest of the World than receipts *from* the Rest of the World, as shown on the next row in the table. Likewise, Households had a negative net balance. They had relatively small receipts, mostly in the form of interest and dividends, from the Rest of the World, but, on the other hand, they purchased a good deal of commodities imported from the Rest of the World (610 millions). In part, the large export surplus found for the production sectors can be ascribed to the fact that, above, only current disbursements were considered on the import side. If we add their imports for capital formation purposes, we arrive at a somewhat reduced net surplus. Altogether, the imports of commodities for capital formation in Stockholm amounted to some 135 millions, as estimated.[1]

Adding all the items, with their respective signs, we arrive at the total net balance for Stockholm shown on the last row in Table 4.8. Thus, according to the estimates made, the Stockholm area came out with a net surplus of funds[2] in its trade and other current relations with the Rest of the World, amounting to nearly 340 millions.[3]

It is of some interest to see where this surplus in the Stockholm area arose. Unfortunately, available data only permit a binary classification, as has been mentioned before, into 1) receipts from and disbursements to the Rest of Sweden and 2) receipts from and disbursements to Foreign Countries. The result, as drawn from the Intersectoral Flow Datum Table, is shown below.

	Millions of Sw. Cr.
The receipts of Stockholm *from* the Rest of Sweden	2 918
The disbursements of Stockholm *to* the Rest of Sweden	2 293
Net balance: Stockholm vis-à-vis the Rest of Sweden	+ 625
The receipts of Stockholm *from* Foreign Countries	1 048
The disbursements of Stockholm *to* Foreign Countries	1 335
Net balance: Stockholm vis-à-vis Foreign Countries	— 287
Total net balance: Stockholm vis-à-vis the Rest of the World	+ 338

Thus, the Stockholm area had a relatively large surplus (of receipts over disbursements) in its trade and other current relations with the Rest of Sweden (625 millions). This was partly countered by a negative balance in Stockholm's corresponding relations with Foreign Countries (287 millions).[4]

[1] The figure also includes capital goods imported by the City of Stockholm and, probably, a small amount of capital goods imported by National Government authorities for use in Stockholm.

[2] In the sense of »receivables minus payables».

[3] Increases in inventories of goods produced in Stockholm in the year 1950 are excluded from this estimate. This means that I assumed that all such increases, registered in the table, did take place within Stockholm. With the contrary assumption, the estimated net balance would have been even larger than 338 millions, as given above. However, my estimates on changes in inventories are extremely weak, generally speaking, so the possibility is by no means excluded that I have underestimated the increases in inventories that in fact took place in Stockholm. An analogous reasoning can be used for the import side, as regards decreases in inventories; such decreases were treated as if they had taken place in the Rest of Sweden, i. e., as »imports» to Stockholm. It should be mentioned here that according to estimates for Sweden as a whole, there was a net decrease in inventories in 1950, amounting to some 145 millions. If we simply apportioned a fraction of that amount to Stockholm, we would come out with a still larger export surplus for the area than that obtained above.

[4] Incidentally, the Rest of Sweden had a surplus in its trade and other current relations with Foreign Countries, amounting to some 700 millions. For purposes of comparison, the corresponding relations of National Government have been excluded from that figure.

Three qualifying remarks should now be made. First, one must not conclude from these data that the Stockholm area can be characterized as a surplus area, with respect to the balance between its exports and imports. The data above cover only one single year and it is impossible to generalize for a longer period from that information alone.

Secondly, the balance arrived at is only a balance of trade and services (including interest and dividends, etc.). Long-term loans and other capital transactions are not covered by this study. In his enquiry into commodity and factor movements between *regions,* in addition to the traditionally studied field of commodity and factor movements between nations, OHLIN pointed to the almost complete lack of statistical evidence on the absolute and relative size of capital transactions between various parts of the same country.[1] With few exceptions,[2] this state of affairs still seems to exist. As regards Sweden, banks do have data on *some* interregional movements of capital in different years, namely regarding the net balance, for each county, between deposits received and loans given. But as pointed out by KRAGH,[3] it is, for several reasons, doubtful whether such partial data are significantly correlated with total movements of capital between regions. For instance, some of the largest Swedish companies have their main activity concentrated in one region (say, Northern Sweden), while they happen to have their main bank transactions in another part of the country (say, in Stockholm). Clearly, to base a study of regional movements of capital upon such data would be misleading. Further, one could not possibly leave out of the picture the capital movements channelled through insurance companies and other financial institutions. The conclusion to be drawn from this, is that we simply do not know whether Stockholm's export surplus in 1950 had some counterpart in a (long-term) capital export.

Thirdly, there is the question of the National Government. In the estimations given above, all the receipts obtained from and the disbursements (allocations) made to the National Government are excluded. At first sight this may seem to be a rather odd procedure, but I should really like to make a modest plea for it and suggest similar treatment also in other regional or local studies. For one thing, to incorporate in the Stockholm balance of payments as presented above, transfers and other current relations between the National Government and the Stockholm area, would imply that the National Government was somehow referred to the Rest of Sweden. That would be artificial, since, obviously, National Government activity serves the country as a whole. Also, it seems that to study the size of the payables and receivables for a particular area vis-à-vis the National Government has an interest of its own, quite apart from that as an ordinary balance-of-payments study.[4]

[1] Ohlin, B., (1933) Interregional and international trade, particularly chs. 18 and 19.

[2] See, e. g., Hartland, P., (1950) Balance of interregional payments of New England; Harris, S. E., (1952) The economics of New England, pp. 91—103; and Harris, S. E., (1957) International and interregional economics, pp. 165—192. Cf., also, Lösch, A., (1954) The economics of location, pp. 505—507.

[3] Kragh, B., (1945) Den regionala kapitalförsörjningen (The regional supply and demand of capital; in: Ekonomisk Revy, vol. 2, no. 1).

[4] This view is supported by Harris in his case study of the New England area. See Harris, S. E., (1952) The Economics of New England, pp. 104—114.

Stockholm vis-à-vis the National Government: Receipts and disbursements (accrued)

Stockholm is a center of National Government administration, including defense, in Sweden. Consequently, it may be expected that a considerable income stream is poured into the Stockholm area by the National Government, to pay the salaries of government employees, to pay for goods and services purchased from business firms in Stockholm, etc. Also, to Stockholm, as well as to the Rest of Sweden, large transfers are made by the National Government in the form of pensions, family allowances, subsidies to schools, hospitals and housing projects, subsidies to certain municipal government activities and so on.

To finance these various forms of National Government expenditure, people and business firms contribute by paying direct and indirect taxes, customs duties and other fees, to the National Government, and the interesting question then arises: To what extent do the receipts obtained by any particular area *from* the National Government, *balance* the disbursements from the same area *to* the National Government? This question has at least three interesting aspects. First, it may be asked with reference to the total payments accrued during a particular period of time. Second, it may be asked with reference to *changes* in the balance from period to period. Third, it may be asked with reference to any specific government action of fiscal or other economic policy, as to its probable local or regional income effects. Only the first aspect can be taken up here.

To start with an illustrative example, the Swedish town of Karlskoga delivers commodities to the National Government for defense purposes. Of course, households, factories and other business firms in this town pay their tribute to the National Government through income taxes, but, even so, it seems likely that Karlskoga comes out with a large net surplus in its current-payments relations with the National Government. Thus assuming for simplicity that the Government budget has a zero balance, other parts of the country must create the surplus of Karlskoga through their payments to the National Government.

Now, considering the large income stream being poured into the Stockholm area by the National Government, as indicated above, it may seem reasonable to think of Stockholm as a parallel to Karlskoga, that is, as having a surplus in its current relations with the National Government. However, exactly the opposite was true for the period investigated in the present study. This is evidenced by *Table 4.9.*

As can be seen, the National Government had larger receipts than disbursements on current account in 1950. According to the estimates the net balance amounted to 518 millions. The corresponding figures for the three areas involved were as follows:

National Government net balance vis-à-vis the Stockholm area	+ 474
» » » » » » Rest of Sweden	+ 306
» » » » » » Foreign Countries	— 262
Total net-balance	+ 518

Table 4.9. *The sources of National Government receipts — and the destinations of National Government disbursements (accrued), in 1950.*

Disbursements	Mill. of Sw. Cr.	Sources	Mill. of Sw. Cr.
Salaries to government employees, transfers and other current payments *to the Stockholm area*	794	Direct and indirect taxes and other receipts *from the Stockholm area* ..	1 268
Thereof: accrued to Households 491		Thereof: from Households.. 856	
Salaries, transfers, etc., *to the Rest of Sweden*	3 776	Direct and indirect taxes, etc., *from the Rest of Sweden*	4 082
Thereof: accrued to Households 2 134		Thereof: from Households.. 2 858	
Subsidies on imported goods, purchases for defense purposes, and other transactions giving receipts *to Foreign Countries*	315	Taxes and other receipts *from Foreign Countries*	53
Residual: Net surplus of receipts on the National Government budget	518		
Total	5 403	Total	5 403

Notes. Due to difficulties in tracing the destinations of National Government disbursements, the entries on the left hand side of the ledger are uncertain.
Depreciations on National Government assets are excluded from this table. The same applies to a small internal item (see the Intersectoral Flow Datum Table, rows 71—72 and 80, column 78—80).

If we apportion the negative balance vis-à-vis Foreign Countries, 262 millions, to the Stockholm area and the Rest of Sweden, using, very roughly, their respective shares in total national income as a basis, we get the following results:

National Government net balance vis-à-vis the Stockholm area . . . . . + 422
» » » » » » Rest of Sweden . . . . . + 96
Total net-balance + 518

Thus, the government surplus drawn from the Stockholm area was considerable, as seen in relation to the total surplus on the National Government current account. One contributing factor to this state of affairs was the following. As can be seen from the Intersectoral Flow Datum Table, the average (nominal) income per income earner in the Stockholm area was much larger than the average (nominal) income per income earner in the Rest of Sweden. This fact coupled with the prevailing system of progressive taxation, contributed to make government *receipts from* the Stockholm area so large that they even outweighed the heavy government *disbursements to* the area. A similar influence was exerted through the distribution of indirect taxes.

The estimated remainder of the surplus, coming from the Rest of Sweden, was of course composed of plus and minus items, the geographical distribution of which, however, we do not know.

In 1950, capital formation (including the building of roads, etc.) by the Na-

tional Government was relatively small in the Stockholm area, so that the figure arrived at above, a surplus of 422 millions, would only be reduced to some 400 millions, if we also included the National Government capital account in the calculations.

Now, does all this mean that the Stockholm area paid »too much», in comparison with the Rest of Sweden, for the services obtained from the National Government (including defense, etc.)? Indeed, it would be fallacious to make such an interpretation on the sole basis of data presented here. However, by means of the Intersectoral Flow Datum Table, it can be estimated that about one third of (the monetary value of) the services provided by the National Government should go to the Stockholm area, in order to equal the value of taxes and other receipts obtained by the National Government from the same area. As mentioned before, in 1950 the Stockholm area had about one seventh of the total population of the country and contributed by about one fifth to national income.

FINDINGS BASED ON THE ASSUMPTIONS OF FACTORABILITY

Some analysis of the current-payments relations between the production sectors and the Rest of the World

Above, we found that altogether the production sectors of the Stockholm area had export receipts, i. e., receipts from the Rest of Sweden and from Foreign Countries, amounting to nearly 3 900 millions. Seen in relation to the total receipts of the production sectors, this figure represented some *39 percent.*

We might interpret this percentage figure as indicating, on the average, the extent to which the production sectors directly depended upon exports. But there was a wide dispersion around this average for the individual sectors as shown by the second column of *Table 4.10.* At the one extreme we find the sectors Ocean Transport (no. 49), Manufacture of Insulated Wire and Cable (no. 14), and Manufacture of Electrical Lamps (no. 15), whose export receipts accounted for more than 85 percent of their total receipts. At the other extreme we find the sectors Manufacture of Dairy Products (no. 4), Electricity, Gas and Water Services (no. 34) and Lessors of Real Property (no. 54) having no export receipts or relatively very small ones.

The wide dispersion mentioned is also indicated by *Chart 4.1.*, which, among other things, shows that 14 out of the 62 production sectors had an export percentage below 20, and that 16 sectors had an export percentage above 60.

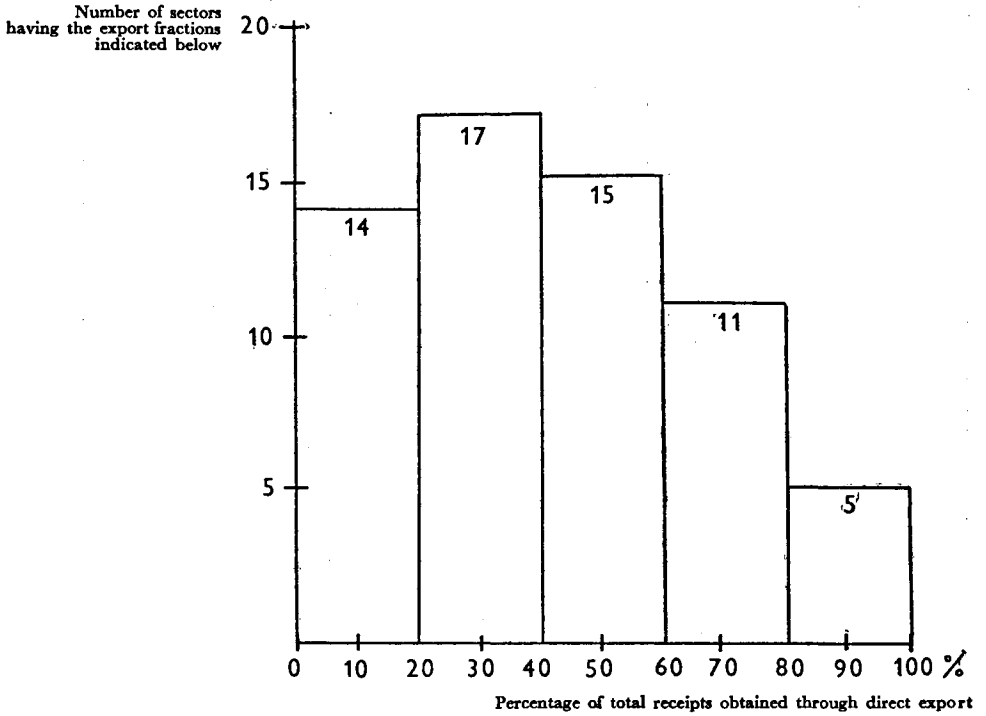
One thing stands out clearly from the Table and the Chart, namely that any distinction between »basic» and »nonbasic» industries would be highly arbitrary. Nearly all the sectors do have some exports, and if one did not want to label all of them as »basic industries», one would have to fix quite arbitrarily along the scale some point through which to draw the division line.

Table 4.10. *The direct exports of the production sectors to the Rest of the World, in 1950.* (*Millions of Sw. Cr.*)

Sector No.	Percentage of total receipts obtained through direct exports	Absolute amount of export receipts (mill. of Sw. Cr.)	Sector No.	Percentage of total receipts obtained through direct exports	Absolute amount of export receipts (mill. of Sw. Cr.)
1. Agriculture and fishing	2,8	2	31. Manufacture of perfumes and washing compounds	64,8	43
2. Beverage industries and tobacco manufactures	32,8	43	32. Manuf. of plastic materials and plastic products	43,0	9
3. Manufacture of cocoa and chocolate	67,4	44	33. Manuf. of other chemicals and chemical products	57,4	76
4. Manufacture of dairy products	0,2	—	34. Electricity, gas and water services	0,5	1
5. Other food manufacturing: consumers' goods	23,0	86	35. Building construction	13,0	91
6. Other food manufacturing: industrial goods	50,6	60	36. Construction other than building	64,7	317
7. Wholesale trade: food products	55,2	44	37. Wholesale trade: hardw., lumber, constr. materials	69,1	114
8. Retail trade: food products (including beverages)	1,6	3	38. Wholesale trade: fuels	51,8	31
9. Manufacture of wearing apparel	52,0	69	39. Wholesale trade: shop and office fittings	48,9	13
10. Other textile manufacturing	40,5	38	40. Wholesale trade: machinery, equipm., and supplies	71,8	57
11. Wholesale trade: apparel and dry goods	58,6	41	41. Wholesale trade: pulp, paper and paper products	80,2	38
12. Retail trade: apparel and dry goods	6,7	8	42. Wholesale trade: other kinds of business	68,3	137
13. Manufacture of tinware, castings and forgings	30,9	40	43. Retail trade: motor vehicles	35,7	10
14. Manufacture of insulated wire and cable	87,1	118	44. Retail trade: other consumers' durables	7,8	7
15. Manufacture of electrical lamps	86,6	25	45. Retail trade: department stores and variety stores	6,7	4
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	75,7	223	46. Retail trade: all other stores (including tobacco)	8,8	9
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	67,6	75	47. Railway transport	33,5	60
18. Ship building and repairing	34,9	18	48. Urban and suburban tram. and omnib. operators.	3,0	3
19. Manuf. of automobiles and automobile bodies.	76,4	62	49. Ocean transport, involving foreign countries	93,7	370
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	82,2	235	50. Other transport activities	45,6	126
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	46,8	100	51. Services incidental to transport (including storage)	36,0	32
22. Repair of motor vehicles and electric appliances	29,9	40	52. Communication services	39,5	79
23. Other metal manufacturing	51,9	64	53. Banking and insurance	60,7	182
24. Manufacture of non-metallic mineral products	40,2	42	54. Lessors of real property	—	—
25. Manufacture of articles of paper and paperboard	48,9	15	55. Drinking and eating places; hotels, etc.	29,4	94
26. Manufacture of wood, cork, paper and paperboard	31,2	21	56. Motion pictures and other amusements	37,1	35
27. Printing and publishing	44,8	107	57. Laundries; barber and beauty shops	2,4	2
28. Bookbinding, photographing, etc.	66,7	175	58. Business services (including legal services)	36,0	50
29. Manufacture of leather, rubber and fur products	26,3	17	59. Medical and other health services	3,1	7
30. Manufacture of dyes, paints and varnishes	44,5	32	60. Educational services; religious activities, etc.	4,0	8
			61. Labor and political org., trade assoc., etc.	42,2	25
			62. Other economic activities in Stockholm	24,7	15
			Total	38,9	3 896

Notes. The classification into production sectors is identical to that found in the Intersectoral Flow Datum Table (see, also, Appendix 2). — For each production sector, exports are defined as the sum of the entries in columns 63, 64, 65—70, 72, 77 and 86—87, in the Intersectoral Flow Datum Table. Thus, property income accrued to the Rest of the World from the Stockholm area is included. — Total receipts are found in column 88 (rows 1—62). — The absolute amounts are rounded off to the nearest million.

Chart 4.1. *The distribution of the 62 production sectors, with regard to the percentage of receipts obtained through direct exports to the Rest of the World.*



The last column of Table 4.10. shows the absolute amounts of exports,[1] i. e., it shows the size of the export receipts that each sector brought into the Stockholm area. Now, it would be one-sided and therefore rather misleading to rank the industries having *large exports* as, somehow, »the area's bread-winners».[2] It might very well be the case that such industries were largely dependent upon imports of raw materials, etc., for their current production needs. Thus, it might even happen that a particular industry with large export receipts had even larger import payments, so that, on a net basis, the industry would give rise to a *leakage* of receipts away from the city.

Clearly, to find out about such things we must estimate the total imports of each production sector and then calculate some *balance* between exports and imports. At first sight it may seem more or less self-evident that the imports of each production sector should be defined — in the terms of the Intersectoral Flow Datum Table —

[1] As indicated in Ch. III, the export amounts have been measured in terms of producer's values. The consequences hereof with regard to the evaluation of the exports of the wholesale and retail trade sectors have also been indicated in Ch. III.

[2] Cf., Mattila, J., and Thompson, W., (1955) The measurement of the economic base of the metropolitan area, p. 216 (Land Economics, vol. 31).

as the sum of the entries in the rows referring to transactions with the Rest of the World. For instance, the sector Drinking and Eating Places, Hotels, etc. (see column 55), is found to have imported goods and services from the Rest of Sweden to a sum of 32,6 millions (rows 63 and 64) and from Foreign Countries to a sum of 4,8 millions (rows 65—70), giving rise to a total of some 37 millions.

However, this figure only tells us how much the sector imported *directly*. But through its demand upon other production sectors in the Stockholm area it also imported goods and services *indirectly*. As seen from the Intersectoral Flow Datum Table (column 55), Drinking and Eating Places, etc., purchased large amounts of commodities from the sectors Beverage Industries and Tobacco Manufactures (no. 2), Manufacture of Dairy Products (no. 4), and Other Food Manufacturing (no. 5), in Stockholm. These sectors, in turn, imported raw materials, etc., for their own production needs, in order to be able to supply, among others, the sector Drinking and Eating Places. To some extent these sectors also purchased commodities from other production sectors, which in their turn were dependent upon imports for current production needs, and so on *ad infinitum*.

Thus, if we take into account the interdependence that exists between the production sectors, we must, among other things, adopt a more comprehensive view in defining the »imports» of a sector — to include not only the *direct* imports but also the *indirect* imports.

The theoretical problems involved in estimating the direct-as-well-as-the-indirect-imports of a sector have been dealt with in Ch. II, and I shall now apply the results found.

Denoting the Rest of the World by »*R*», we write the *direct* imports of production sector λ as follows:

$$x_{R\lambda}$$

This expression states the amount of commodities delivered from the Rest of the World (R) directly to sector λ. What we really want to know, however, is the amount of imports incorporated in the total deliveries to sector λ, regardless of whether these imports were absorbed *directly* by sector λ, or *indirectly*, incorporated in the supplies to sector λ from all the 62 production sectors. As already indicated, these indirect imports may have passed through (and may have been processed by) an indefinitely long chain of production sectors before finally being absorbed by sector λ. Using the denotations of Ch. II,[1] we want to find

$$x_{R\,|\,\lambda}$$

Assuming, now, that the factorability assumptions are fulfilled, this expression can be expanded according to (23) in Ch. II, as follows:

$$x_{R\,|\,\lambda} = x_\lambda \sum_{\alpha=1}^{62} a_{R\alpha} A_{\alpha\lambda}$$

[1] Cf., Ch. II, pp. 16—19.

Table 4.11. *The imports of the production sectors (from the Rest of the World), in 1950 (Millions of Sw. Cr.).*

Sector No.	Total direct imports	Direct imports per million's worth of output	Direct-plus-indirect imports per million's worth of output	Direct-plus-indirect imports incorporated in deliveries to final demand
1. Agriculture and fishing	15	0,191	0,237	11
2. Beverage industries and tobacco manufactures	64	0,489	0,528	53
3. Manufacture of cocoa and chocolate	31	0,478	0,611	39
4. Manufacture of dairy products	178	0,822	0,850	141
5. Other food manufacturing: consumers' goods	198	0,529	0,698	217
6. Other food manufacturing: industrial goods	99	0,832	0,850	70
7. Wholesale trade: food products	4	0,056	0,102	5
8. Retail trade: food products (including beverages)	5	0,030	0,074	12
9. Manufacture of wearing apparel	81	0,612	0,635	83
10. Other textile manufacturing	40	0,431	0,494	41
11. Wholesale trade: apparel and dry goods	7	0,096	0,114	5
12. Retail trade: apparel and dry goods	1	0,005	0,057	7
13. Manufacture of tinware, castings and forgings	56	0,441	0,472	23
14. Manufacture of insulated wire and cable	93	0,682	0,702	94
15. Manufacture of electrical lamps	7	0,228	0,356	10
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	119	0,401	0,442	119
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	42	0,396	0,472	46
18. Ship building and repairing	6	0,121	0,263	13
19. Manufacture of automobiles and automobile bodies	58	0,713	0,739	59
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	95	0,317	0,428	111
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	91	0,444	0,536	86
22. Repair of motor vehicles and electric appliances	40	0,295	0,358	30
23. Other metal manufacturing	43	0,349	0,420	44
24. Manufacture of non-metallic mineral products	18	0,176	0,216	11
25. Manufacture of articles of paper and paperboard	9	0,292	0,503	11
26. Manufacture of wood, cork, paper and paperboard	40	0,589	0,610	22
27. Printing and publishing	88	0,368	0,418	59
28. Bookbinding, photographing, etc.	48	0,185	0,354	77

29. Manufacture of leather, rubber and fur products	30	0,468	0,510	27
30. Manufacture of dyes, paints and varnishes	40	0,547	0,640	27
31. Manufacture of perfumes and washing compounds	37	0,549	0,630	38
32. Manufacture of plastic materials and plastic products	8	0,364	0,451	7
33. Manufacture of other chemicals and chemical products	71	0,536	0,660	61
34. Electricity, gas and water services	46	0,267	0,311	18
35. Building construction	92	0,129	0,243	108
36. Construction other than building	203	0,419	0,466	197
37. Wholesale trade: hardware, lumber, constr. materials	28	0,173	0,203	25
38. Wholesale trade: fuels	8	0,127	0,148	5
39. Wholesale trade: shop and office fittings	5	0,178	0,203	5
40. Wholesale trade: machinery, equipment, and supplies	12	0,155	0,186	15
41. Wholesale trade: pulp, paper and paper products	5	0,100	0,123	5
42. Wholesale trade: other kinds of business	31	0,155	0,180	26
43. Retail trade: motor vehicles	3	0,118	0,165	5
44. Retail trade: other consumers' durables	4	0,040	0,093	8
45. Retail trade: department stores and variety stores	3	0,057	0,091	5
46. Retail trade: all other stores (including tobacco)	2	0,024	0,075	7
47. Railway transport	36	0,204	0,356	47
48. Urban and suburban tramway and omnibus operators	13	0,130	0,204	21
49. Ocean transport, involving foreign countries	199	0,504	0,529	209
50. Other transport activities	53	0,193	0,256	56
51. Services incidental to transport (including storage)	28	0,308	0,356	22
52. Communication services	17	0,086	0,175	25
53. Banking and insurance	35	0,118	0,141	33
54. Lessors of real property	101	0,131	0,181	91
55. Drinking and eating places; hotels, etc.	37	0,117	0,319	102
56. Motion pictures and other amusements	37	0,394	0,466	43
57. Laundries; barber and beauty shops	2	0,038	0,102	6
58. Business services (including legal services)	18	0,133	0,158	12
59. Medical and other health services	38	0,161	0,259	58
60. Educational services; religious activities, etc.	25	0,122	0,159	33
61. Labor and political org., trade assoc., etc.	5	0,088	0,127	7
62. Other economic activities in Stockholm	19	0,318	0,335	18
Total	2 873	—	—	2 873

Notes. The figures given in this table have been rounded off. — The classification into production sectors is identical to that found in the Intersectoral Flow Datum Table (see, also Appendix 2). — For each production sector, total direct imports are defined as the sum of the entries in rows 63, 64, 65, 66, 67, 68, 69, 70, 73, 86 and 87. Thus, property income accrued to Stockholm from the Rest of the World is included.

Here, $a_{R\alpha}$ ($\alpha = 1, 2, \ldots\ldots 62$), denotes the average amount of direct imports absorbed by sector α, per unit of its output.[1] Thus, it may be referred to as a coefficient of direct imports for the period investigated.

$A_{\alpha\lambda}$ ($\alpha = 1, 2, \ldots\ldots 62$) is an element of the inverse of the matrix (I — a). With the assumptions used, we can interpret $A_{\alpha\lambda}$ as the average amount of supply from sector α that is needed to enable sector λ to produce one unit of output.

For the sector chosen as an illustration above, namely Drinking and Eating Places, etc. (sector no. 55), the total direct and indirect imports amounted to some *102* million Sw. Cr., as computed by means of the above formula. This figure may be compared to the estimated value of the *direct* imports of the sector, namely *37* millions. Thus, the indirect imports of the sector Drinking and Eating Places, etc., were nearly twice as high as the direct imports.

If interest is focused upon one particular sector, the procedure of computation used above seems suggestive. However, if we made similar computations for a group of sectors — let us say for the subset of sectors classified as metal manufacturing — the data of the individual sectors could not be meaningfully added to form the total direct and indirect imports of the group concerned, because of double-counting. The indirect imports of one sector would, simultaneously, constitute parts of the direct imports of other sectors.

To arrive at import estimates which are *additive,* we must modify the problem posed above. Instead of computing the imports incorporated in the *total* deliveries from a production sector λ, we compute the imports incorporated in the deliveries from λ to the final demand sectors. More precisely, we want to find

$$x_{R\,|\,\lambda\Omega}$$

where, as before, Ω denotes the set of final demand sectors, and λ denotes any one of the 62 production sectors. This expression can be expanded in accordance with (25), Ch. II, p. 19, to give

$$x_{R\,|\,\lambda\Omega} = x_{\lambda\Omega} \sum_{\alpha=1}^{62} a_{R\alpha} A_{\alpha\lambda} .$$

Computations according to this formula give estimates of the import contents of the commodities absorbed by the final demand sectors. The very complex net of existing interrelationships between the production sectors is thereby rendered, as it were, transparent. On the basis of the computations we are enabled to make such statements as: »A shift in final demand of such-and-such a character would, other things being equal, imply such-and-such changes in total import needs.»

For the particular sector considered above, Drinking and Eating Places, etc., this revised computation leads only to a slight reduction in the import value, due to the simple fact that nearly all the output from this sector was absorbed by the final demand sectors.

Table 4.11. presents the results of the computations for all the 62 production sectors. Direct-plus-indirect imports are defined according to (25), Ch. II, as above.

[1] The unit is measured here conventionally as one million's worth of output.

For purposes of comparison, the table also gives data on the direct imports of each sector. For the same purposes, two sets of import coefficients are presented in the table, one set giving the direct imports per million's worth of output and the other giving the direct-plus-indirect imports per million's worth of output.[1]

Computed in the way indicated, the direct-plus-indirect imports are additive and their total, for the 62 production sectors, should agree with the total value of the direct imports of the production sectors. This was used as a check in the computational procedures. It was found that the computations gave a total of 2 872.7 million Sw. Cr., as against a total value of direct imports of 2 873.3 million Sw. Cr., when calculated from the Intersectoral Flow Datum Table — a negligible difference.

Table 4.11. shows, for instance, that the sector Electricity, Gas and Water Services (no. 34) imported commodities for some 46 millions, *directly*. The total value of the imports of the sector (i. e., direct as well as indirect imports) contained in its deliveries to the final demand categories, were, however, no larger than some 18 millions, as can be seen from the table. Thus, the rise in the value of imports, due to the inclusion of indirect imports, was more than offset by the reduction obtained through tracing only that fraction of the total which was absorbed by the final demand sectors.

The size of the first-mentioned component, that due to the inclusion of indirect imports, can be indicated by paired comparisons as between the two sets of import coefficients given in the table. Thus, it can be seen from the table that in order to produce one million's worth of services, the sector Electricity, Gas and Water Services (no. 34) absorbed commodities imported *directly* to a sum, on the average, of 0.267 million Sw. Cr. Including also the indirect imports, the corresponding figure will be 0.311 million Sw. Cr., as the table shows.

Altogether, there were five sectors for which the direct-plus-indirect-import coefficient was 0.150 (million Sw. Cr.) larger than the corresponding direct-import coefficient, namely Other Food Manufacturing: Consumers' Goods (sector no. 5), Manufacture of Articles of Paper and Paperboard (sector no. 25), Bookbinding, Commercial Photographing, etc. (sector no. 28), Railway Transport (sector no. 47) and Drinking and Eating Places, Hotels, etc. (sector no. 55).

Now we are in a better position to cope with the problem raised above: to calculate the balance between the exports and imports of each production sector. Denoting the exports of a sector λ ($\lambda = 1, 2, \ldots 62$) to the Rest of the World by $x_{\lambda R}$, a traditional approach would be to estimate the unadjusted balance

$$x_{\lambda R} - x_{R\lambda} \qquad (\lambda = 1, 2, \ldots 62) \tag{28}$$

The alternative procedure discussed above[2] would be to estimate the balance adjusted for the deliveries between the production sectors, or

[1] The results of similar computations, based upon a 21-sector table referring to the Danish economy in 1949, were recently published by Rasmussen. See Rasmussen, P. N., (1956) Studies in inter sectoral relations, pp. 50—51. Reference should also be made to Frisch, R., (1952) Reperkusjons analytiske problemer ... (Lectures on problems of repercussion analysis ...).

[2] The differences between the two alternatives are illustrated by means of a simple numerical example in Rasmussen, P. N., (1956), op. cit. pp. 19—26.

Table 4.12. *The balance between exports and imports for the production sectors in 1950. (Millions of Sw. Cr.)*

Sector No.	Difference between exports and: a) direct imports	b) direct-plus-indirect imports incorporated in the deliveries to final demand	Sector No.	Difference between exports and: a) direct imports	b) direct-plus-indirect imports incorporated in the deliveries to final demand
1. Agriculture and fishing	− 13	− 9	31. Manufacture of perfumes and washing compounds	+ 7	+ 5
2. Beverage industries and tobacco manufactures	− 21	− 11	32. Manuf.of plastic materials and plastic products	+ 1	+ 2
3. Manufacture of cocoa and chocolate	+ 13	+ 6	33. Manuf. of other chemicals and chemical products	+ 5	+ 14
4. Manufacture of dairy products	− 178	− 140	34. Electricity, gas and water services	− 45	− 17
5. Other food manufacturing: consumers' goods	− 112	− 131	35. Building construction	− 2	− 17
6. Other food manufacturing: industrial goods	− 39	− 9	36. Construction other than building	+ 114	+ 120
7. Wholesale trade: food products	+ 40	+ 40	37. Wholesale trade: hardw., lumber, constr. materials	+ 86	+ 89
8. Retail trade: food products (including beverages)	− 2	− 9	38. Wholesale trade: fuels	+ 24	+ 26
9. Manufacture of wearing apparel	− 12	− 14	39. Wholesale trade: shop and office fittings	+ 8	+ 8
10. Other textile manufacturing	− 2	− 3	40. Wholesale trade: machinery, equipm., and supplies	+ 45	+ 43
11. Wholesale trade: apparel and dry goods	+ 34	+ 36	41. Wholesale trade: pulp, paper and paper products.	+ 34	+ 34
12. Retail trade: apparel and dry goods	+ 8	+ 1	42. Wholesale trade: other kinds of business	+ 106	+ 111
13. Manufacture of tinware, castings and forgings	− 17	+ 17	43. Retail trade: motor vehicles	+ 7	+ 5
14. Manufacture of insulated wire and cable	+ 26	+ 24	44. Retail trade: other consumers' durables	+ 3	− 1
15. Manufacture of electrical lamps	+ 18	+ 15	45. Retail trade: department stores and variety stores	+ 1	− 1
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	+ 103	+ 103	46. Retail trade: all other stores (including tobacco)	+ 7	+ 2
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	+ 33	+ 29	47. Railway transport	+ 23	+ 12
18. Ship building and repairing	+ 12	+ 5	48. Urban and suburban tram. and omnibus operators	− 10	− 18
19. Manuf. of automobiles and automobile bodies	+ 4	+ 3	49. Ocean transport, involving foreign countries	+ 171	+ 161
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	+ 140	+ 124	50. Other transport activities	+ 72	+ 69
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	+ 9	+ 14	51. Services incidental to transport (including storage)	+ 5	+ 10
22. Repair of motor vehicles and electric appliances	0	+ 10	52. Communication services	+ 62	+ 54
23. Other metal manufacturing	+ 21	+ 20	53. Banking and insurance	+ 147	+ 149
24. Manufacture of non-metallic mineral products	+ 24	+ 31	54. Lessors of real property	− 101	− 91
25. Manufacture of articles of paper and paperboard	+ 6	+ 4	55. Drinking and eating places; hotels, etc.	+ 57	− 8
26. Manufacture of wood, cork, paper and paperboard	− 19	− 1	56. Motion pictures and other amusements	− 2	− 8
27. Printing and publishing	+ 19	+ 48	57. Laundries; barber and beauty shops	− 1	− 5
28. Bookbinding, photographing, etc.	+ 126	+ 98	58. Business services (including legal services)	+ 31	+ 38
29. Manufacture of leather, rubber and fur products	− 13	− 10	59. Medical and other health services	− 31	− 51
30. Manufacture of dyes, paints and varnishes	− 7	+ 5	60. Educational services; religious activities, etc.	− 17	− 24
			61. Labor and political org., trade assoc., etc.	+ 20	+ 19
			62. Other economic activities in Stockholm	− 4	− 4
			Total net balance	+ 1 023	+ 1 023

Notes. The classification into production sectors is identical to that found in the Intersectoral Flow Datum Table (see, also, Appendix 2). — For the definitions of exports and imports, see Tables 4.10. and 4.11. — All figures are rounded off to the nearest million.

Table 4.13. *The ten sectors with the largest export receipts ranked according to different criteria.*

Criteria	Sector No.:									
	49.	36.	20.	16.	53.	28.	42.	50.	14.	37.
Absolute amount of export receipts	I	II	III	IV	V	VI	VII	VIII	IX	X
Percentage of total receipts obtained through exports	I	VIII	III	IV	IX	VII	VI	X	II	V
Balance between exports and direct imports	I	V	III	VII	II	IV	VI	IX	X	VIII
Balance between exports and direct-plus-indirect imports incorporated in deliveries to final demand	I	IV	III	VI	II	VII	V	IX	X	VIII

(29) $$x_{\lambda R} - x_{R \mid \lambda \Omega} \qquad \lambda = (1, 2, \ldots 62)$$

Table 4.12. presents two sets of balances between exports and imports, one obtained by means of (28) and the other by means of (29). Thus, we can study here in considerable detail how the total net balance between exports and imports of the production sectors, + 1 023 millions, as shown in Table 4.8., was composed. It should be remembered that imports on capital account are excluded; such imports amounted to a total of some 135 millions in 1950, as seen from Table 4.8.

Perhaps the most striking disagreement between the two estimates of the balance between exports and imports, is found in sector no. 13 (Manufacture of Tinware, Castings, etc.) and in sectors no. 55 (Drinking and Eating Places, Hotels, etc.). For the first-mentioned sector, a *negative* balance amounting to 17 millions is obtained when its direct imports are subtracted from its exports. However, the adjusted balance results in an *export surplus* amounting to 17 millions. As can be seen from the table, the opposite outcome is obtained for Drinking and Eating Places (sector no. 55), for which the unadjusted balance consists of an export surplus of 57 millions, whereas the adjusted balance consists of an *import* surplus of eight millions.

However, both methods of estimating point to the same sector as the one with the largest export surplus, namely sector no. 49 (Ocean Transport). Likewise, both procedures indicate that sector no. 4 (Manufacture of Dairy Products), among all the production sectors, had the largest import surplus.

It is of some interest to compare the results obtained here with those presented in Table 4.10. which incidentally come more into line with the frame of reference provided by the theory of the economic base. A simple but admittedly crude comparison is made in *Table 4.13.*

The first row in Table 4.13. gives the rank order of the ten sectors which had the largest export receipts, among the 62 production sectors. Thus, one finds that sector no. 49 (Ocean Transport) came out at the top as an exporter. The second largest was sector no. 36 (Construction Other Than Building), and so on. It is

sometimes suggested by proponents of the theory of the economic base[1] that the truly »basic» industries of an area are those which make the largest *fractions* of their sales to the export market. If we use this criterion for ranking the ten sectors specified at the head of Table 4.13., we get the order shown by the second row in the table. We find that this order does not agree closely with the rankings according to the absolute size of exports.[2] For instance, sector no. 36 was ranked *second* according to absolute size of export, but only *eighth* when ranked according to the percentage of its total receipts obtained through exports.

If the ten sectors are ranked according to the size of the *balance* between exports and direct imports, we find on the whole a closer agreement with the rank order first obtained. Except for sectors 36, 16 and 53, the ranks assigned are close to each other. This also holds good if, instead, we use the adjusted balance between exports and imports as a criterion for assigning the ranks.[3]

It may be claimed that each of the four criteria gives a rank order according to the power of »bringing money into the Stockholm area», for the ten sectors selected. However, the first concentrates attention on the export side, while neglecting the import side. The second has the same limitation, but in addition it gives equal weight to all the sectors, regardless of the size of their total receipts. The third criterion considers, for each sector, the balance between exports and direct imports, i. e., it accounts for the drain on money (or other financial resources) which the imports directly absorbed by a sector give rise to. Finally the fourth criterion also accounts for the *indirect* imports, i. e., the drain or leakage due to the existing net of interrelations between the production sectors themselves.

For the ten sectors selected, the rankings according to size of export receipts agreed fairly well with the rankings according to the balance between exports and direct-plus-indirect imports incorporated in deliveries to final demand, as indicated by Table 4.13. Considering, generally speaking, that it is simpler to estimate the size of export receipts than to estimate the above-mentioned type of balance, it may thus seem superfluous to estimate such an adjusted balance, although theoretically preferable. However, it should be remembered that the comparisons made are relatively crude; they neglect the size of the absolute distance between the ranks. Further, the agreement seems to hold only for the largest exporters. When we select the next set of ten sectors, ranked eleventh to twentieth in order of export receipts, and rank them according to the other three criteria, we find no agreement whatsoever with the rankings according to export size.[4]

Although modest in scope, the above analyses may serve to indicate that any statements about the economic »importance» of different sectors in a city — state-

[1] Cf., Alexander, J. W., (1954) The basic-nonbasic concept of urban economic functions, pp. 253—255 (Economic Geography, vol. 30).

[2] Computation of Spearman's rank correlation coefficient gives a value of + *0,20*.

[3] The correlation between the rankings according to absolute amount of export receipts and the rankings according to the size of the balance between exports and direct imports, is relatively high. Spearman's rank correlation coefficient is found to be + *0,77*. If »direct-plus-indirect-imports incorporated in final demand» are substituted for »direct imports», the corresponding coefficient is found to be + *0,83*.

[4] In fact, for each of the three comparisons Spearman's rank correlation coefficient gives negative values.

ments, for example, of the type that such-and-such sectors constitute »the area's breadwinners» — must be strongly qualified if they are not to be quite meaningless.

In passing let us touch upon the related problem of indirect exports. To illustrate, take the automotive industry of Detroit. Most of the motor cars manufactured in Detroit are of course »exported» to the rest of the U. S. and to foreign countries. Now it might be argued, as indeed it has been argued, that to the extent the automobile factories only assemble parts manufactured by other plants (be they integrated or financially independent), the »real» exporters are the plants manufacturing the parts. In applying the theory of the economic base, a few city planners hold the view that indirect exports of this type should be referred to the economic base and the basic-nonbasic ratio be modified accordingly.[1] However, as far as any large and highly differentiated city is concerned, the problem of assessing the size of such indirect exports turns out to be rather a complicated one. In such a city nearly all industries tend to have indirect exports and the number of intermediate links between the indirect exporter and the direct exporter may at times be very large. Let me illustrate this by some examples from the present study.

According to the Intersectoral Flow Datum Table (row 34), the sector Electricity, Gas and Water Services sold practically nothing outside the Stockholm area in 1950. However, costs for electricity, gas and water were incurred by many industries which, directly *or* indirectly, did produce for exports, that is to say, for the Rest of Sweden and for Foreign Countries. Thus, the amount of electricity, gas and water *indirectly* related to exports might have been considerable — and some of that amount might have been absorbed by a long chain of intermediate sectors before being incorporated in deliveries for exports.

In order to estimate the size of the direct as well as all the indirect exports of any particular sector, we can apply one of the findings from Ch. II, namely the formula given in (27), on p. 19. Substituting R for C, we get

$$x_{\varkappa|R} = \sum_{\lambda=1}^{62} A_{\varkappa\lambda} x_{\lambda R}.$$

In particular, we get for the sector Electricity, Gas and Water Services (sector no. 34):

$$x_{34|R} = \sum_{\lambda=1}^{62} A_{34\lambda} x_{\lambda R}$$

Recalling that a coefficient of the type $A_{\varkappa\lambda}$ may be interpreted as the average amount of supply from sector $\varkappa$ that is needed to enable sector λ to produce one unit of output, we may interpret $A_{34\lambda}x_{\lambda R}$ as the amount of supply from sector no. 34

[1] This point is emphasized by Forbat in a letter (dated September 1955) to Blumenfelt, commenting upon Blumenfelt's critical appraisal of the theory of the economic base (cf. note on p. 62, above). A similar view is expressed by Andrews in his series of articles in Land Economics (cf. p. 61, above).

In empirical applications, Forbat has pioneered by refining the base theory also in other respects, cf. Forbat, F., (1949) Utvecklingsprognos för en medelstor stad (A forecast for the development of an average sized town, with an English summary) and Forbat, F., (1948) Prognos för näringsliv och befolkning (Forecasts for industry and population; Plan, vol. 2, pp. 81—84).

that is needed to enable sector λ to *export* the amount $x_{\lambda R}$. By summing for $\lambda = 1, 2, \ldots\ldots 62$, we exhaust all the possible ways through which flows from sector 34 may be incorporated in the exports of the 62 production sectors (including sector 34 itself).

Carrying out the computations indicated, we find that the total direct-plus-indirect exports of the sector Electricity, Gas and Water Services amounted to 42 million Sw. Cr., that is, about *one fourth* of the total production value of the sector.

According to Table 4.10., on p. 69, the sector Manufacture of Tinware, Castings, etc. (no. 13) obtained about 31 percent of its receipts through direct exports. However, by incorporating the indirect exports too, through computations analogous to those presented above, we find a percentage figure of *74*. That is to say, about three fourths of the total Manufacture of Tinware, Castings, etc., were directly or indirectly related to exports.

Similarly, we find that *73* percent of the output of Printing and Publishing (sector no. 27) were directly or indirectly related to exports, whereas the direct exports alone amounted to some 45 percent, according to Table 4.10.

As a matter of fact the three sectors mentioned had relatively very high indirect exports in comparison with other production sectors. If we turn to a sector like Retail Trade with Food Products (no. 8), for instance, we find that 2.0 percent of its total receipts represented direct-plus-indirect exports, whereas the direct exports alone represented 1.6 percent. Nevertheless, the illustrative analyses above seem to suggest that in any city or other area where the economic life is well differentiated, there may be large discrepancies between direct exports and direct-plus-indirect exports and that the indirect exports may not be easily traceable, such that analyses of the type used here may be indispensable.

Some analysis of household returns and gross factor returns

We have seen before (p. 55) that in 1950 total personal income in the Stockholm area — that is to say, wages and salaries, and other returns to Households in Stockholm — amounted to nearly 4 750 million Sw. Cr. Of this the share contributed by the production sectors amounted to more than 3 900 millions. The entries along rows 84 and 85 in the Intersectoral Flow Datum Table indicate the size of the household returns yielded by each particular production sector (columns 1--62). Thus, in a way, they show how the sum mentioned, 3 900 millions, was composed. For instance, from Banking and Insurance (sector no. 53) households in the Stockholm area earned some 181 millions in the form of wages, salaries and other income. As can be seen, this amount represented some 4.6 percent of their total income from the production sectors. Similarly, we find from the table that, for example, households obtained some 37 millions from the sector Manufacture of Wearing Apparel (sector no. 9) and nearly 78 millions from Retail Trade with Apparel and Dry Goods (sector no. 12). We must of course remember that any comparison between such figures is conditioned by the particular sector classification used in the present study. However, another objection can also be raised to figures

of the type exemplified. They contain only *direct* household returns, whereas they neglect to account for the *indirect* household returns which arise because of the interdependence existing between the production sectors. To satisfy the demand upon its own products, any one of the production sectors raises demands upon the whole system of production sectors; in turn, to fulfil such demands the system of production sectors employs labor and capital, that is, incurs costs to households. Thus, there will be costs incurred to households incorporated in any amount purchased by one production sector from another.

To assess the size of the indirect household returns connected with any specific production sector, we can compare two coefficients, one indicating the direct household returns per million's worth of output from the sector concerned, the other indicating the direct-plus-indirect household returns per million's worth of output from the sector.

In analogy with previous computations, the coefficients of direct-plus-indirect household returns may be estimated as

$$\sum_{\alpha=1}^{62} a_{H\alpha} A_{\alpha\lambda} \qquad (\lambda = 1, 2, \ldots . 62)$$

where H denotes direct household returns and $a_{H\alpha}$ denotes the average amount of direct household returns per million's worth of output from sector α. As before[1] we interpret $A_{\alpha\lambda}$ as the average amount of output from sector α that is needed to enable sector λ to produce one million's worth of output.

This procedure of estimation was used to provide the data of *Table 4.14*. Besides the two types of coefficients mentioned, the table gives data on the size of the total direct household returns and of the direct-plus-indirect household returns incorporated in deliveries to final demand. This latter type of data was computed by multiplying, for each sector, the total deliveries to final demand by the corresponding coefficient of direct-plus-indirect household returns per million's worth of output, or — in the denotations used above — by estimating the value of

$$\sum_{\alpha=1}^{62} a_{H\alpha} A_{\alpha\lambda} x_{\lambda\Omega} \qquad (\lambda = 1, 2, \ldots . 62)$$

Several interesting findings can be extracted from Table 4.14. To begin with the coefficients of direct household returns, it is seen that *three* sectors rendered household returns amounting to more than 0,700 per million's worth of output. The three sectors were Wholesale Trade with Apparel and Dry Goods (sector no. 11), Laundries, Barber and Beauty Shops (sector no. 57) and Educational, etc., Activities (sector no. 60). Thus, a demand for the services of any of these industries amounting to, let us say, ten million Sw. Cr. would imply that households obtained more than seven million Sw. Cr. in return, on the average, from the sector in question.

[1] Cf., p. 79.

Table 4.14. *The direct and direct-plus-indirect household returns rendered by the production sectors in 1950. (Millions of Sw. Cr.)*

Sector No.	Direct household returns	Direct household returns per million's worth of output	Direct-plus-indirect household returns per million's worth of output	Direct-plus-indirect household returns incorporated in deliveries to final demand
1. Agriculture and fishing	50	0,630	0,682	31
2. Beverage industries and tobacco manufactures	28	0,219	0,263	27
3. Manufacture of cocoa and chocolate	13	0,198	0,279	18
4. Manufacture of dairy products	11	0,049	0,117	19
5. Other food manufacturing: consumers' goods	60	0,160	0,237	74
6. Other food manufacturing: industrial goods	8	0,063	0,109	9
7. Wholesale trade: food products	51	0,641	0,779	35
8. Retail trade: food products (including beverages)	107	0,648	0,816	130
9. Manufacture of wearing apparel	37	0,278	0,318	42
10. Other textile manufacturing	34	0,361	0,434	36
11. Wholesale trade: apparel and dry goods	51	0,729	0,805	33
12. Retail trade: apparel and dry goods	78	0,620	0,833	103
13. Manufacture of tinware, castings and forgings	52	0,403	0,443	22
14. Manufacture of insulated wire and cable	26	0,191	0,218	29
15. Manufacture of electrical lamps	12	0,410	0,539	15
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	102	0,350	0,400	108
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	39	0,338	0,419	40
18. Ship building and repairing	24	0,460	0,603	31
19. Manufacture of automobiles and automobile bodies	10	0,123	0,160	13
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	79	0,290	0,398	103
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	64	0,280	0,370	59
22. Repair of motor vehicles and electric appliances	66	0,495	0,567	47
23. Other metal manufacturing	50	0,406	0,484	51
24. Manufacture of non-metallic mineral products	40	0,381	0,460	24
25. Manufacture of articles of paper and paperboard	8	0,248	0,403	9
26. Manufacture of wood, cork, paper and paperboard	22	0,319	0,344	13
27. Printing and publishing	97	0,406	0,486	68
28. Bookbinding, photographing, etc.	80	0,307	0,532	116

29. Manufacture of leather, rubber and fur products	24	0,362	0,419	23
30. Manufacture of dyes, paints and varnishes	14	0,197	0,282	12
31. Manufacture of perfumes and washing compounds	14	0,209	0,291	18
32. Manufacture of plastic materials and plastic products	8	0,388	0,468	7
33. Manufacture of other chemicals and chemical products	26	0,197	0,267	25
34. Electricity, gas and water services	42	0,242	0,281	17
35. Building construction	270	0,386	0,632	281
36. Construction other than building	175	0,358	0,447	188
37. Wholesale trade: hardware, lumber, constr. materials	99	0,600	0,679	84
38. Wholesale trade: fuels	33	0,550	0,608	19
39. Wholesale trade: shop and office fittings	16	0,574	0,636	17
40. Wholesale trade: machinery, equipment, and supplies	49	0,612	0,678	54
41. Wholesale trade: pulp, paper and paper products	30	0,621	0,692	27
42. Wholesale trade: other kinds of business	125	0,625	0,703	101
43. Retail trade: motor vehicles	16	0,557	0,706	20
44. Retail trade: other consumers' durables	57	0,636	0,808	73
45. Retail trade: department stores and variety stores	39	0,652	0,732	43
46. Retail trade: all other stores (including tobacco)	68	0,643	0,787	71
47. Railway transport	50	0,284	0,448	60
48. Urban and suburban tramway and omnibus operators	55	0,542	0,622	63
49. Ocean transport, involving foreign countries	77	0,194	0,237	94
50. Other transport activities	114	0,413	0,532	117
51. Services incidental to transport (including storage)	33	0,363	0,488	31
52. Communication services	73	0,365	0,494	70
53. Banking and insurance	181	0,603	0,670	158
54. Lessors of real property	290	0,376	0,482	244
55. Drinking and eating places; hotels, etc.	109	0,341	0,480	153
56. Motion pictures and other amusements	22	0,227	0,394	36
57. Laundries; barber and beauty shops	46	0,722	0,813	50
58. Business services (including legal services)	94	0,680	0,757	58
59. Medical and other health services	140	0,596	0,697	156
60. Educational services; religious activities, etc.	160	0,769	0,815	168
61. Labor and political org., trade assoc., etc.	40	0,667	0,787	41
62. Other economic activities in Stockholm	33	0,547	0,594	33
Total	3 917	—	—	3 915

Notes. The figures given in this table are rounded off. — The classification into production sectors is identical to that found in the Intersectoral Flow Datum Table. — Household returns are defined as the sum of the entries in rows 84 and 85.

By incorporating also the *indirect* household returns, we find that no less than 13 of the 62 sectors had a household-return-coefficient above 0.700, namely — in order of size of the coefficients — Retail Trade with Apparel and Dry Goods (sector no. 12), Retail Trade with Food Products (no. 8), Educational Activities, etc. (no. 60), Laundries, Barber och Beauty Shops (no. 57), Retail Trade with Consumers' Durables, other than motor vehicles (no. 44), Wholesale Trade with Apparel and Dry Goods (no. 11), Retail Trade, not elsewhere cited (no. 46), Labor, Trade and Other Organisations (no. 61), Wholesale Trade with Food Products (no. 7), Business Services (no. 58), Department Stores and Variety Stores (no. 45) Retail Trade with Motor Vehicles (no. 43) and, finally, another sector of Wholesale Trade (no. 42).

Thus, two branches of the retail trade are found at the top of the list, and among the 13 sectors that yield the highest direct-plus-indirect household returns per million's worth of output, are all the six sectors into which the retail trade has been specified in the basic table. Depending upon the size of the absolute amounts involved, this circumstance may be of importance in any attempt to assess the future potentialities of the Stockholm area. A future shift in final demand towards more retail trade services might increase the amount of household returns, quite apart from changes in total final demand, provided only that the retail trade maintains its position as rendering relatively high household returns per million's worth of output.

Just to illustrate the possible implications of these statements, let us construct a simple example. Assume that over a period the final demand for retail trade services increases by some 30 percent above the 1950 level. Assume further that the present very strong concentration of the Swedish wholesale trade, banking and insurance and other business services to the Stockholm area will be somewhat weakened by decentralization, so that the final demand for such services to be satisfied by the sectors in Stockholm will decrease by, let us say, 20 percent. This is indeed a very arbitrary assumption, but it will leave the total amount of final demand for the services of the retail trade, wholesale trade, banking and insurance and other business services unchanged, so that the assumptions made imply only a shift in final demand towards the retail trade services and away from the business services, etc. In order to bring out the implication of this shift explicitly and not to complicate the illustration unnecessarily, we simply assume that all other conditions remain unchanged. How would such a shift affect total household returns?

First of all, let us have a look at the size of the absolute amounts involved. We find from Table 4.14 that the largest individual retail trade sector, Retail Trade with Food Products (no. 8), contributed some 107 millions, directly, to households. However, as can be seen from the table, the direct-plus-indirect household returns incorporated in the deliveries to final demand from this particular sector amounted to no less than 130 million Sw. Cr. By adding the individual data given in the table we find the corresponding amounts for the total retail trade, wholesale trade, etc.:

	Direct household returns	Direct-plus-indirect household returns incorporated in deliveries to final demand
	Millions of Sw. Cr.	
Retail trade (nos. 8, 12, 43—46)	364	440
Wholesale trade (nos. 7, 11, 37—42)	454	370
Banking and insurance (no. 53)	181	158
Business services (no. 58)	94	58
All other production sectors (nos. 1—6, 9—10, 13—36, 47—52, 54—57, 59—62)	2 824	2 889
Total for the production sectors	3 917	3 915[1]

[1] The discrepancy between the two sums (1,5 mill. Sw. Cr.) is due to errors of rounding off.

Now, to return to our assumed shift in final demand, if we made the mistake of applying the percentages to the above data on direct household returns, we should come out with the following results:

	Mill. of Sw. Cr.
Increase in household returns rendered by retail trade (30 % of 364)	109
Decrease in household returns rendered by wholesale trade (20 % of 454)	
banking and insurance (20 % of 181)	— 146
business services (20 % of 94)	
Resulting net *decrease* in household returns	37

Thus, by such a computational procedure we should find that the assumed shift in final demand would imply a decrease in total household returns amounting to 37 millions. Clearly, all indirect household returns would then have been neglected. To account for such returns we should use, instead, the data on direct-plus-indirect household returns incorporated in deliveries to final demand. The result will then be as follows:

	Mill. of Sw. Cr.
Increase in household returns rendered by retail trade (30 % of 440)	132
Decrease in household returns rendered by wholesale trade (20 % of 370)	
banking and insurance (20 % of 158)	— 117
business services (20 % of 58)	
Resulting net *increase* in household returns	15

Thus, instead of the net *decrease* of 37 millions found above, we arrive at a net *increase* of 15 millions. That is to say, household returns must increase by 15 million Sw. Cr. in order to be consistent with the assumed shift in final demand. The lesson to be learnt from this example is that it might be quite misleading to neglect to account for the indirect returns. Further, it should be observed that the assumed shift was limited to the final demand for *services;* we simply assumed that to a

Table 4.15. *The direct and direct-plus-indirect gross factor returns rendered by the production sectors in 1950. (Millions of Sw. Cr.)*

Sector No.	Direct gross factor returns	Direct gross factor returns per million's worth of output	Direct-plus-indirect gross factor returns per million's worth of output	Direct-plus-indirect gross factor returns incorporated in deliveries to final demand
1. Agriculture and fishing	55	0,686	0,753	34
2. Beverage industries and tobacco manufactures	40	0,311	0,372	38
3. Manufacture of cocoa and chocolate	16	0,245	0,356	23
4. Manufacture of dairy products	13	0,062	0,143	24
5. Other food manufacturing: consumers' goods	72	0,192	0,287	89
6. Other food manufacturing: industrial goods	10	0,082	0,139	11
7. Wholesale trade: food products	56	0,705	0,874	39
8. Retail trade: food products (including beverages)	116	0,701	0,910	145
9. Manufacture of wearing apparel	40	0,297	0,347	45
10. Other textile manufacturing	37	0,395	0,484	40
11. Wholesale trade: apparel and dry goods	55	0,788	0,883	37
12. Retail trade: apparel and dry goods	84	0,669	0,934	115
13. Manufacture of tinware, castings and forgings	60	0,473	0,525	26
14. Manufacture of insulated wire and cable	35	0,255	0,292	39
15. Manufacture of electrical lamps	14	0,483	0,642	17
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	139	0,478	0,542	146
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	47	0,408	0,512	49
18. Ship building and repairing	28	0,530	0,721	37
19. Manufacture of automobiles and automobile bodies	14	0,175	0,223	18
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	115	0,416	0,550	143
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	76	0,333	0,446	71
22. Repair of motor vehicles and electric appliances	74	0,548	0,636	53
23. Other metal manufacturing	58	0,469	0,565	59
24. Manufacture of non-metallic mineral products	68	0,650	0,771	40
25. Manufacture of articles of paper and paperboard	10	0,305	0,487	11
26. Manufacture of wood, cork, paper and paperboard	24	0,356	0,389	14
27. Printing and publishing	111	0,464	0,566	80
28. Bookbinding, photographing, etc.	94	0,356	0,631	138

29. Manufacture of leather, rubber and fur products	27	0,417	0,485	26
30. Manufacture of dyes, paints and varnishes	18	0,244	0,349	15
31. Manufacture of perfumes and washing compounds	17	0,260	0,361	22
32. Manufacture of plastic materials and plastic products	10	0,463	0,563	9
33. Manufacture of other chemicals and chemical products	32	0,243	0,332	31
34. Electricity, gas and water services	68	0,399	0,457	27
35. Building construction	310	0,443	0,744	331
36. Construction other than building	202	0,414	0,526	222
37. Wholesale trade: hardware, lumber, constr. materials	112	0,682	0,790	97
38. Wholesale trade: fuels	46	0,758	0,842	27
39. Wholesale trade: shop and office fittings	18	0,684	0,779	21
40. Wholesale trade: machinery, equipment, and supplies	58	0,720	0,807	64
41. Wholesale trade: pulp, paper and paper products	37	0,777	0,873	34
42. Wholesale trade: other kinds of business	143	0,716	0,815	117
43. Retail trade: motor vehicles	17	0,611	0,803	22
44. Retail trade: other consumers' durables	61	0,681	0,897	81
45. Retail trade: department stores and variety stores	47	0,783	0,899	53
46. Retail trade: all other stores (including tobacco)	76	0,722	0,913	83
47. Railway transport	67	0,374	0,581	77
48. Urban and suburban tramway and omnibus operators	66	0,647	0,748	76
49. Ocean transport, involving foreign countries	158	0,401	0,455	180
50. Other transport activities	142	0,517	0,668	147
51. Services incidental to transport (including storage)	41	0,457	0,630	40
52. Communication services	93	0,465	0,638	90
53. Banking and insurance	211	0,703	0,789	186
54. Lessors of real property	519	0,673	0,807	408
55. Drinking and eating places; hotels, etc.	118	0,369	0,557	178
56. Motion pictures and other amusements	26	0,276	0,522	48
57. Laundries; barber and beauty shops	47	0,741	0,874	54
58. Business services (including legal services)	100	0,728	0,831	63
59. Medical and other health services	143	0,610	0,736	165
60. Educational services; religious activities, etc.	161	0,774	0,839	173
61. Labor and political org., trade assoc., etc.	42	0,707	0,858	44
62. Other economic activities in Stockholm	35	0,587	0,649	36
Total	4 833	—	—	4 829

Notes. The classification agrees with that of the Intersectoral Flow Datum Table. — All figures are rounded off. — Gross factor returns are defined in Table 4.5., p. 57.

certain extent final demand shifted from one type of services to another (from business services to retail trade services, etc.). It is apparent that if instead we had assumed that there was a shift in final demand towards more services, for example, more retail trade services at the expense of goods, let us say foodstuffs, we should have found a much larger increase in household returns; as can be seen from Table 4.14, the food manufacturing industries (nos. 2—6) had relatively very low coefficients of direct-plus-indirect household returns.

The analysis above concentrated attention on household returns. Pursuing the same general line of enquiry, we can easily extend the analysis to include also all other returns accrued to the factors of production in the Stockholm area. By substituting data on *gross factor returns* for the data on household returns in the computations that led to Table 4.14., we arrive at figures which can be given a more inclusive interpretation. As previously defined (see Table 4.5.), the gross factor returns of the production sectors contain depreciation allowances, retained profits, corporate taxes, etc., besides the returns rendered to households. In a way, they will show the industrial origin of the gross city income. Such data have already been presented in Table 4.5., in summarized form. It was shown there that in 1950 the gross city income amounted to nearly 5 400 million Sw. Cr., of which the production sectors altogether contributed more than 4 800 millions, that is to say, nearly 90 percent.

The extent to which the individual production sectors contributed to gross city income is indicated by the first row of data in *Table 4.15.*

Seen per million's worth of output (second row of the table), the sectors which had the largest gross factor returns were the following: Wholesale Trade with Apparel and Dry Goods (no. 11), Wholesale Trade with Fuels (no. 38), Wholesale Trade with Pulp, Paper and Paper Products (no. 41), Department Stores and Variety Stores (no. 45) and Educational Activities, etc. (no. 60).

However, from the point of view of judging the future size of gross income in the Stockholm area, and thereby the future development of the area, it seems to be of greater interest to study the coefficients of direct-plus-indirect gross factor returns, which are given in the third row of the table.

The highest coefficients are found for the following ten sectors, each of which had a coefficient exceeding 0,850:

Sector no.	Coefficients of direct-plus-indirect gross factor returns
12. Retail Trade with Apparel and Dry Goods	0,934
46. Retail Trade, not elsewhere cited	0,913
8. Retail Trade with Food Products	0,910
45. Department Stores and Variety Stores	0,899
44. Retail Trade with Other Consumers' Durables	0,897
11. Wholesale Trade with Apparel and Dry Goods	0,883
7. Wholesale Trade with Food Products	0,874
57. Laundries, Barber and Beauty Shops	0,874
41. Wholesale Trade with Pulp, Paper, etc.	0,873
61. Labor, Trade and Other Organizations	0,858

Multiplying the corresponding amount of final demand by each of these coefficients gives the size of the gross factor returns incorporated in deliveries to final demand, from the sectors in question. These data are entered in the bottom row of Table 4.15. We see for instance that the deliveries of services from Retail Trade with Apparel and Dry Goods (no. 12) to final demand contained some 115 millions' worth of gross factor returns. Altogether, the deliveries to final demand from the ten sectors specified incorporated some 685 millions' worth of gross factor returns. Of this, some 477 millions referred to the five retail trade sectors mentioned first, above.

The next set of ten sectors, in order of size of coefficients, is rather an interesting one, because it contains some sectors with very large deliveries to the final demand categories. The list is as follows:

Sector no.		Coefficients of direct-plus-indirect gross factor returns
38.	Wholesale Trade with Fuels	0,842
60.	Educational Activities, etc.	0,839
58.	Business Services	0,831
42.	Wholesale Trade, not elsewhere cited	0,815
40.	Wholesale Trade with Machinery, etc.	0,807
54.	Lessors of Real Property	0,807
43.	Retail Trade with Motor Vehicles	0,803
37.	Wholesale Trade with Hardware, Lumber, etc.	0,790
53.	Banking and Insurance	0,789
39.	Wholesale Trade with Shop and Office Fittings	0,779

Adding as before the gross factor returns incorporated in the deliveries to final demand from these ten sectors, we arrive at a total value of some 1 180 millions — thus, a much higher figure than that found for the first set of ten sectors. Altogether, the deliveries to final demand from the twenty sectors now specified, incorporated some 1 865 millions' worth of gross factor returns, that is to say, about 35 percent of the total city income — or, in other words, about 40 percent of the contributions to city income rendered by the 62 production sectors.

To sum up, in 1950 the twenty sectors specified above were the most vital industries in the Stockholm area, in the sense that their contributions to gross city income were the largest, as seen per million's worth of deliveries to the final demand categories. Thus, on the average, each million's worth of final demand implied larger gross factor returns when directed towards any of these sectors than when directed towards any other sector. This fact would have been of little significance in absolute numbers, however, if the total amount of final demand directed towards these sectors had been small, that is to say, if the weights of the coefficients had been relatively light. But, as indicated above, in 1950 this was not the case.

Turning our attention now to the other end of the scale, we find that the following ten sectors had the lowest coefficients of direct-plus-indirect gross factor returns:

Sector No.		Coefficients of direct-plus-indirect gross factors returns
6.	Food Manufacturing, n. e. c.: Industrial goods	0,139
4.	Manufacture of Dairy Products	0,143
19.	Manufacture of Automobiles and Automobile Bodies[1]	0,223
5.	Food Manufacturing, n. e. c.: Consumers' Goods	0,287
14.	Manufacture of Insulated Wire and Cable	0,292
33.	Manufacture of Chemicals and Chemical Products, n. e. c.	0,332
9.	Manufacture of Wearing Apparel (except custom tailoring)	0,347
30.	Manufacture of Dyes, Paints and Varnishes	0,349
3.	Manufacture of Cocoa, Chocolate, etc.	0,356
31.	Manufacture of Perfumes, Washing and Cleaning Compounds, etc.	0,361

[1] Very little real assembly work was done in the automotive industry of the Stockholm area.

Thus, using the contribution to gross city income per »million's worth of final demand deliveries» as a yardstick, these ten industries were the least significant of all in the Stockholm area. As can be seen, no less than seven out of the ten sectors belong to the food and the chemical industries. Altogether, the ten sectors delivered goods to final demand for some 1 160 million Sw. Cr. The amount of gross factor returns incorporated in this sum was some 315 millions. From these two figures it is found that the weighted average coefficient of direct-plus-indirect gross factor returns for this set of sectors came to 0.273. These figures and the corresponding data for all other subsets of sectors are brought together in *Table 4.16.*

Now, let us conceive of another metropolitan area which happens to have 1) the very same sets of production sectors and final demand sectors as the Stockholm area, 2) the same *structural relationships* between the production sectors and 3) about the same total *level* of final demand as the Stockholm area, but 4) a different *structure* of final demand. As an example, assume that in this hypothetical city the deliveries to final demand from the four groups of sectors (A—D, specified in Table 4.16.) have the following distribution:

	Deliveries to the final demand categories (Mill. of Sw. Cr.)
Group A	400
» B	800
» C	2 000
» D	4 700
Total	7 900

Assuming that the relative distribution of final demand *within* the four groups is identical to that in Stockholm, we can apply the weighted average coefficients given in Table 4.16. Then it is found that the contributions to gross city income rendered by the production sectors would be more than 500 millions, or some 10 percent, *lower* in this hypothetical city than in Stockholm.

Table 4.16. *The production sectors grouped according to the size of their coefficients of direct-plus-indirect gross factor returns.*

	Gross factor returns incorporated in the deliveries to final demand (Mill. of Sw. Cr.)	Deliveries to the final demand categories (Mill. of Sw. Cr.)	Weighted average coefficients of direct-plus-indirect gross factor returns
A. The five retail trade sectors topping the list[1]	477	523	0,912
B. The fifteen sectors coming next[2]	1 386	1 696	0,817
C. The ten sectors with the lowest coefficients[3]	317	1 163	0,273
D. Remaining sectors[4]	2 648	4 531	0,584
Totals	4 829	7 912	0,610

[1] Sectors nos. 12, 46, 8, 45, 44.
[2] Sectors nos. 11, 7, 57, 41, 61, 38, 60, 58, 42, 40, 54, 43, 37, 53, 39.
[3] Sectors nos. 6, 4, 19, 5, 14, 33, 9, 30, 3, 31.
[4] Sectors nos. 1, 2, 10, 13, 15—18, 20—29, 32, 34—36, 47—52, 55, 56, 59, 62.

To illustrate further the significance of the structural patterns, assume that, for the four groups of sectors, the weighted average coefficients of direct-plus-indirect gross factor returns also differ from the Stockholm figures in this hypothetical city, as follows:

	Weighted average coefficients of direct-plus-indirect gross factor returns
Group A	0,90
» B	0,80
» C	0,20
» D	0,50
Applying these coefficients, we find	0,90 × 400 = 360 0,80 × 800 = 640 0,20 × 2 000 = 400 0,50 × 4 700 = 2 350
	Total gross factor returns: 3 750

That is to say, the production sectors of this hypothetical city would contribute nearly one quarter less to gross city income than the production sectors in Stockholm.

Some analysis of the manpower and space usage

Early in this chapter, data were presented on the size of the manpower resources employed by the production sectors. Data, although inferior in quality, were also given on the extent to which the production sectors used building capacity (space), as measured in terms of floor space. By means of the factorability assumptions we can

Table 4.17. *The manpower usage of the production sectors in 1950/51.*

Sector No.	Direct manpower usage	Direct manpower used per million's worth of output	Direct-plus-indirect manpower per million's worth of output	Direct-plus-indirect manpower incorporated in deliveries to final demand
1. Agriculture and fishing	8 800	105,0	110,9	5 100
2. Beverage industries and tobacco manufactures	2 950	22,6	26,8	2 700
3. Manufacture of cocoa and chocolate	1 650	25,1	34,2	2 150
4. Manufacture of dairy products	1 350	6,2	15,7	2 600
5. Other food manufacturing: consumers' goods	8 650	23,1	32,8	10 200
6. Other food manufacturing: industrial goods	800	6,7	11,8	950
7. Wholesale trade: food products	5 100	63,8	78,2	3 500
8. Retail trade: food products (including beverages)	15 850	96,1	112,4	17 950
9. Manufacture of wearing apparel	5 750	43,2	47,7	6 250
10. Other textile manufacturing	6 000	63,8	72,9	6 050
11. Wholesale trade: apparel and dry goods	4 200	60,0	66,4	2 750
12. Retail trade: apparel and dry goods	10 450	83,6	101,5	12 550
13. Manufacture of tinware, castings and forgings	6 350	49,6	53,9	2 650
14. Manufacture of insulated wire and cable	3 050	22,4	25,4	3 400
15. Manufacture of electrical lamps	1 500	51,7	67,2	1 850
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	12 700	43,2	48,9	13 200
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	5 250	47,3	57,0	5 500
18. Ship building and repairing	2 950	56,8	73,1	3 750
19. Manufacture of automobiles and automobile bodies	1 150	14,2	18,1	1 450
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	9 300	32,5	45,4	11 800
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	7 950	37,1	47,9	7 700
22. Repair of motor vehicles and electric appliances	8 950	66,6	74,9	6 250
23. Other metal manufacturing	6 900	55,6	65,0	6 800
24. Manufacture of non-metallic mineral products	4 000	38,1	46,4	2 450
25. Manufacture of articles of paper and paperboard	1 150	36,5	57,3	1 300
26. Manufacture of wood, cork, paper and paperboard	3 250	47,6	50,5	1 850
27. Printing and publishing	10 900	45,6	54,4	7 650
28. Bookbinding, photographing, etc.	9 850	37,5	62,5	13 700

29. Manufacture of leather, rubber and fur products	3 700	56,9	64,0	3 450
30. Manufacture of dyes, paints and varnishes	1 450	20,1	28,8	1 200
31. Manufacture of perfumes and washing compounds	1 750	26,1	34,4	2 050
32. Manufacture of plastic materials and plastic products	1 250	58,4	68,7	1 100
33. Manufacture of other chemicals and chemical products	3 100	23,5	31,3	2 900
34. Electricity, gas and water services	5 100	29,7	34,1	2 000
35. Building construction	32 800	46,9	74,7	33 200
36. Construction other than building	14 700	30,0	39,4	16 600
37. Wholesale trade: hardware, lumber, constr. materials	8 650	52,4	59,3	7 300
38. Wholesale trade: fuels	3 000	50,0	54,9	1 750
39. Wholesale trade: shop and office fittings	1 500	55,6	60,3	1 650
40. Wholesale trade: machinery, equipment, and supplies	4 200	52,5	59,2	4 700
41. Wholesale trade: pulp, paper and paper products	2 650	55,2	61,5	2 400
42. Wholesale trade: other kinds of business	11 450	57,2	64,4	9 200
43. Retail trade: motor vehicles	1 950	69,6	82,5	2 300
44. Retail trade: other consumers' durables	6 750	75,0	90,4	8 150
45. Retail trade: department stores and variety stores	6 000	100,0	106,6	6 300
46. Retail trade: all other stores (including tobacco)	10 550	100,5	113,4	10 250
47. Railway transport	7 000	39,3	54,5	7 250
48. Urban and suburban tramway and omnibus operators	6 900	67,8	76,0	7 700
49. Ocean transport, involving foreign countries	7 650	19,4	23,9	9 450
50. Other transport activities	13 450	48,9	62,1	13 600
51. Services incidental to transport (including storage)	3 500	38,9	49,9	3 150
52. Communication services	10 500	52,5	66,4	9 400
53. Banking and insurance	19 200	64,0	70,9	16 700
54. Lessors of real property	12 000	15,6	27,6	13 950
55. Drinking and eating places; hotels, etc.	13 550	42,3	57,4	18 350
56. Motion pictures and other amusements	3 350	35,3	48,4	4 450
57. Laundries; barber and beauty shops	9 350	148,4	156,2	9 650
58. Business services (including legal services)	9 350	67,8	75,3	5 700
59. Medical and other health services	15 000	63,8	75,2	16 850
60. Educational services; religious activities, etc.	16 000	84,1	88,3	18 250
61. Labor and political org., trade assoc., etc.	4 800	80,0	92,4	4 750
62. Other economic activities in Stockholm	4 800	80,0	85,5	4 700
Total	443 700	—	—	444 450

Notes. Units: As in Table 4.1., p. 50. — All figures are rounded off. — The classification agrees with that of the Intersectoral Flow Datum Table.

Table 4.18. *The space usage of the production sectors in 1950.* (*Thousands of square metres.*)

Sector No.	Direct space usage	Direct space used per million's worth of output	Direct-plus-indirect space used per million's worth of output	Direct-plus-indirect space incorporated in deliveries to final demand
1. Agriculture and fishing	180	2,2	2,3	110
2. Beverage industries and tobacco manufactures	200	1,5	1,6	160
3. Manufacture of cocoa and chocolate	50	0,8	1,1	70
4. Manufacture of dairy products	40	0,2	0,4	70
5. Other food manufacturing: consumers' goods	400	1,1	1,4	430
6. Other food manufacturing: industrial goods	40	0,3	0,4	40
7. Wholesale trade: food products	200	2,5	2,9	130
8. Retail trade: food products (including beverages)	450	2,7	3,2	510
9. Manufacture of wearing apparel	70	0,5	0,6	80
10. Other textile manufacturing	90	1,0	1,2	100
11. Wholesale trade: apparel and dry goods	100	1,4	1,5	60
12. Retail trade: apparel and dry goods	300	2,4	2,8	340
13. Manufacture of tinware, castings and forgings	150	1,2	1,3	60
14. Manufacture of insulated wire and cable	60	0,4	0,5	60
15. Manufacture of electrical lamps	30	1,0	1,4	40
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	250	0,9	1,0	280
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	100	0,9	1,1	110
18. Ship building and repairing	60	1,2	1,6	80
19. Manufacture of automobiles and automobile bodies	60	0,7	0,8	60
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	280	1,0	1,3	340
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	220	1,0	1,3	200
22. Repair of motor vehicles and electric appliances	200	1,5	1,7	140
23. Other metal manufacturing	150	1,2	1,4	150
24. Manufacture of non-metallic mineral products	100	0,9	1,1	60
25. Manufacture of articles of paper and paperboard	30	0,9	1,5	40
26. Manufacture of wood, cork, paper and paperboard	100	1,5	1,6	60
27. Printing and publishing	200	0,8	1,0	140
28. Bookbinding, photographing, etc.	250	1,0	1,5	340

29. Manufacture of leather, rubber and fur products	100	1,5	1,7	90
30. Manufacture of dyes, paints and varnishes	80	1,1	1,4	60
31. Manufacture of perfumes and washing compounds	80	1,2	1,5	90
32. Manufacture of plastic materials and plastic products	40	1,8	2,1	30
33. Manufacture of other chemicals and chemical products	150	1,1	1,4	130
34. Electricity, gas and water services	200	1,2	1,3	80
35. Building construction	250	0,4	0,9	410
36. Construction other than building	150	0,3	0,5	230
37. Wholesale trade: hardware, lumber, constr. materials	300	1,8	2,0	240
38. Wholesale trade: fuels	100	1,7	1,8	60
39. Wholesale trade: shop and office fittings	60	2,2	2,3	60
40. Wholesale trade: machinery, equipment, and supplies	120	1,5	1,7	130
41. Wholesale trade: pulp, paper and paper products	100	2,1	2,3	90
42. Wholesale trade: other kinds of business	400	2,0	2,2	320
43. Retail trade: motor vehicles	60	2,1	2,5	70
44. Retail trade: other consumers' durables	250	2,8	3,3	290
45. Retail trade: department stores and variety stores	180	3,0	3,1	180
46. Retail trade: all other stores (including tobacco)	300	2,9	3,2	290
47. Railway transport	200	1,1	1,4	180
48. Urban and suburban tramway and omnibus operators	150	1,5	1,7	170
49. Ocean transport, involving foreign countries	20	0,05	0,2	80
50. Other transport activities	400	1,4	1,7	370
51. Services incidental to transport (including storage)	180	2,0	2,2	140
52. Communication services	250	1,2	1,5	210
53. Banking and insurance	400	1,3	1,4	340
54. Lessors of real property	30	0,04	0,3	140
55. Drinking and eating places; hotels, etc.	475	1,5	2,0	630
56. Motion pictures and other amusements	275	2,9	3,2	290
57. Laundries; barber and beauty shops	200	3,2	3,4	210
58. Business services (including legal services)	200	1,5	1,7	130
59. Medical and other health services	700	3,0	3,4	750
60. Educational services; religious activities, etc.	1 350	6,5	6,6	1 370
61. Labor and political org., trade assoc., etc.	120	2,0	2,3	120
62. Other economic activities in Stockholm	70	1,2	1,3	70
Total	12 300	—	—	12 320

Notes. All figures are rounded off. — The classification agrees with that of the Intersectoral Flow Datum Table.

Table 4.19. *The amounts of manpower and floor space "contained" in export deliveries from the production sectors in 1950.*

Sector No.	Manpower contained in export deliveries (number of full-time workers)	Floor space contained in export deliveries (thousands of square metres)	Sector No.	Manpower contained in export deliveries (number of full-time workers)	Floor space contained in export deliveries (thousands of square metres)
1. Agriculture and fishing	250	10	31. Manufacture of perfumes and washing compounds	1 500	70
2. Beverage industries and tobacco manufactures	1 150	70	32. Manuf. of plastic materials and plastic products	650	20
3. Manufacture of cocoa and chocolate	1 500	50	33. Manuf. of other chemicals and chemical products	2 350	110
4. Manufacture of dairy products	—	—	34. Electricity, gas and water services	50	—
5. Other food manufacturing: consumers' goods	2 850	120	35. Building construction	6 800	80
6. Other food manufacturing: industrial goods	700	30	36. Construction other than building	12 450	170
7. Wholesale trade: food products	3 450	130	37. Wholesale trade: hardw., lumber, constr. materials	6 750	220
8. Retail trade: food products (including beverages)	300	10	38. Wholesale trade: fuels	1 700	60
9. Manufacture of wearing apparel	3 300	40	39. Wholesale trade: shop and office fittings	800	30
10. Other textile manufacturing	2 800	40	40. Wholesale trade: machinery, equipm., and supplies	3 400	100
11. Wholesale trade: apparel and dry goods	2 700	60	41. Wholesale trade: pulp, paper and paper products	2 350	90
12. Retail trade: apparel and dry goods	850	20	42. Wholesale trade: other kinds of business	8 800	300
13. Manufacture of tinware, castings and forgings	2 150	50	43. Retail trade: motor vehicles	850	20
14. Manufacture of insulated wire and cable	3 000	50	44. Retail trade: other consumers' durables	650	20
15. Manufacture of electrical lamps	1 700	30	45. Retail trade: department stores and variety stores	450	10
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	10 900	230	46. Retail trade: all other stores (including tobacco)	1 050	30
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	4 250	80	47. Railway transport	3 250	80
18. Ship building and repairing	1 300	30	48. Urban and suburban tram. and omnibus operators	250	10
19. Manuf. of automobiles and automobile bodies	1 100	50	49. Ocean transport, involving foreign countries	8 850	80
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	10 700	310	50. Other transport activities	7 800	210
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	4 800	130	51. Services incidental to transport (including storage)	1 600	70
22. Repair of motor vehicles and electric appliances	3 000	70	52. Communication services	5 250	120
23. Other metal manufacturing	4 200	90	53. Banking and insurance	12 900	260
24. Manufacture of non-metallic mineral products	1 950	50	54. Lessors of real property	—	—
25. Manufacture of articles of paper and paperboard	900	20	55. Drinking and eating places; hotels, etc.	5 400	190
26. Manufacture of wood, cork, paper and paperboard	1 100	30	56. Motion pictures and other amusements	1 700	110
27. Printing and publishing	5 800	110	57. Laundries; barber and beauty shops	250	10
28. Bookbinding, photographing, etc.	10 950	270	58. Business services (including legal services)	3 750	80
29. Manufacture of leather, rubber and fur products	1 100	30	59. Medical and other health services	550	20
30. Manufacture of dyes, paints and varnishes	900	50	60. Educational services; religious activities, etc.	750	60
			61. Labor and political org., trade assoc., etc.	2 350	60
			62. Other economic activities in Stockholm	1 250	20
			Total	196 050	4 970

Notes. All figures are rounded off. — The classification agrees with that of the Intersectoral Flow Datum Table. — The units used to measure manpower are defined in Table 4.1., p. 50.

Table 4.20. *The amounts of manpower and floor space "contained" in the deliveries from the production sectors to households in Stockholm in 1950.*

Sector No.	Manpower contained in deliveries to households (number of full-time workers)	Floor-space contained in deliveries to households (thousands of square metres)	Sector No.	Manpower contained in deliveries to households (number of full-time workers)	Floor-space contained in deliveries to households (thousands of square metres)
1. Agriculture and fishing	4 450	90	31. Manufacture of perfumes and washing compounds	550	20
2. Beverage industries and tobacco manufactures	1 550	90	32. Manuf. of plastic materials and plastic products	450	10
3. Manufacture of cocoa and chocolate	650	20	33. Manuf. of other chemicals and chemical products	400	20
4. Manufacture of dairy products	2 500	60	34. Electricity, gas and water services	1 900	70
5. Other food manufacturing: consumers' goods	6 900	290	35. Building construction	—	—
6. Other food manufacturing: industrial goods	250	10	36. Construction other than building	—	—
7. Wholesale trade: food products	—	—	37. Wholesale trade: hardw., lumber, constr. mateials	—	—
8. Retail trade: food products (including beverages)	17 550	500	38. Wholesale trade: fuels	—	—
9. Manufacture of wearing apparel	2 800	30	39. Wholesale trade: shop and office fittings	100	—
10. Other textile manufacturing	3 050	50	40. Wholesale trade: machinery, equipm., and supplies	50	—
11. Wholesale trade: apparel and dry goods	—	—	41. Wholesale trade: pulp, paper and paper products	—	—
12. Retail trade: apparel and dry goods	11 650	320	42. Wholesale trade: other kinds of business	50	—
13. Manufacture of tinware, castings and forgings	400	10	43. Retail trade: motor vehicles	1 250	40
14. Manufacture of insulated wire and cable	—	—	44. Retail trade: other consumers' durables	7 250	260
15. Manufacture of electrical lamps	50	—	45. Retail trade: department stores and variety stores	5 750	170
16. Manuf. of electr. equipm. n. e. c.: with more than 200 empl.	900	20	46. Retail trade: all other stores (including tobacco)	9 050	260
17. Manuf. of electr. equipm. n. e. c.: with not more than 200 empl.	550	10	47. Railway transport	3 800	100
18. Ship building and repairing	—	—	48. Urban and suburban tram. and omnibus operators	6 850	150
19. Manuf. of automobiles and automobile bodies	250	10	49. Ocean transport, involving foreign countries	600	10
20. Manufacture of engines, etc., n. e. c.: with more than 200 empl.	450	10	50. Other transport activities	5 600	150
21. Manufacture of engines, etc., n. e. c.: with not more than 200 empl.	1 200	30	51. Services incidental to transport (including storage)	1 500	70
22. Repair of motor vehicles and electric appliances	3 150	70	52. Communication services	2 700	60
23. Other metal manufacturing	1 650	40	53. Banking and insurance	3 600	70
24. Manufacture of non-metallic mineral products	250	10	54. Lessors of real property	13 800	140
25. Manufacture of articles of paper and paperboard	350	10	55. Drinking and eating places; hotels, etc.	12 900	450
26. Manufacture of wood, cork, paper and paperboard	500	20	56. Motion pictures and other amusements	2 650	180
27. Printing and publishing	1 650	30	57. Laundries; barber and beauty shops	9 350	200
28. Bookbinding, photographing, etc.	2 500	60	58. Business services (including legal services)	700	10
29. Manufacture of leather, rubber and fur products	2 250	60	59. Medical and other health services	5 250	240
30. Manufacture of dyes, paints and varnishes	300	10	60. Educational services; religious activities, etc.	3 100	230
			61. Labor and political org., trade assoc., etc.	2 300	60
			62. Other economic activities in Stockholm	2 150	30
			Total	171 350	4 870

Notes. All figures are rounded off. — The classification agrees with that of the Intersectoral Flow Datum Table. — The units used to measure manpower are defined in Table 4.1., p. 50.

Table 4.21. A. *The amounts of manpower "contained" in different categories of final demand deliveries from the production sectors in 1950. Summary of Tables 4.19. and 4.20. (Number of full-time workers.)*

	Direct-plus-indirect manpower incorporated in deliveries to final demand from the production sectors	*Thereof:*		
		Incorporated in export deliveries	Incorporated in deliveries for private consumption in Stockholm	Incorporated in all other deliveries to final demand
I. Metal and engineering industry.	64 350	47 100	8 500	8 750
II. Printing and publishing, etc. ...	21 350	16 750	4 150	450
III. Food processing	18 600	6 200	11 850	550
IV. All other manufacturing, etc....	80 400	35 800	12 800	31 800
V. Wholesale trade	33 250	30 000	200	3 050
VI. Retail trade	57 500	4 050	52 500	950
VII. Transportation and communication, etc.	50 550	27 000	21 050	2 500
VIII. Business and personal services, etc.	68 800	24 000	43 050	1 750
IX. Medical and educational services	35 100	1 300	8 350	25 450
X. Agriculture and all other production	14 550	3 850	8 900	1 800
I—X. Total for the production sectors.	444 450	196 050	171 350	77 050
Percentage distribution	100,0	44,1	38,6	17,3

Notes. All figures are rounded off.
The classification into groups of sectors is specified in Table 4.2., p. 52.
The units used to measure manpower are defined in Table 4.1., p. 50.

rearrange the very same data, so that they indicate the size of the inputs of manpower and space *contained* in the deliveries to final demand. We can, as it were, trace the inputs concerned on their way through the system of production sectors until they are finally[1] absorbed by final demand categories.

The ensuing results are presented in *Tables 4.17. and 4.18.*, the data being arranged as in Tables 4.11., 4.14. and 4.15.

Tables 4.17. and 4.18. furnish material for comparisons similar to those made in previous sections. I leave it to the reader to carry out such comparisons as may seem of interest.

In the tables above we have analysed the amounts of imports, gross factor returns, manpower inputs, etc., incorporated in the *total* deliveries to final demand. It goes without saying that we may as well select any particular category of final demand deliveries and analyse its contents of imports, manpower inputs, etc.[2] Two examples of this kind of analysis are given in the following tables. The first, presented in *Table 4.19.*, indicates the amounts of manpower and of floor space contained in export deliveries from the production sectors. One finds, for instance, that in 1950

[1] Finally, that is, within the theoretical framework used here.

[2] The first empirical results of this kind were published by Leontief in 1946 (Quarterly Journal of Economics vol. nr 60, pp. 171—191). See, also, Leontief, W., (1951) The structure of American economy, 1919—1939, pp. 168—186.

Table 4.21. B. *The amounts of floor space "contained" in different categories of final demand deliveries from the production sectors in 1950. Summary of Tables 4.19. and 4.20. (Thousands of square metres.)*

	Direct-plus-indirect floor space incorporated in deliveries to final demand from the production sectors	*Thereof:*		
		Incorporated in export deliveries	Incorporated in deliveries for private consumption in Stockholm	Incorporated in all other deliveries to final demand
I. Metal and engineering industry.	1 520	1 130	200	190
II. Printing and publishing, etc.	480	380	90	10
III. Food processing	770	260	480	30
IV. All other manufacturing, etc. ..	1 460	710	320	430
V. Wholesale trade	1 090	990	10	90
VI. Retail trade	1 680	120	1 540	20
VII. Transportation and communication, etc.	1 150	570	530	50
VIII. Business and personal services, etc.	1 740	650	1 050	40
IX. Medical and educational services	2 120	80	470	1 570
X. Agriculture and all other production	300	80	180	40
I—X. Total for the production sectors.	12 320	4 970	4 870	2 480
Percentage distribution	100,0	40,3	39,5	20,2

Notes. All figures are rounded off.
The classification into groups of sectors is specified in Table 4.2., p. 52.

the labor inputs of 12 900 full-time workers were needed, directly and indirectly, in order to enable the sector Banking and Insurance (sector no. 53) in Stockholm to render its services to the Rest of Sweden and to Foreign Countries, that is, to export. Some 220 thousand square metres of building capacity were needed in order to enable Wholesale Trade with Hardware, Lumber, etc. (sector no. 37) to export its services, and so on.

Table 4.20., the second example, indicates the amounts of manpower and of floor space contained in private consumption, in Stockholm, as delivered by the production sectors. It can be seen that the greatest demands, upon labor as well as upon building capacity, were made by Retail Trade with Food Products (sector no. 8); the services rendered to households in Stockholm by this sector required, directly and indirectly, the labor inputs of some 17 550 full-time workers and some 500 thousand square metres of floor space.

A summary of Tables 4.19. and 4.20. is provided by *Tables 4.21., A.* and *B.* Of the total deliveries to final demand from the 62 production sectors, exports comprised some 49.2 percent, private consumption some 36.5 percent and the residual categories of final demand[1] some 14.3 percent. It is interesting, now, to compare these percentage figures to those found on the bottom rows of Tables 4.21.

[1] As seen from the Intersectoral Flow Datum Table, these remaining types of final demand deliveries were absorbed 1) for capital formation purposes, 2) for purchases on current account by government authorities, 3) for public consumption purposes (schools, hospitals, etc.) and 4) by a residual category of final demand, predominantly consisting of inventory increase.

Whereas the export deliveries comprised some 49.2 percent of total deliveries to final demand, the amount of manpower contained in exports represented only 44.1 percent of the total amount of manpower put into the production sectors. This means that, on the average, export deliveries were relatively less labor intensive than the other categories of final demand, taken together. The same tendency, although even more pronounced, is found for the usage of building capacity, as measured in terms of floor space. Only about 40 percent of the amount of floor space utilized by the production sectors were, directly or indirectly, needed for export production (to be compared to 49 percent, as above).

On the other hand, the deliveries for private consumption in Stockholm were relatively more labor intensive than the average final demand delivery. Some 38.6 percent of the total manpower inputs were required, directly or indirectly, for the deliveries to households in Stockholm from the production sectors, but, as mentioned, households in Stockholm absorbed only 36.5 percent of total deliveries to final demand. The deliveries for private consumption also required a relatively large amount of space (39.5 percent of the total capacity used by the production sectors, to be compared to 36.5 percent, as above).

As regards the remaining categories of final demand, the deliveries for capital formation in Stockholm required relatively much labor and relatively little space. The deliveries for public consumption and for government current needs required both much space and much labor, relatively speaking. In particular, public consumption, as provided by schools, hospitals, etc., required a great deal of space, as one would expect.

It can be seen further from Table 4.21., that the two groups of sectors which raised the largest requirements upon manpower, directly and indirectly, for their own export deliveries, were Metal and engineering industry and the group All other manufacturing. The requirements of building capacity, for exports, were largest for Metal and engineering industry and for Wholesale trade. As regards the deliveries for private consumption, it is seen that Retail trade[1] made the greatest demands upon manpower as well as upon building capacity.

As mentioned before, Tables 4.19.—4.21. are intended only to illustrate possible applications of the theory used here. The reader who may feel that the two measures used in these tables, number of full-time workers and amount of floor space utilized, are too crude, may easily extend the analysis to cover also gross factor returns, household returns, etc.

At the beginning of this chapter we set out to compare the simple employment patterns of the 12 largest American cities with that of the Stockholm area. It would be interesting, now, to carry the comparative analysis one step further by studying the similarities and dissimilarities between the cities in question regarding the distributions of household returns, gross factor returns, floor space, etc., and regarding such magnitudes as the relative amount of manpower absorbed in deliveries to households and in export deliveries. However, no such analysis is possible

[1] It should be remembered that the producer's value of goods is excluded from the value of deliveries rendered by Retail trade.

as yet, and whenever it can be executed, we should bear in mind that the above findings are related to conditions that prevailed in the year 1950. It *may* be that many of our findings on the relative distributions of phenomena are rather stable over time, but just *how* stable we do not know. Only repeated investigations can throw some light on this problem.

Thus, as emphasized before, the findings as such do not allow any statement about the future of the economy of the Stockholm area. Nevertheless, they can serve as a starting-point for forecasts. Furthermore, the theoretical framework through which data have been comprehended here, may serve as a framework also for forecasting purposes. Among other things, the next chapter will indicate a possible procedure for such purposes, in terms of the concepts used in the present study.

CHAPTER V

Problems for Further Research

The purpose of the present study was to try to probe into the flow relationships that link together the different sectors of the Stockholm economy. It was hoped that the study would lay a foundation for the study of the economic future of the Stockholm area. An exposition was given in the previous chapter regarding the *state* of the Stockholm economy in the year 1950. Attention was focused on the flows of goods and services between producers and users, and the flows of receipts and expenditures, *within* Stockholm as well as *between* Stockholm and the Rest of the World. These phenomena were comprehended by means of a simple theoretical system.

It has already been apparent that the work reported on here suffers from many shortcomings and limitations. But, at the same time, it also appears that continued work along the same line of enquiry would be very promising and capable of considerable development, even for city planning purposes.

THE PRESENT STUDY AS A BASIS FOR FORECASTS. AN ILLUSTRATIVE APPLICATION OF THE ASSUMPTION OF INVARIANT STRUCTURAL RELATIONS

It has been emphasized that all the information derived in Ch. IV is related to conditions that happened to prevail in 1950. However, in order to get some perspective on these findings, we also constructed some »hypothetical» situations with which the findings could be compared. A further step in that direction might be to indicate the economic consequences of intended actions by government or even individual business firms, under specified conditions. To illustrate the type of questions that might be probed into, we could enquire into the changes in the city income, in the city balance of payments, in the need of manpower and so on, which would be consistent with, let us say, relocations of some large manufacturing establishments, away from the Stockholm area.

Proceeding still further in the same direction, we might attempt to forecast the whole development of the Stockholm economy up to some future point, under specified conditions. In fact, according to present plans, a set of conditional forecasts are now to be made regarding the levels of production and the amounts of manpower and building capacity needed in the Stockholm area in the years 1960,

1965 and 1970, and perhaps even further ahead. The data found in the present study for the year 1950 will form a basis, a datum, for the work. Sales to the Rest of Sweden and to Foreign Countries, as well as expenditure for capital formation and government current expenditure, will have to be stipulated. Households in Stockholm will be treated as an endogenous sector. On the basis of the information available *ad hoc* alterations in the structural coefficients and in the patterns of household consumption will have to be adhered to. Due to the uncertainties involved, a large number of alternatives will be presented, based on different assumptions regarding the development of exports, investment activity, consumption patterns, etc. Once a basic table and a program for the computations are available, the cost per alternative will be very low, relatively speaking.

An advantage of elaborating alternative estimates regarding the future development seems to be that we can learn more about the possible limits within which the economy may develop and, furthermore, that possible bottle-necks in the development may be uncovered. Also, »working with alternatives offers the advantage that the conditional character of the estimates receives more emphasis»[1].

The most difficult problem involved is to judge the future export possibilities of the Stockholm area. Locational considerations will have to be made regarding each particular industry, using general location theory as a tool.[2]

A problem common to all conditional forecasts based upon the present work, is that we do not know which pressures or tensions, if any, were inherent in the economic structure that was found to prevail in the year 1950. Here again, we are faced with a shortcoming due to the lack of data, in particular regarding the capacities available in different sectors and their utilization.[3]

Further, it should be stressed here that conditional forecasts of the type discussed

[1] Scope and methods of the Central Planning Bureau (1956), p. 40.

[2] An American study to be published in 1959 is of particular interest here, namely: Hirsch, W., Projecting economic activity and population of the St. Louis Metropolitan area: The input-output approach. Dr. Hirsch applied methods similar to those used here in attempts to forecast the future of the St. Louis Metropolitan area. With reference to the problem discussed above, his method was as follows (quotation from manuscript, pp. 27—28): »First, an analysis was made of the relative importance of and expected changes in an industry's location considerations in a national setting. The relative importance in industrial location decisions of the following factors were assessed: Market considerations, Production relationships, Availability of material, Management relationships, Labor, Wages, Productivity, Labor supply, Labor-management relations, Sites and plant, Water rates and supply, Industrial fuel rates and supply, Electricity rates and supply, Waste disposal, Transportation facilities, Tax considerations, Availability of risk capital, Distribution facilities.

Second, with the aid of industry experts the locational advantages and disadvantages of the main industries in the St. Louis metropolitan area were determined. Here an attempt was made to duplicate the process through which industry goes in deciding upon the location of new plants and expansion, contraction or abandonment of existing ones. Two important assumptions were made in this connection. It was assumed that the recommendations for governmental reorganization made by the Metropolitan St. Louis Survey would promptly be implemented; and also, that the St. Louis County Council would proceed forthwith to prepare a master plan and zoning ordinance which would make available a substantial portion of the St. Louis county to industry.»

[3] In this context, reference should be made to the work done on decision models by Frisch, who conceives of capacity limitations as just one kind of *bounds* that are imposed on the dependent variables. His conceptual framework is much wider than the one used here, embracing linear equations as well as linear inequalities; he further uses a preference function, in order to render the system solvable (i. e., to give an optimum solution). For summary of the work, see Frisch, R., (1957) Oslo decision models (mimeographed memorandum from the University Institute of Economics, Oslo). See, also, Isard, W., & Whitney, V., (1952) Atomic power and regional development (Bulletin of the Atomic Scientists, vol. 8, pp. 119—124) and Rasmussen, N., (1956) Studies in inter-sectoral relations, pp. 42—45.

above should be »followed up» and tested against empirical data. In that way, the technique may be further improved. To conclude this section and to illustrate the procedure used in carrying out a conditional forecast, I shall now report on an application of the assumption of invariant structural relations which was introduced in Ch. II.

Illustrative application of the assumption of invariant structural relations 1950—1955

Estimates have been made regarding the level and composition of final demand in the year 1955, the most recent period for which data were avilable at the time of investigation (end of 1956). The data covered the following sectors of final demand (figures in brackets indicate the corresponding column numbers in the Intersectoral Flow Datum Table):

a) Households, in Stockholm as well as in the Rest of Sweden (84—87);
b) National and municipal government authorities, purchases on current account as well as transfers (75—83);
c) Gross domestic capital formation, in Stockholm as well as in the Rest of Sweden (71—73);
d) Foreign countries (65—70)

The data arrived at for the year 1955 are presented in Appendix 3, which also indicates the sources used. Regrettably, these data are, on the whole, rather more uncertain than those referring to 1950. For one particular category of final demand, namely exports to industries in the Rest of Sweden, no data were available. This category had to be treated in a provisional manner, as will appear from the following description.

No systematic evidence could be gathered, within the scope of the present study, regarding the changes in the structural relations between the production sectors that might have occurred between 1950 and 1955. So I had to avail myself of the assumption of invariant structural relations which was introduced in Ch. II. Thus, strictly speaking, the only achievement that we can claim here is to indicate the implication of this assumption when applied to final demand conditions in the year 1955. We can indicate the levels of activity, etc., which would be *consistent* with the assumption of invariant structural relations. We can make a »conditional forecast», as it were, the main condition being that the structural relations that were found to prevail in 1950 should apply also the year 1955.

Due to lack of data, the two sectors of industries in the Rest of Sweden, Agriculture (no. 63) and Other Industries (no. 64), had to be treated as endogenous sectors in this application. That is to say, it was assumed here that their purchases on current account from the production sectors had the same structure in 1955 as in 1950, and that the corresponding input coefficients of the production sectors were also invariant. Further, the application of the factorability assumptions was correspondingly widened. These might have been rather unrealistic assumptions, particularly for the Other Industries. But they meant that the repercussions between industries in Stockholm and industries in the Rest of Sweden could be incorporated in the analysis.[1]

Thus, the matrix of technical coefficients used in previous computations was enlarged so as to include also the 1950 patterns of production sector deliveries to, and purchases from, Agriculture and Other Industries, in the Rest of Sweden.

The final demand vector, pertaining to 1955, was premultiplied by the inverse of this enlarged matrix, in order to estimate the values indicating the levels of production in 1955.

[1] Cf. Moore, F. T., (1955) Regional economic reaction paths, pp. 133—148 (American Economic Review, Proceedings, no. 45) and discussion by Moses, op. cit., p. 152.

Table 5.1. *Estimated increase in production values 1950—1955, for groups of production sectors in Stockholm (current prices).*

Group of sectors	Increase %
I. Metal and engineering industry	52
II. Printing and publishing, etc.	34
III. Food processing	39
IV. All other manufacturing, incl. construction	53
V. Wholesale trade	51
VI. Retail trade	36
VII. Transportation and communication services	52
VIII. Business and personal services, incl. banking, etc.	54
IX. Medical and educational, etc., services	66
X. Agriculture and all other production sectors	49
I.—X. Total	50

Notes. The classification agrees with that used in Table 4.2.
The estimates given in the table are based on the assumption of invariant structural relations between 1950 and 1955.

These values were then divided by the corresponding values for 1950, to indicate the percentage changes in production levels that occurred between 1950 and 1955, under the assumptions here used. The results are summarized in *Table 5.1.* For details of computations, see Appendix 3.

According to Table 5.1., the largest increase in value of production should have occurred to the group Medical and Educational Services, and the smallest increase to the group Printing and Publishing. As can be seen from the table, the average increase should have been some 50 percent. All data are expressed in current prices. Since prices rose rather heavily between 1950 and 1955, the increase would be much lower if expressed in terms of volume; the figure would probably be no higher than 15—20 percent above the 1950 level.[1]

It will be a very important task for future research to test the predictive ability of the technique here used. If rigorously formulated and executed, such tests must cover not only data on production levels, but also data on final demand and structural relations. Thus in the present case it would not be sufficient only to gather data on production levels in 1955 and to compare them to the estimates here made. Such a procedure would really lead to a test of several things at the same time. It would not be possible to isolate deviations due, for instance, to errors in the final demand estimates made here, to inadequacies arising from the treatment of industries in the Rest of Sweden as endogenous sectors and to inadequacies of the assumption of invariant structural relations.

Taking a very short-sighted view, however, we may leave the question of theoretical development for the moment, and say that we want a prediction, in its own right, regarding the changes occurring in Stockholm between 1950 and 1955. From the point of wiew of planning for the future of the Stockholm area, the interest will then very likely be greatest for changes in the gainfully employed population. At first sight, therefore, the data that are presented in Table 5.1. may not seem very useful, particularly when it is considered that the changes indicated by the table are expressed in current prices. However through the following

[1] There is no price index which would show the changes in the prices of the commodities produced in Stockholm. According to official index series (found, for instance, in the list of tables issued by the Konjunkturinstitut), a general index of such commodities for the country as a whole would probably show an increase of some 25—30 percent for the period 1950—1955.

identity we may transform the estimates of changes in production levels into estimates of changes in the gainfully employed population:

$$\frac{\text{Number of persons gainfully employed, 1955}}{\text{Number of persons gainfully employed, 1950}} = \frac{\text{Level of production, 1955}}{\text{Level of production, 1950}} \cdot \frac{\text{Personal-income coefficient, 1955}}{\text{Personal-income coefficient, 1950}} \cdot \frac{\text{Average income (calculated per gainfully employed), 1950}}{\text{Average income (calculated per gainfully employed), 1955}}$$

The »personal-income coefficient» states the amount of returns (wages, salaries, dividends, etc.) accruing to households per million's worth of output, or production.[1]

Thus, given the changes in personal-income coefficients and in income per gainfully employed person, we can transform the estimates of Table 5.1., so that they indicate the changes to which the total labor force was subjected. Such a transformation has been carried out here, and the results are summarized in *Table 5.2.* For details of computations, see Appendix 3.

Table 5.2. *Estimated changes in the number of persons gainfully employed by the production sectors (groups of sectors), 1950—1955.*

Group of sectors	Number of persons gainfully employed (full-time) *1950*	Change 1950—1955	Change %
I. Metal and engineering industry	66 050	+ 3 750	+ 6
II. Printing and publishing	20 750	− 2 300	− 11
III. Food processing	15 400	+ 150	+ 1
IV. All other manufacturing, incl. construction	84 000	− 1 100	− 1
V. Wholesale trade	40 750	+ 1 850	+ 5
VI. Retail trade	51 550	− 350	− 1
VII. Transportation and communication services	49 000	− 850	− 2
VIII. Business and personal services, incl. banking, etc.	66 800	+ 4 850	+ 7
IX. Medical and educational, etc., services	31 000	+ 4 300	+ 14
X. Agriculture and all other production sectors	18 400	− 650	− 4
I.—X. Total for the production sectors	443 700	+ 9 650	+ 2

Notes. The classification agrees with that used in Table 4.2.
For underlying assumptions and details of computations, see Appendix 3.

Here again, I was faced with great difficulties in the search for adequate data regarding the changes which occurred in personal-income coefficients and in income calculated per gainfully employed person. For service industries other than retail and wholesale trade, I had to assume that the personal-income coefficients remained invariant between 1950 and 1955. For manufacturing industries and for retail and wholesale trade, the index numbers showing changes in the national coefficients had to be applied. As regards the changes in average income, data for sectors other than manufacturing industries and agriculture were available only for rather broad groups, such as »transportation and communication services». Further, as seen from Appendix 3, the index numbers applied were in most cases rounded off, due to the uncertainties involved.

[1] As can be seen, the formula is very weak from the point of view of statistical estimation, since it may lead to cumulative errors. For instance, a five-percent error in each of the three indices included might lead to a total error of about 15 percent, if they all happened to work in the same direction.

Thus, according to these estimates, the total employment of the production sectors should have increased by a little less than 10,000 people, or just over two percent, between 1950 and 1955. In the light of previous experience regarding growth in the Stockholm area, this figure may seem unexpectedly low. However, it would of course be easy to »invent» explanations for the individual figures gives in the table. For instance, the standstill registered for the retail trade, one of the main service industries, could possibly be explained with reference to the laborsaving transition to self-service which took place in the food industry, the decrease which occurred in the textile and clothing industry, the relative expansion of automotive and similar trades, which have required relatively little labor per million's worth of output, and so on. But I shall refrain from using such *ex post facto* rationales; they deserve little, if any, credit in a scientific study. For a comparison let us turn instead to other available data.

The total population of the Stockholm area in age groups 15—65 years, that is, those age groups from which the working population has been recruited in the past, increased by some *4.9 percent* between 1950 and 1955. Ahlberg[1] compared the corresponding percentage for the period 1945—1950 to the registered increase in the number of people gainfully employed, and found the following results:

Population in the Stockholm area	Percentage increase 1945—1950
Total population in age groups 15—65 years	6,2
Total working population	4,8

Assuming that this tendency towards a slower increase in the working population than in the corresponding age groups of the total population was maintained to the same extent during the period 1950—1955, we should obtain a figure of *3.5—3.8 percent,* indicating the increase in the working population between 1950 and 1955. However, that figure also includes government employees (national and municipal government administration) and domestic workers, whereas the previous estimate did not. Available data indicate that the number of domestic workers decreased and the number of government employees increased in the period mentioned. The net change was very likely an increase, perhaps by as much as 2,000 persons. Since the total personnel of the two categories concerned was 54,000 persons in 1950, this would mean that the net increase amounted to a little less than four percent, that is to say, about the same as the increase estimated for the working population as a whole. Thus, it appears that the figure for the production sectors which was arrived at before, namely just over two percent, is too low. In other words, the procedure used here has probably somewhat *underestimated* the actual growth of the working population in 1950—1955. As has been recognized, this underestimate may be ascribed to many different causes, none of which can be isolated at present.

ENDOGENOUS VS. EXOGENOUS SECTORS

In analysing the state of the Stockholm economy in 1950, we applied the assumptions of factorability as an instrument. The interrelations between the production sectors that were conceptualized, formed the endogenous mechanism upon which we operated by force of the factorability assumptions. To state the position of the

[1] Ahlberg, G., (1955) Den förvärvsarbetande befolkningen i Stor-Stockholm åren 1945 och 1950 (Statistisk Månadsskrift, vol. 50, no. 7, pp. 10—14).

sectors vis-à-vis the endogenous mechanism, we also referred to the production sectors as *endogenous* sectors and to the final demand sectors as *exogenous* sectors.

Judging from the structure of total final demand deliveries in 1950, the largest gain from an extension of the endogenous mechanism used here, would have been obtained by including household demand in the endogenous categories. This statement would very likely hold also for any intended applications to other large cities, with the possible exception of cities like Detroit, Pittsburgh and Cleveland.

However, to include Households in Stockholm among the endogenous sectors, the following condition would have to be at least approximately fulfilled: the services rendered by households, or subsets of households, to the production sectors should have the same relative content of production-sector goods and services, regardless of which production sector received the services concerned. To illustrate, persons[1] earning their living from, say, the engineering industry in Stockholm, should spend about the same fraction of their income upon food products, delivered by industries in Stockholm, as would persons earning their living from, say, employment in the banking and insurance sector. In fact, this is only another way of expressing that the factorability assumptions should hold also for »deliveries» from households. When the present study was being carried out, available data regarding consumption patterns could not be arranged so as to fulfil this condition. Had they been more detailed, such an arrangement would very likely have been feasible.

Turning attention to future research, however, it seems that a good deal can be done in this direction. It appears likely that, in a city like Stockholm, consumption patterns tend to be quite independent of sectoral or industrial origin of income, *within* the same occupational group. For instance, one would probably find that clerical personnel in the city have about the same consumption patterns, regardless of whether they are employed by, say, a manufacturing industry or by an insurance company. If this is so, it would be useful to classify households into some main occupational groups, let us say, technical and clerical personnel, shop personnel, wage-earners other than shop personnel, and perhaps one or two more groups.[2] The problem arising in the households having more than one member employed and with the members employed in different occupational groups, would not cause any serious difficulty in the procedure of classification.

Empirical investigations would then have to be made to find out about the consumption patterns of the groups of households chosen. If the classificatory scheme here indicated turned out to be successful, one would expect to find that variations in consumption patterns *between* groups would account for most of the over-all variation in consumption patterns. However, since consumption patterns are found to be correlated with, among other things, the number of members, and their age distribution, per household, the variations in patterns *within* the occupational classes of households, would probably not be insignificant.

The fractions of household returns accruing to each (occupational) group of households, per sector, could be estimated fairly well by means of the statistics available.

[1] Or, rather, households.

[2] For instance, it might be worth while to single out top executives, or, in this sense, special groups like restaurant personnel, nurses and other social welfare workers.

Such estimates could *not* be made, however, if it turned out that cross-classifications according to, say, number of members and number of children per household, had to be used. In that case, further empirical investigations would be necessary.

As seen from the Intersectoral Flow Datum Table, nearly 30 percent of all deliveries from the production sectors went to Households in Stockholm; the corresponding figure for deliveries between production sectors was slightly over 20 percent. Thus it appears that the model would gain considerable as a description of conditions, if it were extended in the way suggested above.

These suggestions have dealt with the steps that would be necessary in order to fulfil the fundamental assumptions of factorability, *if* the model were extended to embrace households. For purposes of prediction, however, one would in addition have to stipulate the form of the consumption functions involved.[1] In so doing, one would probably be led to attempt to remedy another shortcoming of the present work, namely its failure to allow for the substitution effects due to changes in relative prices, within the model.

Similar considerations would apply if deliveries to and from industries in the Rest of Sweden were to be included in the endogenous mechanism. The factorability assumptions would then require that the »imports» absorbed by each of the 62 production sectors, from industries in the Rest of Sweden, should have the same relative content of production-sector goods and services.

However, in a few years' time this step can probably be taken with much greater justification than now. The new input-output table for Sweden as a whole, which is now under preparation, will be completed by then, and it will be possible to split up the industries in the Rest of Sweden into more homogeneous sectors.

A further limitation of the model used here, stems from the fact that it can only be used to analyse and describe states, but not processes. It is sometimes suggested that a model of this kind could be manipulated, so that its operation would resemble the processes in real life. This idea is suggested by an iterative procedure used for inverting the matrix of structural coefficients, the individual steps in the iteration being referred to as »rounds».[2] The idea is then that alterations in the coefficients could be made, from round to round, to adapt the model to constraints in the variability of real phenomena due to capacity limitations, inertia, etc. This idea really presupposes an isomorphy between the numerical operations to which data are subjected in the procedure of matrix inversion and the »operations» to which

[1] In this respect it is likely that the present work can be integrated with the econometric studies carried out by Bentzel and associates. They used time-series data, usually containing about twenty observations per commodity (for the periods 1931—39, 1946—55) as a basis for least-squares regression analyses, and the consumption functions they worked with were of the common type with constant elasticities. That is to say, the functions were, generally speaking, non-linear. If such data were integrated with the present work, the computations involved would therefore be more complicated, but not prohibitively so. More problematic would probably be the fact that their results referred to Sweden as a whole, that the two explaining variables used, income and prices, were in some cases highly correlated, and that their regression estimates, although being specified for about forty commodities, did not single out retail trade services and some other groups with a fairly high weight in the present study. See Bentzel, R., Eklöf, K., and others, (1957) Den privata konsumtionen i Sverige 1931—65 (Private consumption in Sweden 1931—65). Cf., also, Wold, H., (1952) Demand analysis, pp. 28—59, and Duesenberry, J., and Kistin, H., (1953) The role of demand in the economic structure (In: Studies in the structure of the American economy, pp. 451—482).

[2] Cf. Isard, W., (1954) Location theory and trade theory, short-run analysis, pp. 314—315 (Quarterly Journal of Economics, vol. 68, no. 2).

the phenomena of real life are subjected. That such an isomorphy should exist seems unlikely. If the reaction paths in real life could be traced at all, one would probably find that the complex interactions involved would occur at different speeds in different sectors.

By contrast, the present model *would* acquire dynamic properties, if capital formation[1] were introduced as a dependent variable in the system. The investment demand, and all its individual components, would then be generated via a set of capital stock coefficients, which would be related to changes in the *rate* of current production, per sector. The theoretical system would consist of a set of differential equations. Thereby, the computational difficulties would be much greater than those of the present model, although manageable. However, the most serious problem would be to find the necessary empirical data. The capacity of the different production sectors, in terms of units of output, and the amount of capital neededper unit of capacity, would both have to be known. As such data was completely lacking, the demand for investment purposes had to be treated as an exogenous category in the applications made here.[2]

Incidentally, the deliveries of the production sectors for purposes of capital formation in the Stockholm area in 1950 amounted to some six percent of their total deliveries, as seen from the Intersectoral Flow Datum Table. Considering this relatively small fraction, it might not seem worth while to bother with the formal inclusion of the investment demand as an endogenous sector. However, assuming that Households in Stockholm as well as Industries in the Rest of Sweden were embraced by the endogenous mechanism, the demand for capital formation in the Stockholm area in 1950 would have comprised some 15 percent of the final demand then remaining. Consequently, in applying the model for prediction purposes, errors committed in assigning values to the elements of this vector, might not be insignificant, particularly since the non-zero elements of the vector would be relatively few and of very uneven size.

DETERMINISTIC VS. PROBABILISTIC MODELS

It has been stressed before that I have been unable to state the reliability or probabilistic properties of the estimates made in the present investigation. The data presented were seemingly exact, although, in a roundabout fashion, it was stated that many figures were »unreliable» and that the theoretical assumptions were only »approximately» applicable.

The consequence of having used a deterministic model, is really that we do not know whether the differences found, for example, from comparisons between figures from different sectors were significant with regard to the errors involved, and that

[1] That is to say, purchases of machinery, construction works, including housing, etc.

[2] Leontief and other members of the Harvard Economic Research Project have pioneered also in this particular field, see Leontief, W., (1953) Dynamic analysis, pp. 53—90; Grosse, R., (1953) The structure of capital, pp. 185—242; and Clark, P., (1953) The telephone industry: A study in private investment, pp. 243—294 (All in: Studies in the Structure of the American economy).

further, in the attempt to make a conditional forecast for 1955, no criteria could be devised for judging the performance of the basic theory applied. Indeed, this may be the most serious shortcoming of all, because it means that, at present, the theory applied here is not refutable.

It would be helpful if the present work could be tied in with the theory of probability and statistical inference. A probabilistic model could be constructed, if, for instance, time-series data were available for the structural coefficients, but, obviously, the necessary empirical work would be extremely cumbersome. Further, it is possible that such a study of the aggregates concerned would be too mechanical to be of much use for prediction purposes.

Instead, it might be worthwhile to dig a little deeper and investigate the way in which microeconomic behavior is integrated so as to result in macroeconomic behavior, that is to say, the way in which the behavior of the sector is shaped by the behavior of its constituent acting units. It is obviously a fiction to think of the sectors as being homogeneous, and it is by no means certain that the remedy is to have more sectors. To begin with, some helpful subclassifications of the establishments belonging to each individual sector could be made. Some indication has been brought out by the present investigation that there may be significant differences in the cost structures as between establishments of different size, and it might be helpful to single out, for example, very small establishments. Further, in retrospective studies regarding individual sectors, it would be desirable to analyse changes in the cost structures of establishments which have ceased to exist and, on the other hand, of new entrants to the trade, as compared to the cost structures of establishments which have been in business during the whole of the period investigated. Likewise, it would be desirable to analyse the corresponding structures of deliveries and changes in them.

Such studies might give some indication of the range of variations in the cost structures of different establishments and of the variability, over time, in the cost elements of individual establishments. If weights could be assigned to the subclasses — existing small establishments, »births» of establishments, »deaths» of establishments, etc. — a probability model might begin to take shape. Such a model would work with given cost structures for each subclass, although if possible with known probability distributions for the individual cost elements. To go one step further, one might study the innovation processes through which new techniques, and perhaps new products, are being diffused among the individual establishments constituting a sector. Such processes could very likely be comprehended by means of relatively simple stochastic models.[1]

[1] Cf. Hägerstrand, (1953 Innovationsförloppet ur korologisk synpunkt (The innovation process from a chorological point of view).

A SPECIAL PROBLEM WITH REGARD TO THE APPLICABILITY FOR CITY PLANNING PURPOSES

A serious limitation of the approach used here is that the Stockholm area itself has been treated as if it were a point. Although the area was kept distinct from the Rest of the World, no analysis was made regarding the spatial distribution of establishments *within* the Stockholm area. That is to say, any conditional forecast generated by the present model will refer to Stockholm as a whole. The results can be specified for individual sectors, but in order to carry the disaggregation one step further, to render the results specifiable for particular *parts* of the Stockholm area, it would have been necessary to possess information on the intersectoral flows *between* and *within* different parts of the area. It is apparent that such information would be extremely hard to collect. Further, it is not known to what extent the trading relationships on that level would be stable, and this would make it even more complicated to stipulate the final demand values and to construct the endogenous mechanism for prediction purposes.

To overcome this particular limitation of the present work, a supplementary study was designed to account for the spatial arrangement of establishments within Stockholm. A progress report on that work is given in the next chapter.

CHAPTER VI

On Locational Patterns. A Progress Report on Further Research

A method of exploring the future developmental possibilities of the Stockholm area was outlined in the previous chapter. Starting from data characterizing the *initial situation,* it was indicated how conditional forecasts could be generated by assuming that certain *invariant or predictable relationships* could be established and that values could be assigned to the variables referring to the *exogenous sectors.*

As was mentioned, however, a major limitation of the whole analysis and description so far, is that all the findings derived or derivable relate to the Stockholm area as a whole. Therefore, a worthwhile extension of the work seems to be to explore whether such findings can be *linked up* with findings that relate to smaller zones, such as the central business district or a part thereof, *within* Stockholm. Work is now in progress in this direction, and the present chapter can give no more than a progress report. The ultimate goal of this work will be to establish invariant or predictable *locational* relationships or patterns of urban land-use, such that analyses and descriptions of the present type can be pushed one step further: to comprehend, also, the *spatial arrangement* of economic activities *within* the community under study. Considered from the point of view of the general theory of location and space-economy, however, work in this direction may not be capable of contributing very much. Its orientation is *not* toward seeking universal laws, but rather toward seeking specific, delimited and testable hypotheses. Further, for the time being at least, the work will concentrate on the analysis and description of states rather than of processes.

The scope of the present investigation

The conditional forecasts referring to the Stockholm area as a whole, can be expressed in terms of *employment* requirements in the way indicated in the previous chapter. The simplest procedure for relating such employment figures to small areas or districts *within* Stockholm, would probably be to assume that each area or district would exactly maintain its share of total employment. That is to say, we would assume that the spatial distribution of total employment remained invariant.

With such an assumption, however, we would use only a small part of the information provided by the conditional forecasts, since they would give employment figures for each particular sector. A somewhat more refined method would be to assume that the spatial distribution, *per sector,* remained invariant. Thus if we know that

at present about 40 percent of the personnel of the banking and insurance sector are employed within a small central district of Stockholm, the assumption would be that the same fraction of the personnel of the sector would be employed in that particular district also in the future.

Since different sectors, having different locational distributions, might be expected to develop at different rates, the two assumptions would not be equivalent to each other; they would very likely give different results. However, neither procedure would be likely to give results compatible with certain long-run tendencies of differentiation in the Stockholm area. One is the tendency toward relocation of very large manufacturing establishments away from the inner city, in turn giving additional space to various types of service establishments. Another is the tendency toward suburbanization of the resident population, reflected in a sharp increase of the population of the suburbs, on the one hand, and in a depopulation of the inner city, on the other. Therefore, results obtained through the assumption of invariant spatial patterns of employment, per sector or totally, can only serve as a first approximation. To try to comprehend the locational distributions and changes in them, it seems necessary to analyse in greater detail the locational characteristics of each particular type of industry and to frame hypotheses regarding their locational patterns and interrelations with other variables.

However, any such undertaking is a very time-consuming job, and it has not been possible to cover more than a limited area of research in this report; it is confined to an investigation into the spatial distribution in 1951 of retail establishments, and certain other types of establishments providing personal services. The reasons for this particular choice were several:

1. Somewhat axiomatically, we may assume that the locational distribution, within a city, of industries which predominantly consist of many small establishments can be more easily comprehended, in terms of a limited number of concepts, than industries typified by large (and few) establishments. Small establishments is a characteristic of most branches of retail trade. In theorizing about regularities in their spatial arrangement within a city, we should probably be willing to accept a theory which accounted for all but a few of the locations of the individual establishments.
2. On the whole, relatively little research work has been done regarding the spatial distribution of different types of activities within cities. Nontheless, by studying retail trade and related activities we can build upon a greater body of previous research than by confining the study to any other major type of industry.
3. We may expect to find stronger »linkages» between the spatial distribution of the service establishments concerned and the spatial distribution of the population than between any other type of industry and the population. This is supported, for instance, by data in the Intersectoral Flow Datum Table. As was indicated above, we may here take the spatial distribution of the population as a datum.

In order to get some insight into the spatial characteristics, it was considered necessary to use relatively small areas as basic units in the investigation. On the other hand it turned out that the analysis of the small areas chosen required so much time that the whole Stockholm area could not be investigated at once. Consequently,

the present investigation is sharply confined even in space. It covers only a densely populated central district, which answers for no more than 0,6 percent of the total land area in Stockholm. However, this small area comprises more than 75 percent of the service industries to be investigated, as measured in terms of their employment.

In this report I must refrain from any attempt to review all previous research in this field. I shall give no more than a selective survey, the only purpose being to indicate to the reader my frame of reference.

PREVIOUS RESEARCH

The type of broad generalization regarding the arrangement of activities within cities that was suggested by BURGESS (1925) and HOYT (1939), is really too broad to be useful in this particular context. Burgess envisaged the city as comprising a number of concentric zones, each with its particular grouping of activities; Hoyt modified this conception by emphasizing that the spatial patterns were radial rather than concentric, around the urban core.[1]

Likewise, the classical works on location theory by THÜNEN (1826), WEBER (1909), OHLIN (1933), PALANDER (1935) and LÖSCH (1940) may also seem to be of little relevance to our attempts to elucidate relationships pertaining to the spatial arrangement of activities within Stockholm by means of specific and testable hypotheses.

THÜNEN was concerned with a theory of the location of agriculture; to be sure, his »isolierte Staat» had a center of consumption, as we all know, but in his conceptual framework Thünen treated this city as if it were a point. The same limitation, from the point of view of the present approach, applies to Weber's theory of the location of manufacturing industries: the market, or center of consumption, was a point. To be sure, WEBER's framework contained what he called »agglomerating factors», which tended to draw together the industries of a region into agglomerations, but he was not concerned with the possible effects of these and other factors in shaping the locational patterns within the agglomerations.

OHLIN viewed trade theory as part of a general theory of location, but his main interest was with international trade and he included, therefore, only so much location theory as he needed for the treatment of international trade problems; explicit attention was paid only in passing to the special problem of interest here.

Besides giving a thorough critical appraisal of previous research, PALANDER confined his interest, mainly, to problems related to transport costs, such as their variance with distance, the importance of terminal and breaking points, the competition between different means of transport, the nature of transport surfaces and other features of

[1] Both conceptions have been criticized for being loose and non-formalized. See, for instance, Jansson, C. G., (1955) Amerikanska ekologer om storstadens inre differentiering (American ecologists on the inner differentiation of the metropolis), p. 242: »They look at their maps and tables and find everything rather good, or rather bad, at their own discretion . . .» . . .»The many investigations of New York City exemplify how entirely different hypotheses can be 'confirmed' by the differentiation in the same area.» (my transl.) (In: Aktuella samhällsfrågor).

the transport pattern, that is, problems not directly related to the present problem. Further, he treated the problem of the economic location of the individual firm rather than the problem of general location patterns. LÖSCH, on the other hand, developed a theoretical framework through which a general interdependence of all locations was elucidated. However, the system of networks that he elaborated by means of different-sized hexagons which were turned around a common center, was applied to analyse and describe orders of economic *regions;* he was not explicitly concerned with the spatial arrangement of activities *within* the common center, which he thought of as a metropolis.

On the face of it, therefore, these central works on location theory appear to be of minor interest in the present context. However, that is not the case. THÜNEN's theory may be brought to bear also on the spatial arrangement of activities within a city, since his theory contains fundamental elements of a theory of rent. The same applies to WEBER's contribution; his main deglomerating factor is rent. Furthermore, Ohlin[1] and Palander[2] clarified Weber's rather diffuse concept of »agglomerating factors» and showed that one of the categories involved concerned the external economies of concentration of a particular industry, and this concept of external economies may help to elucidate also the locational patterns within a city. OHLIN further introduced the concept of »transfer costs» embracing all the obstacles to movement, which, from the point of view of the present approach, seems to be a much more useful concept than the narrower concept of transport costs. PALANDER examined and developed further Hotelling's case,[3] which may be brought to bear on the locational associations of different establishments within a city, their mutual attraction and repulsion. LÖSCH also paid attention to this particular problem. Moreover, we shall find that Lösch's fundamental approach, that of using nets as a frame of reference (in his case consisting of hexagons),[4] can be fruitfully applied also in the analysis of spatial arrangements within a city, although perhaps not with equally far-reaching and striking results.

In fact, one can find that all the works cited above formed part of HOOVER's (1948) frame of reference, in his study of the location of economic activity, and — what is particularly interesting in this context — Hoover also applied his central concepts of transfer costs and processing costs to the study of the spatial arrangement of activities within urban and metropolitan communities. He summarized his findings in the following rather concrete terms (pp. 140—141).

»Characteristic patterns of internal urban structure arise from the different requirements of the various land uses with respect to transfer and intrinsic qualities of land. Heavy industry is found along rail and water routes; commercial and service facilities needing contact with the metropolitan area as a whole are mainly at the focus of local transit routes; retailing of convenience goods and other activities serving only neighborhoods are strung along main commuting arteries; and residential uses are influenced by the advantages of access to workplace and the disadvantages of high site cost and nearness to industrial uses.»

[1] Ohlin, B., (1933) Interregional and international trade, pp. 203—206.
[2] Palander, T., (1935) Beiträge zur Standortstheorie, pp. 206—207.
[3] Cf. Hotelling, H., (1929) Stability in competition, pp. 41—57 (Economic Journal, vol. 39).
[4] As was pointed out by Lösch himself, the use of hexagons was not a novel idea of his. It was used, for instance, by Christaller (1933). In fact, Bühler (1949) traced its usage back to: Müller, A., (1809) Elemente der Staatskunst.

In juxtaposition to this we can view the following statement of HARRIS and ULLMAN (1945), who conceived of the arrangement of activities within cities as occurring in the form of multiple nuclei.

»The rise of separate nuclei and differentiated districts reflects a combination of the following four factors:

1. Certain activities require specialized facilities. The retail district, for example, is attached to the point of greatest intracity accessibility, the port district to suitable water front, manufacturing districts to large blocks of land and water or rail connection, and so on.

2. Certain like activities group together because they profit from cohesion. (Exceptions are service-type establishments such as some grocery stores, dry cleaners and gasoline stations.) ..... Retail districts benefit from grouping which increases the concentration of potential customers and makes possible comparison shopping. Financial and office-building districts depend upon facility of communication among offices within the district. The Merchandise Mart of Chicago is an example of wholesale clustering.

3. Certain unlike activities are detrimental to each other. The antagonism between factory development and high-class residential development is well known.

4. Certain acitvities are unable to afford the high rents of the most desirable sites.«

Focusing the interest on the location of service establishments, where conceptualization in terms of regularities is perhaps more easily achieved, HAWLEY (1950, p. 277) writes:

»To reduce an involved set of relationships to simplest terms, manufacturing is an independent variable in relation to population while nonmanufacturing activities constitute a dependent variable.....

Differences in the distribution patterns of various types of service units are quite conspicuous, however. It may be stated as a general rule that the more specialized the function of a unit the greater is the tendency to occupy a central location..... The converse of the rule is that the more unspecialized and standardized is a function the more pronounced is the tendency of the units so engaged to assume a distributional pattern comparable to that of the population..... But there is also another factor influencing this location pattern..... needs which recur with high frequency must have their sources of supply within easy reach, while those which arise infrequently may be served by units lying farther afield.

,.... there are definite symbiotic combinations in the distribution of units in the central business district. The financial district, though occupied by units which are alike in that all are concerned with money matters is actually quite differentiated in its composition. Not only does it include banking houses which themselves are often specialized.... Supplementing these units and rounding out the complement of financial services are legal, engineering, accounting, and other related agencies. Likewise in the retail shopping district, supplemental units cluster together. Theaters, restaurants, and florists' shops locate in close proximity to one another, as do variety, department, shoe, and women's clothing stores.«

Hawley has here summarized findings from many different quarters; for instance, a large number of marketing specialists have written on the location of retail trade.[1] In the case of so-called »shopping-goods», HOOVER, too, has pointed out the tendency among rival sellers to cluster in the same small district; he noted that this phenomenon could apply also to the wholesale and manufacturing stages. But he thought of this tendency as an exception, rather than as a rule, among sellers competing for the

[1] One of the earliest contributors was M .T. Copeland, who distinguished between »convenience goods stores», »shopping goods stores» and »specialty goods stores (Principles of merchandising, 1924).

Scandinavian readers may refer to Törnqvist, G., (1946) Varudistributionens struktur och kostnader, pp. 30—37 and 231—261, and Alkjaer, E., (1953) Erhvervslivets beliggenhedsproblemer (2nd ed.), pp. 52—71.

same markets; ordinarily the tendency would be towards mutual repulsion, according to Hoover. This problem of the locational attraction or repulsion among sellers is clearly related to Hotelling's case, as has already been indicated. Incidentally, CHAMBERLIN (1948, 6th. ed., pp. 260—265), too, started from Hotelling's case in his analysis of pure spatial competition.

To conclude this part of the survey of previous research, WILLIAM-OLSSON's (1937) study of the geographical development of Stockholm between 1850 and 1930 should be mentioned. He also used the concepts of mutual attraction and repulsion in summing up some of his results and found, among other things (pp. 184—191), a locational attraction among offices and among shopping-goods stores and specialty-goods stores. He further found that residence attracted convenience-goods establishments and that offices attracted printing-and-publishing activities. On the other hand, convenience-goods establishments were found to repel each other.

The works cited above have described in *verbal* form, or by means of maps, the spatial distribution of activities. I shall turn now to a survey of studies which have used *quantitative* methods in the analysis of the phenomena concerned.[1] I shall pay more attention to the methods than to the results.

SARGANT FLORENCE (1948) worked out a statistical measure of the degree of localization of different manufacturing industries; as his measure he used an *index* of localization which, for a particular industry, indicated the local or regional concentration of that industry compared with the distribution of industries as a whole. Most of his data refer to fairly large regions, but in a few cases he was able to calculate location quotients based upon local data; he recorded, for instance, how various metal industries were localized in certain telephone exchange areas in Birmingham.

RANNELLS (1956) had access to data which referred to much more detailed areal units, namely individual blocks, in his study of the Philadelphia Business District, and he, too, endeavoured to develop *measures* of the locational characteristics. He was particularly concerned with indicating the relative concentration, dispersion and proximity of establishments, within as well as between different kinds of business. In the scheme that he applied for the analysis of land use, the concept of »linkages» played a central role. Like Florence he used purely descriptive measures, but of a different kind. For instance, in order to indicate the degree of concentration of establishments he used Lorenz curves[2] (oriented to a system of coordinates having »percent of blocks», in the area under study, along one axis and »percent of establishments» along the other).

Blocks were also used as units in RATCLIFF's (1939) study of retail site selection, which was based upon data pertaining to the central business districts of 24 large American cities. He confined his study to the central business district under the assumption that the central area exhibited a more definite internal structure than outlying retail areas. Ratcliff studied the extent to which different types of retail

[1] I shall not here argue that quantitative methods are necessary, if we are to be able to carry out *comparative* studies, between different cities or within the same city over time. Many researchers will probably maintain that the use of visual comparison of a series of maps (for instance, in the form of translucent overlays) are sufficient for such purposes. It is enough to state here that *for present purposes* the goal must be to find numerical relationships.

[2] Cf. Smith, Jr., G. C. (1947) Lorenz curve analysis of industrial decentralization, pp. 591—596 (Journal of the American Statistical Association, vol. 42).

establishments occurred in blocks which contained a) department stores; b) variety stores; c) shoe stores; d) jewelry stores; e) furniture stores; f) florists; and g) theatres. He used an index of concentration to measure the tendency of locational attraction, or »self-affinities» as he termed it, among establishments of the same type.[1] Further, he was able to explore the associations between different types of establishments.

In a methodological study, PETERS (1950) suggested three theoretical distribution patterns, or »reference situations», to be used in the study of retail trade centralization and decentralization in metropolitan areas, but as Peters pointed out himself, the results obtained from applications would be strongly dependent upon the size of the area selected as the basic unit. More interesting in this context is his suggestion to correlate (p. 295) »the movements over time in retail sales in the various districts with the movements in each independent variable». By independent variables Peters meant

»..... factors that determine the location of retail establishments. Among such factors, obviously, are population and purchasing power.» ... »Population has been taken as located at place of residence, but place of employment and the location of social gathering places may be almost as significant.»

STEWART's (1941) concept of »population potential» deserves attention here. It is interpreted as an indicator of »the quantitative influence of people at a distance»,[2] and it is calculated as

$$_iV = \sum_{j=1}^{m} \frac{1}{d_{ij}} D_j \qquad (i = 1, 2, \ldots\ldots m)$$

where $_iV$ is the total population potential of district i; D_j is the population of district j; and d_{ij} is the distance between district i and district j; m is the total number of districts. This expression is stated to give an approximation, for practical purposes; the theory treats the population distribution as continuous and confined to a surface. In analogy with this concept ISARD and FREUTEL (1954) introduced the concept of »income potential» in a study of the economic interdependence between regions. For the moment we shall only pose the question: can these concepts be usefully applied also in the study of locational relationships within a city?

Multiple regression and covariance analysis was applied by members of the Population Research and Training Center, University of Chicago, and Scripps Foundation, to the study of factors in the growth and suburbanization of 125 principle standard metropolitan areas, in the United States. BOGUE and HARRIS (1954) thoroughly described the regression techniques used and their inherent limitations. They applied the method to the study of four problems of metropolitan growth, between 1940 and 1950, namely the total rate of metropolitan growth, the degree of metropolitan suburbanization, the rate of metropolitan suburbanization and the rate of central city

[1] Ratcliff's index has been rather neglected in the literature of the subject. In a way, it is far superior to the type of index used by Florence and his followers, since it has a neutral base; it is constructed (p. 33) as »the ratio of the standard deviation of appearances per block to the standard deviation that would occur if only chance forces were operative».

[2] Stewart, J. Q. (1950) Potential of population and its relationships to marketing, p. 21 (In: Theory in Marketing, ed. by Cox & Alderson). Reilly's famous »law of retail gravitation» is considered as a special case of the general formula.

growth. Further applications were made by KITAGAWA and BOGUE (1955) and CUZZORT (1955), in studies of the suburbanization of different industries between 1940 and 1950. Since these studies had to use areal units as large as the central cities and the »rings» of S. M. A.'s, the results obtained, as such, are perhaps less significant in the present context but they appear to be so provocative as to justify an application of the same basic method to the present study.

HÄGERSTRAND (1953) studied the diffusion of various types of innovation over certain regions in South Sweden. Although he did not study phenomena directly relevant to the present investigation, his study deserves attention here, because he *referred* his data to completely neutral areal units consisting of a net of equilateral rectangles, and *not* to any administrative units. These units, five by five kilometers, formed part of the new Swedish land-use map to the scale of 1 : 10 000. The same procedure was used by GODLUND (1954) and both authors gave convincing reasons for the use of this particular reference system (HÄGERSTRAND, 1953, pp. 27—29; GODLUND, 1954, pp. 102—108; and HÄGERSTRAND, 1955, pp. 233—255).

THE PRESENT INVESTIGATION

As was indicated previously, retail establishments and certain other types of service establishments, to be specified further on, will constitute the objects of the present investigation. I shall attempt to indicate here how data pertaining to the spatial distribution of such establishments, in Stockholm, could be *integrated* with results obtained from the investigations of intersectoral flows. If such an integration, on a grander scale, were to be successful, it would mean, in a way, that the framework used to analyse and describe the intersectoral flows could be widened so as to account also for the spatial arrangement of activities within the community studied. On a different level of aspiration, the present attempts may perhaps give a modest contribution to the theory of retail site selection.

The area investigated and the reference system used

The first step was to devise *areal units* such that data, pertaining to the spatial arrangement of establishments, would be amenable to quantitative analysis and description. The new Swedish land-use map has been used as a basis. It is made up of small maps, each of which covers an area, five by five kilometers, to the scale of 1 : 10 000, as was mentioned above. Clearly, such areal units would be too large to be of much use in the analysis of spatial distributions within a city; each unit would be very heterogeneous and might thus conceal interesting locational characteristics. On the other hand, these areal units might be divided into smaller areas and by carrying the division sufficiently far, we should obtain perfectly homogeneous areas, but such areas would not enable us to study the concomitant variation of two or more variables. In the present investigation I chose to divide each unit of the land-use map into 400 small squares, each 250 by 250 metres. It

was expected that this choice of basic unit would give a reasonably detailed picture of the spatial arrangements.

It should be clear to the reader, however, that between the two extremes, very large and »too» heterogeneous areas on the one side and very small and »too» homogeneous areas on the other, our choice of basic unit was to some extent an arbitrary one. If the problem had been to study the spatial distributions of one or two phenomena, the size of the basic unit could have been pretty well adapted to fit the frequency of occurrence of the phenomena concerned[1]. But since the problem here was to study a large number of spatial distributions, the choice could not be a clear-cut one. Apart from the two extremes mentioned above, the only constraint on the choice was really that the unit of the land-use map should be a multiple of the units chosen, to make it easier to link this investigation to others.

The fact that we are here dealing with *modifiable units* will have statistical consequences, too. Any covariations found between the variables studied will be *relative* to the areal units chosen for the present work. They have no absolute validity. Here I can only point out the existence of this problem. At the stage of estimating the covariations, further on, I shall illustrate its consequences.

Thus, we shall here consider the Stockholm area through a net of squares, each 250 by 250 metres. This reference system is related to Greenwich and to the equator via the Swedish land-use map[2]. To our knowledge, it is completely independent of the topography of the Stockholm area, of the direction and extension of streets, of the shapes of blocks, etc. This I consider to be a great merit of the system[3].

As has been indicated, the present investigation is confined to the densely populated central districts of Stockholm. When, in the future, the study is extended to cover the remaining areas, where the resident population as well as the working population are more dispersed, one possibility would be to use larger areas as units, perhaps of the size of one sq. kilometer.

The area investigated here has been delimited by means of two criteria, namely the size of the resident population, per square, and the size of the working population per square. The following conditions have been imposed: a) each square should have a resident population of no less than 500 people *or* a working population of no less than 500 people; b) the sum of the two should be no less than a thousand people[4].

To obtain a *contiguous* area, eight squares were included although they did not

[1] Cf. Godlund, S., (1954) Busstrafikens framväxt och funktion i de urbana influensfälten, pp. 104—108 (The growth and function of bus services within the urban fields of influence).

[2] Within this system, the following values of the coordinates cover the Stockholm area completely: X: 1 590—1 670; Y: 6 520—6 620. Here, the X-coordinates give the positions measured (in km) from Greenwich (West-East) and the Y-coordinates the positions measured (in km) from the equator (South—North).

[3] It might be thought that many American cities, with their simple, often right-angled ground plans, would provide a readily available play-ground for research along these lines. However, whereas the net of squares referred to above is distributed over the Stockholm area in a random fashion, the existing »net of blocks» in an American city very likely affects the spatial arrangement of activities and thus gives rise to systematic errors. In fact, this is indicated by Rannells. See: Rannells, J., (1956) The core of the city, p. 106.

[4] This procedure implies that the same person can be counted twice, namely if he both dwells and works within a particular square.

fulfil the requirements stipulated. The procedure used in estimating the size of the resident population and the size of the working population, per square, is indicated in Appendix 3.

Chart 6.1. indicates the area thus delimited. The area comprises altogether 210 squares. For each of these, two figures are shown in the diagram; the upper figure in each square shows the size of the resident population of the square at the end of 1950; the lower figure shows the size of the working population of the square in 1951. Certain categories of the working population could not be referred to individual squares, however, and data regarding them had to be omitted. In particular, this applies to people who »move while they work», for instance, taxi-drivers, tram and omnibus operators, and to people who shift their place of work quite often, such as builders and similar categories of operatives.

About 70 percent of the working population of Stockholm had their work-place within the area investigated. The corresponding figure for the resident population was 40 percent. On the other hand, the area investigated covered less than one percent of the total land area of Stockholm.

To sum up, data pertaining to the spatial distribution of the resident population and the working population, within the densely populated central districts of Stockholm, have been referred here to a net of small squares. This reference system gives, in a way, a neutral spatial basis to the present investigation, and in the following pages I propose to indicate that the use of such a reference system will enable us to *quantify* data pertaining to the spatial distributions, which in turn makes it easier for us to handle more complex relationships. Furthermore, it appears that *comparative studies* will be facilitated through the use of such reference systems; without comparative studies in this field, we shall never be able to rise above the case-study level, that is to say, the study of particular cities with all their individual characteristics.

Some theorizing on retail site selection

Assume now that data on the size of the resident population and the working population were available, per square, for the Stockholm area as a whole. A fruitful approach to the present problem would then seem to be to investigate *whether we could develop some concept analogous to Stewart's population potential and Isard's income potential.* First of all it seems that, in an *intracity* study of the present type, Stewart's and Isard's device of taking the places of residence of the population as the points of orientation, is not quite sufficient. In a city, and particularly in a metropolitan area, people are also oriented towards many other places, perhaps above all to their places of work. To take a concrete example, in analysing the composition of the customers of a downtown store we may expect to find that many of the customers have their work-places quite near by. Indeed, a plausible hypothesis seems to be

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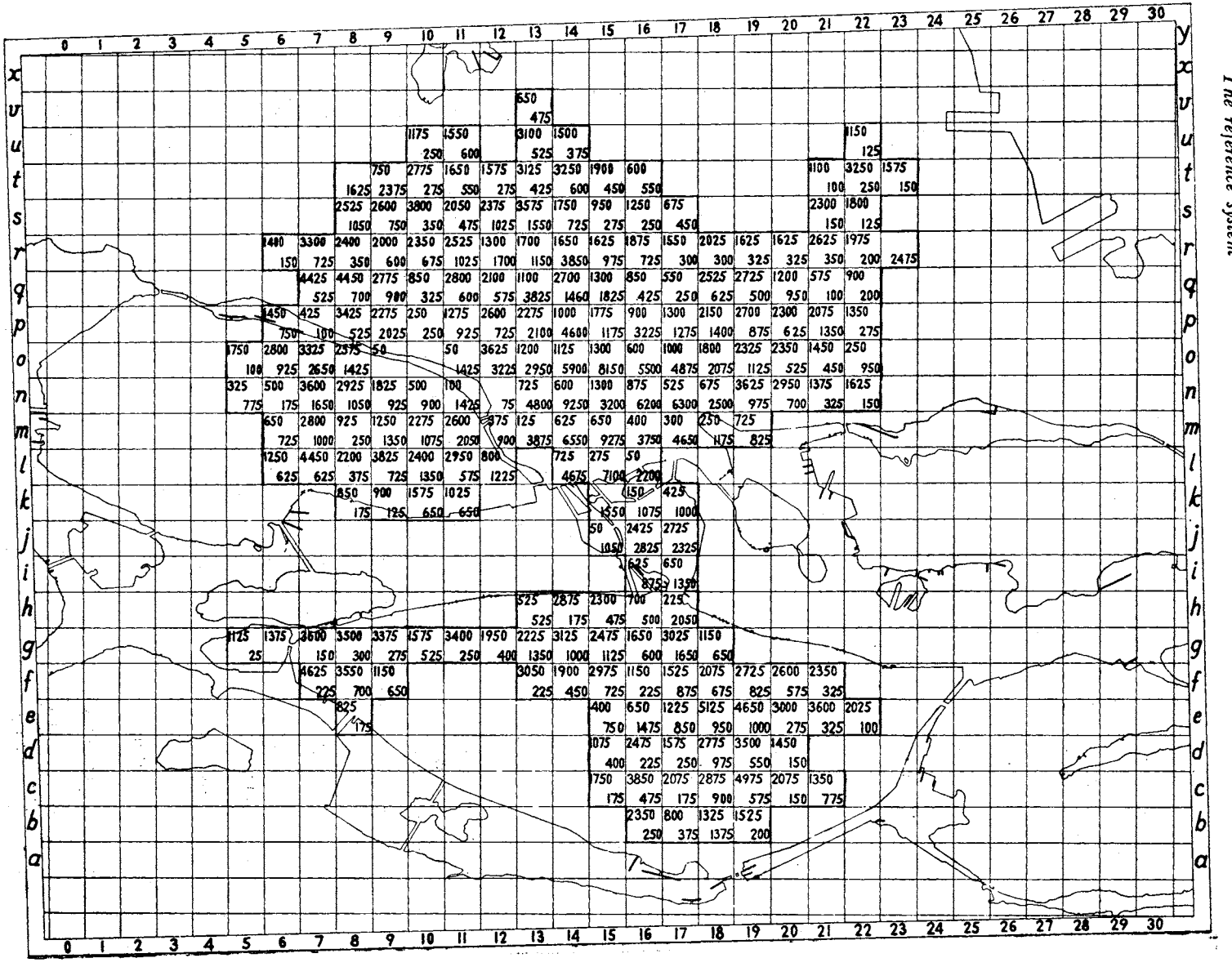
Chart 6.1. *The size of the resident population and the working population per square within the densely populated central districts of Stockholm 1950/51.*


0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
x u t s r q p o n m l k j i h g f e d c b a

that many service establishments in the downtown area cater almost exclusively for people who work near by. A statement that 2 000 people dwell within a radius of, say, two miles from a luncheon restaurant downtown may be of no relevance whatsoever to the restaurant. Their »influence at a distance» on the sales of the restaurant may very well be nil.

This discussion suggests that we should here consider two types of points of orientation, namely places of residence and places of work. That is to say, in measuring »the influence of people at a distance», in Stewart's terms, we should account for the distances from places of work, as well as for the distances from places of residence. However, in any such attempt one soon runs into rather intricate problems of assigning weights to work-places and to places of residence. To begin with, we shall therefore follow Stewart's and Isard's procedure of taking the places of residence as the only points of orientation.

From the Intersectoral Flow Datum Table we can get data on the total disposable income of the resident population of the Stockholm area. With sufficient knowledge regarding the variations in the disposable income *per capita* in different parts of the Stockholm area, we could estimate the *disposable income per square* from the data on the distribution of the resident population over squares.[1] A more simplified procedure would be to assume that the average income per capita was the same all over the Stockholm area.

The idea is then that the income of people in any particular square will have a potential influence on all other squares within the Stockholm area. In analogy with Isard's and Freutel's terminology, we can define the potential of income produced by any square j on another square i as

$$_iV_j = \frac{G_{ij}Y_j}{d_{ij}} \qquad (i = 1,2, \ldots m)$$

where G_{ij} is a constant; Y_j is the income of people resident in square j; d_{ij} is the distance between square i and square j; and m is the total number of squares. For simplicity, we may measure the distances between squares from central points within the squares. Isard and Freutel conceive of the constant G »as a factor for converting actual distance into effective economic distance».[2]

To avoid duplications, it seems suitable to define the expressions $\frac{G_{ij}}{d_{ij}}$, $(i, j = 1,2, \ldots m)$, in such a way that their sum equals unity. To illustrate the possible effects of these distance factors or factors of transfer costs, we may consider two extreme cases. First, take the case where $\frac{G_{ij}}{d_{ij}} = 1$ for $i = j$; and $\frac{G_{ij}}{d_{ij}} = 0$ for $i \neq j$. It means that the distance factors tend to reduce the income effects so sharply that in estimating the income potentials produced by all squares on a given square,

[1] Such income data are in fact available, but they are drawn from a sample. To make the estimation errors negligible, we should have to combine the basic areal units into much larger squares. That work has not been carried out.

[2] Isard, W., and Freutel, G., (1954) Regional and national product projections and their interrelations, p. 436 (In: Long-range economic projection, Studies in Income and Wealth, vol. 16).

we need only consider its own income. Second, take the case where $\frac{G_{ij}}{d_{ij}} = \frac{1}{m}$. As before, *m* denotes the total number of squares. In this case there would be no barriers whatsoever to movement within the Stockholm area; transfer costs would be zero. The effect would be to make the Stockholm area completely homogeneous, from the point of view of income potential; every square would have the same income potential.

We now proceed by relating the concept of income potential more closely to the particular phenomena under discussion here, namely the spatial distribution of retail establishments and similar activities. From the Intersectoral Flow Datum Table we can see, for instance, that about four percent of the total disposable income in Stockholm in 1950 was spent on services provided by Retail Trade with Food Products (sector no. 8). Similarly, we can see that about 1.5 percent of the income was spent on services provided by Laundries, Barber and Beauty Shops (sector no. 57), and so on for all the different service sectors. Through the conditional forecasts we can get corresponding percentage figures for the future. By applying these figures to the income potentials (which would also be derivable from the conditional forecasts) *we may estimate the future demand for the services concerned as related to all the individual squares.*

Taking these future demands per square as estimates of the possible future receipts of the sectors concerned, we could then estimate the distribution over squares of the establishments and personnel of the sectors. However, it is evident that the procedure outlined here has been built on several simplifying assumptions, which may not be quite realistic.

First, there is the assumption that the average propensity to consume the services in question is the same in each square. This assumption is due to the lack of data. When more data become available on the variations in consumption patterns between income groups, social groups, etc., a more realistic assumption can easily be made.

Second, there is the assumption that the places of residence constitute the only points of orientation as a basis for computing the income potentials. As indicated before, we ought to account, also, for the places of work. To do that means that we shall have to solve the problem of dividing the income into one fraction related to place of work and another fraction related to place of residence. To solve that problem, we are led to ask for very detailed data regarding the ways in which people dispose of their income. Such data would make it easier to assign weights to the two types of points of orientation. For instance, we should probably assign a heavy weight to places of work for the item »meals out» and correspondingly a low weight to places of residence. For »food store services» the weights would be assigned in the opposite way.

Third, there is the assumption that the receipts obtainable per square are the only factor influencing the spatial distribution of the establishments. This may lead to untenable results. Within some squares the competition for land would probably lead to such high rents, on the average, that some establishments would be dissuaded from locating there. To account for this complicating factor we are led

to include rent as an »explaining» variable which would be working in the opposite direction (with a minus sign). There is one snag in this, however, namely that the level of rents, measured per front foot for instance, might be rather strongly correlated with the variable discussed first, the amount of receipts obtainable per square. That relationship would have to be analysed.

In reporting here, I shall not carry this discussion any further. To sum up, a model has been suggested which might help to comprehend the spatial arrangement of retail establishments and similar activities within an urban area. Tentatively, variations in the number of establishments (and in the size of their personnel) per square would be related to 1/ variations in the estimated receipts obtainable per square and 2/ variations in the average level of rents per square, to see whether these two variables could serve as explaining variables. As a suggestion, rents would be measured per front foot. The receipts obtainable per square would be derived from data regarding a) the distribution of the resident population over squares; b) the distribution of the working population over squares; c) the relative distribution of the average disposable income *per capita*, also over squares; d) total disposable income of the resident population, as derived from the Intersectoral Flow Datum Table; e) average propensities to consume different goods and services, also derived from the basic table, and, where available, supplemented by data on relative variations in such propensities over squares; f) the relative importance of places of work and places of residence as points of orientation, with regard to the purchasing habits for different goods and services; and, last but not least, g) the distance factors.

Applying a simple model

It has not been possible here to assess all the magnitudes discussed above. In the following exploratory attempts we shall therefore have to use a model which is simpler than that outlined, in the sense that it accounts for fewer variables explicitly. The model will have the following general form:

$$X_0 = a + bX_1 + cX_2 + z$$

where X_0 is the number of establishments per square; X_1 is the size of the resident population per square; X_2 is the size of the working population per square; a, b, c are constants and z is a residual, which stands for the effect of all other factors not explicitly accounted for.

By means of regression techniques we shall set out to analyse to what extent variations in the number of establishments over squares can be related to — or »explained» in terms of — variations over squares in the size of the resident population and the working population.

With reference to the previous discussion, it implies that places of residence as well as places of work will be accounted for but only to the extent that they exert influence on the square where they are located.[1]

[1] Incidentally, this means that we shall apply one of the two extreme cases discussed previously, with regard to the effect of the distance factors.

Considering the very simple assumptions underlying the model to be used here, we cannot expect to comprehend fully the spatial arrangements concerned. Nevertheless, the model appears to be quite helpful as a kind of organizing principle — to organize, that is, a great mass of seemingly chaotic data pertaining to the spatial distributions of phenomena.

On the basis of previous research it has been hypothesized that the coefficients *b* and *c* in the model will be positive and will differ significantly from zero, for data pertaining to a specified set of service trades. Likewise, it has been hypothesized that the coefficient *c* will be positive and will differ significantly from zero for data pertaining to another set of specified trades. Although the present investigation has not been confined to retail trade proper, it has appeared appropriate to refer to the two groups of establishments as »the convenience-goods type of establishment» and »the specialty-goods type of establishment», respectively.

With regard to the potential usefulness of the results for city planning purposes, the specification has been carried quite far. The first-mentioned hypothesis has been tested for 23 branches, classified in accordance with the 1951 Census of Production, Distribution and Services (CPDS); the latter hypothesis has been tested for 19 branches, which except for two trades (namely doctors and dentists) have also been classified in accordance with the CPDS.

The criterion of »least squares» has been applied to estimate the coefficients *a*, *b* and *c*.[1] The computational work was greatly facilitated by the use of Dwyer's square root method (DWYER, 1945). The fact that the equations had identical coefficients on the one side, was also taken advantage of, and this led to a further simplification and standardization of the work (DWYER, 1951, pp. 130—134). Seven decimal places were carried in the computations.

The results are presented in *Tables 6.1. and 6.2.* Out of the 42 kinds (branches) of establishments investigated, those 20 which seemed to be of greatest general interest, have been selected for presentation in this particular report. The branches are arranged in order of the number of their establishments (within the area investigated).

The branches are specified in *the first column;* figures in brackets refer to the code of classification used in the CPDS. *The next three columns* indicate the values estimated for the coefficients *a*, *b* and *c* in the model applied. *The fifth and sixth columns* give confidence intervals at the 95 percent level for the coefficients *b* and *c*. An *asterisk* denotes that the coefficient concerned does not differ significantly from zero. *The seventh column* indicates the standard error of estimate of X_0 from X_1 and X_2. It measures the average discrepancy between the observed values and the fitted line; thus, it indicates the »goodness of fit». *The eighth column* shows the total number of establishments per branch located within the area investigated. It is juxtaposed to the column of standard errors, in order to facilitate comparisons between the different standard errors of estimate. *The ninth column,* finally, gives a traditional measure, namely the coefficient of multiple correlation.

[1] For a good exposition of the terms and methods ordinarily used in regression analysis, see: Bogue, D. J., and Harris, D. L., (1954) Comparative population and urban research via multiple regression and covariance analysis.

Table 6.1. *Relationships found per square between number of establishments of the »convenience-goods type» on the one hand, and the size of the resident population and the working population on the other. The results pertain to the densely populated central districts of Stockholm in 1950/51.*

Branch (figures in brackets denote CPDS nos.) (1)	Coefficients a (2)	b (3)	c (4)	Confidence interval for b (5)	c (6)	$s_{0.12}$ (7)	Number of establishments (8)	$R_{0(12)}$ (9)
I. Dairy products stores, grocery stores and other stores selling milk (298/299, 308—310)	— 0,02	2,43	0,06	2,21—2,66	*	1,82	924	0,84
II. Hairdressing (460)	— 0,61	1,88	1,20	1,53—2,21	0,96—1,44	2,83	886	0,67
III. Cafés, drinking and eating places (444)	— 0,48	1,17	1,55	0,87—1,47	1,34—1,76	2,47	740	0,72
IV. Tobacconists (340)	— 0,43	1,40	0,72	1,22—1,58	0,60—0,85	1,48	621	0,77
V. Dairy products stores (298/299)	— 0,18	1,44	0,14	1,24—1,64	0—0,28	1,62	541	0,71
VI. Fruit stores, confectionery stores and florists (304—306)	— 0,20	1,03	0,68	0,80—1,26	0,52—0,85	1,92	522	0,60
VII. Bakeries (108)	— 0,22	0,90	0,23	0,73—1,06	0,11—0,34	1,33	349	0,60
VIII. Repair of footwear (184)	— 0,33	1,75	0,13	1,62—1,88	0,04—0,22	1,07	326	0,72
IX. Hardware stores, sporting goods stores and bicycle stores (337/338)	— 0,22	0,40	0,51	0,25—0,55	0,41—0,62	1,21	236	0,58
X. Dry cleaning (162)	— 0,07	0,38	0,11	0,27—0,48	0,04—0,19	0,87	156	0,44

All the figures in Tables 6.1. and 6.2. are decoded so that they can be interpreted directly. To see how the regression equations work, let us write down the equation for »tobacconists» by means of the data in Table 6.1. It will appear as follows:

$$X_0 = -0{,}43 + 1{,}40\,X_1 + 0{,}72\,X_2$$

For all the equations, population figures are in thousands of persons. Thus to estimate the number of tobacconists' stores in a square with, let us say, one thousand people dwelling there and three thousand people working there, we substitute *1* for X_1 and *3* for X_2 to get: $X_0 = -0{,}43 + 1{,}40 + 2{,}16 = 3{,}13$. That is to say, on the average we should expect to find 3,13 tobacconists' stores in a square with the population characteristics mentioned.

Although no rigorous tests have been carried out so far, the theoretical assumptions underlying the estimates of confidence intervals and the standard errors of estimate are judged to have been approximately fulfilled. However, the possibilities of *comparing* the different coefficients with each other and of comparing the standard errors of estimate must be further explored. That this problem is a serious one is indicated by the fact that the two independent variables are not normally distributed; the skewness is particularly strong for the distribution of the working population, as is indicated by *Table 6.3.*

Table 6.2. *Relationships found per square between number of establishments of the »specialty-goods type» on the one hand, and the size of the resident population and the working population on the other. The results pertain to the densely populated central districts of Stockholm in 1950/51.*

Branch (figures in brackets denote CPDS nos.)	Coefficients			Confidence interval for		$s_{0.12}$	Number of establishments	$R_{0(12)}$
	a	b	c	b	c			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
I. Dentists	0,03	0,22	1,74	*	1,40—2,09	4,06	538	0,57
II. Doctors (excluding hospitals)	1,34	0,12	0,50	*	0,22—0,77	3,21	453	0,24
III. Perfumery stores, etc. (345/346)	— 0,08	0,38	0,50	0,23—0,54	0,39—0,60	1,28	254	0,55
IV. Lawyers' offices (429)	— 0,57	— 0,21	1,72	*	1,47—1,96	2,87	242	0,71
V. Radio stores, electrical appliances, etc. (335/336)	— 0,35	0,38	0,42	0,25—0,51	0,33—0,51	1,05	178	0,57
VI. Jewelry stores (349)	— 0,27	0,19	0,47	0,07—0,31	0,39—0,56	1,02	137	0,60
VII. Book stores and stationery stores (341/342)	— 0,12	0,17	0,35	0,06—0,28	0,27—0,42	0,90	130	0,53
VIII. Commercial banks and savings banks (excluding the Post Office savings banks) (405/406)	— 0,07	0,00	0,41	*	0,32—0,50	1,21	121	0,52
IX. Men's wear stores (320)	0,23	0,17	0,34	0,04—0,30	0,25—0,42	1,05	103	0,46
X. Motor vehicle dealers (339)	0,18	0,06	0,07	*	*	0,71	80	0,17

The problem of intercorrelation between the two explaining variables appears to be of little relevance in this particular context.[1] One might expect to find a relatively strong negative correlation between the spatial distributions of places of work and places of residence; squares with a big working population might be expected to have a small resident population, and vice versa. However, the correlation between the two variables is found to be very low ($r^2_{12} = 0{,}06$).

As can be seen from Table 6.2., the hypothesis formulated for establishments of the specialty-goods type is rejected for one of the branches, namely for »motor vehicle dealers». Thus, it has not been established that the locations of such establishments are significantly related to the spatial distribution of work-places. For the other nine branches the hypothesis has not been rejected. Five of the branches here presented, namely »perfumery stores», »radio stores», »jewelry stores», »book and stationery stores» and »men's wear stores», appear to be slightly related to places of residence, *as well*, in their site selection. However, that relationship was not hypothesized. Therefore, no significance can be attributed to it here.

The hypothesis formulated for establishments of the convenience-goods type should be modified for one of the branches, namely for »dairy products stores, grocery stores and other stores selling milk». As can be seen from Table 6.1., no significant relationship is established between the spatial arrangement of such stores

[1] Cf., Wold, H., (1952) Demand analysis, pp. 46—48.

Table 6.3. *The distribution of the population over the 250-metre-squares.*

Size of population per square (number of persons)	Number of squares with the indicated size of population	
	A. Resident population	B. Working population
0— 500	26	75
501—1 000	35	66
1 001—1 500	33	28
1 501—2 000	30	7
2 001—2 500	28	9
2 501—3 000	27	4
3 001—3 500	14	3
3 501—4 000	10	4
4 001—4 500	3	—
4 501—5 000	3	5
5 001—5 500	1	—
5 501—6 000	—	2
6 001—6 500	—	2
6 501—7 000	—	1
7 001—7 500	—	1
7 501—8 000	—	—
8 001—8 500	—	—
8 501—9 000	—	—
9 001—9 500	—	3
	210	210

Note. Class intervals of half the size above have been used in the computations.

and the spatial arrangement of work-places. But, apparently, the milk distributors are strongly related to places of residence in their site selection, as was hypothesized. From a comparison with the data referring to the much more narrowly defined branch of »dairy products stores», it appears that the goodness of fit would be relatively more pronounced for the more inclusive branch, which has been defined so as to include all types of stores distributing milk (even grocery stores, etc.). Although, for the present, such comparisons must be marked as having somewhat uncertain meaning, it should be mentioned that the same tendency has been found also for other branches not presented here.

A related problem, that of the modifiable areal units used in the analysis, has been touched on previously. If, instead of using the 210 small squares as the reference system, we had chosen somewhat *larger* areas as basic units, we should in fact have expected to find *stronger* relationships between the variables investigated, that is to say, relatively lower standard errors of estimate and relatively higher coefficients of multiple correlation; intuitively, this can be realized by considering that sharp deviations from the estimated spatial patterns would to some extent be concealed and levelled when referred to larger areal units. This circumstance, among other things, is borne out by *Tables 6.4. and 6.5.*, which give results similar to those presented in Tables 6.1. and 6.2., with the important exception that they refer to *larger*

Table 6.4. *Relationships found per 500-metre-square between number of establishments of the »convenience-goods type» on the one hand, and the size of the resident population and the working population on the other. The results pertain to the densely populated central districts of Stockholm in 1950/51.*

Branch (figures in brackets denote CPDS nos.)	Coefficients			Confidence interval for		$s_{0.12}$	Number of establishments	$R_{0(12)}$
	a	b	c	b	c			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
I. Dairy products stores, grocery stores and other stores selling milk (298/299, 308—310)	— 0,48	2,48	0,12	1,99—2,97	*	3,41	950	0,93
II. Hairdressing (460)	— 4,65	2,16	1,40	1,42—2,90	0,90—1,90	5,16	887	0,88
III. Cafés, drinking and eating places (444)	— 2,54	1,28	1,58	0,56—1,99	1,10—2,07	5,02	740	0,87
IV. Tobacconists (340)	— 0,80	1,28	0,71	0,88—1,69	0,43—0,98	2,89	625	0,88
V. Dairy products stores (298/299)	— 0,16	1,41	0,14	0,95—1,87	*	3,24	568	0,83
VI. Fruit stores, confectionery stores and florists (304—306)	— 2,49	1,24	0,81	0,73—1,75	0,47—1,15	3,55	523	0,84
VII. Bakeries (108)	— 2,12	1,08	0,30	0,71—1,44	0,05—0,54	2,56	350	0,83
VIII. Repair of footwear (184)	— 1,21	0,95	0,15	0,67—1,24	*	1,98	325	0,86
IX. Hardware stores, sporting goods stores and bicycle stores (337/338)	— 1,56	0,51	0,53	0,25—0,77	0,35—0,71	1,83	231	0,86
X. Dry cleaning (162)	— 1,05	0,49	0,16	0,24—0,74	*	1,76	159	0,71

areas. The original squares, 250 by 250 metres, have been systematically combined, four and four, to produce a new net of squares, 500 by 500 metres each. The total area of such squares has been delimited by a procedure similar to that used to delimit the total area of the 250-metre-squares. In this way, an area comprising 67 squares, 500 by 500 metres each, has been delimited. By relating the distribution of the work-places, the places of residence and all the different types of establishment to such squares, it has been possible to estimate quantitative relationships of the kind illustrated in Tables 6.4. and 6.5.

In comparing the figures of Tables 6.4. and 6.5. with those previously obtained, it is found that the total numbers of establishments per branch (column no. 8) differ slightly. For instance, the total number of bakery establishments in the area investigated was 349 according to Table 6.1. and 350 according to Table 6.4. Such discrepancies are due to the fact that the total area of 250-metre-squares is not exactly identical to the total area of 500-metre-squares.

It can be seen from comparisons between the different tables that for all the 20 branches the coefficients of multiple correlation are considerably higher when computed from data referring to the 500-metre-squares. Similarly, the standard errors of estimate are in all cases lower, relatively speaking. That is to say, accounting for the differences in the average number of establishments per square, the discrepancy between the estimated number of establishments in any square and the

Table 6.5. *Relationships found per 500-metre-square between number of establishments of the »specialty-goods type» on the one hand, and the size of the resident population and the working population on the other. The results pertain to the densely populated central districts of Stockholm in 1950/51.*

Branch (figures in brackets denote CPDS nos.)	Coefficients			Confidence interval for		$s_{0.12}$	Number of establishments	$R_{0(12)}$
	a	b	c	b	c			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
I. Dentists	— 2,55	0,56	1,85	*	0,90—2,80	9,82	536	0,70
II. Doctors (excluding hospitals)	— 0,77	0,77	0 80	*	0,01—1,59	8,11	458	0,50
III. Perfumery stores, etc. (345/346)	— 1,75	0,55	0,60	0,20—0,90	0,36—0,83	2,44	252	0,81
IV. Lawyers' offices (429)	— 1,37	— 0,28	1,66	*	1,10—2,22	5,72	243	0,84
V. Radio stores, electrical appliances, etc. (335/336)	— 1,78	0,44	0,48	0,16—0,73	0,28—0,67	2,02	177	0,80
VI. Jewelry stores (349)	— 1,08	0,18	0,52	*	0,37—0,68	1,59	136	0,86
VII. Book stores and stationery stores (341/342)	— 0,76	0,22	0,37	*	0,21—0,53	1,65	130	0,77
VIII. Commercial banks and savings banks (excluding the Post Office savings banks) (405/406)	0,09	0,06	0,36	*	0,14—0,58	2,24	124	0,64
IX. Men's wear stores (320)	— 1,04	0,20	0,36	*	0,18—0,54	1,89	103	0,71
X. Motor vehicle dealers (339)	— 0,06	0,15	0,12	*	*	1,73	84	0,39

observed number of establishments, in the square, is relatively smaller, on the average, for the 500-metre-squares. This fact may be of importance in any attempts to integrate the findings of this kind with those generated from the intersectoral flow analyses.

What we have done so far has been to investigate the relationships between the spatial arrangement of service establishments, on the one hand, and on the other the spatial arrangement of places of residence and places of work. In so doing we have weighted, as it were, the places of residence and the work-places by the *number* of people. Should we not do the same thing with the service establishments? Instead of using the number of establishments as the dependent variable, should we not use the size of their *personnel*? An answer to that might be that *a priori* the number of persons per establishment of each particular type is not likely to vary much within the relatively small area here investigated, considering that, on the whole, establishments of the types concerned are small. However, some exploratory work in that direction has been carried out. About ten branches of establishments of the convenience-goods type have been analysed so far, and the results appear to agree fairly well with the *a priori* assumption made above, although the relationships involved seem to be somewhat weaker; further, the personnel data seem to be more correlated with work-places than was the case for the number of establishments, and correspondingly less correlated with places of residence. These findings are very preliminary, however.

A possible objection to the general procedure used here may be that it is not quite free from double-counting; if a person's work-place and place of residence are both located within the same square, he will be counted twice. I am quite willing to hazard the statement, however, that the number of such persons can safely be neglected, when the net of 250-metre-squares is used. But clearly they will increase in number, the larger the areal units become. I can do no more here than to refer to my previous discussion, where an alternative procedure was suggested, which would cope with this problem, and where, furthermore, it was emphasized that, due to the lack of data and time, the present investigation could not claim to be more than an exploratory attempt.

A measure for describing the spatial relations between establishments

In a previous section, we conceived of an extreme situation, where distance and other barriers to movement would be entirely negligible within the area investigated. From the point of view of the site selection of service establishments, such an area would be completely homogeneous, as was shown.

I shall now use this conception, not in order to »explain» spatial arrangements, but in order to get a descriptive measure, that is to say, a kind of yardstick from which deviations can be measured.

One way of finding such a measure would be to build upon the traditional idea of the »economic man», the reasoning being couched in the following well known terms. Given a homogeneous area of fixed size, the individual establishment would select a site in such a way as to achieve the highest possible profits. New competitors would be attracted into the market until a state of equilibrium of all locations had been achieved. The number of establishments within the area would then have reached its maximum; any further influx of establishments would make all establishments unprofitable. In this state of equilibrium, all the establishments would be located at equal distances from each other. Each establishment would have a small market area shaped like a hexagon, and altogether the homogeneous area would consist of a system of hexagons of equal size, with an establishment at the central point of each hexagon. Also, if we viewed the area through a net of squares, as here, we should find one establishment within each square.

However, all this would mean that we should supplement the conception of the homogeneous area, which for small areas might be quite realistic, by other assumptions which would be utterly unrealistic, such as the assumption that each service establishment possessed perfect information, about the markets, about the actions of competitors, and so on, and the assumption that each establishment adapted itself continuously and instantaneously until the equilibrium had been achieved.

Instead, I have chosen here to conceive of the sites as being selected purely at random. That is to say, I have asked questions of the following type: How would the furniture stores in Stockholm have been located, if they had all been completely

independent of each other in their choice of location, each establishment being located in a random fashion?

We next proceed to find this random arrangement of establishments. Although the final outcome is probably highly familiar to the reader, I shall proceed step by step.

1. A given area is conceived of through a net of squares. There are R squares altogether, and our problem is to locate N stores over this area at random.
2. We let the first store be located and we ask for the probability that it will get a site within a particular square. Since there are R squares altogether, we find that the probability in question is $\frac{1}{R}$. From that we conclude that the probability of its locating somewhere else is $\frac{R-1}{R}$.
3. We now let a second store be located at random. As above, its probability of being located within a particular square is $\frac{1}{R}$.
4. The probability of finding both stores within that particular square is $\frac{1}{R}\cdot\frac{1}{R}$, since they are mutually independent in their choice of site. The probability that only the first store will be located within the particular square and the second store somewhere else, is seen to be $\frac{1}{R}\cdot\frac{R-1}{R}$. Likewise, the probability that only the second store will be located within the particular square and the first somewhere else, is found to be $\frac{R-1}{R}\cdot\frac{1}{R}$.
5. The probability that neither of the two stores will be located within the particular square is $\frac{R-1}{R}\cdot\frac{R-1}{R}$.
6. To sum up, we have found that
$$\Pr(2 \text{ stores}) = \left(\frac{1}{R}\right)^2$$
$$\Pr(1 \text{ store}) = 2\frac{1}{R}\cdot\frac{R-1}{R}$$
$$\Pr(0 \text{ stores}) = \left(\frac{R-1}{R}\right)^2$$
where Pr(2 stores) is the probability that both stores will locate within the particular square, and so on.
7. By letting a third store be located at random over the squares, we find the following possible outcomes:
$$\Pr(3 \text{ stores}) = \left(\frac{1}{R}\right)^3$$
$$\Pr(2 \text{ stores}) = \binom{3}{2}\left(\frac{1}{R}\right)^2\left(\frac{R-1}{R}\right)$$

$$\Pr(1 \text{ store}) = \binom{3}{1}\left(\frac{1}{R}\right)\left(\frac{R-1}{R}\right)^2$$

$$\Pr(0 \text{ stores}) = \left(\frac{R-1}{R}\right)^3$$

8. In general, with N stores located at random the probability of finding x stores in a particular square is $\Pr(x \text{ stores}) = \binom{N}{x}\left(\frac{1}{R}\right)^x\left(\frac{R-1}{R}\right)^{N-x}$

9. For large values of R, we can rewrite this expression as a Poisson distribution

$$\Pr(x \text{ stores}) = \frac{e^{-m} \cdot m^x}{x!},$$

where $m = \frac{1}{R} \cdot N$.

This random distribution can now be applied as a yardstick by means of which we can indicate the degree and direction of spatial association among establishments. In this report, I can only give a few illustrations of its usage.

Chart 6.2. shows the relative associations among the stores of six different branches. Three of the branches are of the shopping-goods type, namely »antique stores», »furniture stores and floor covering stores» and »women's clothing stores». The other three are of the convenience-goods type. The chart records the frequency of occurrence of each particular type of store, over the 250-metre-squares. These frequency distributions are contrasted to those which would have occurred, if the spatial arrangements had been shaped at random.

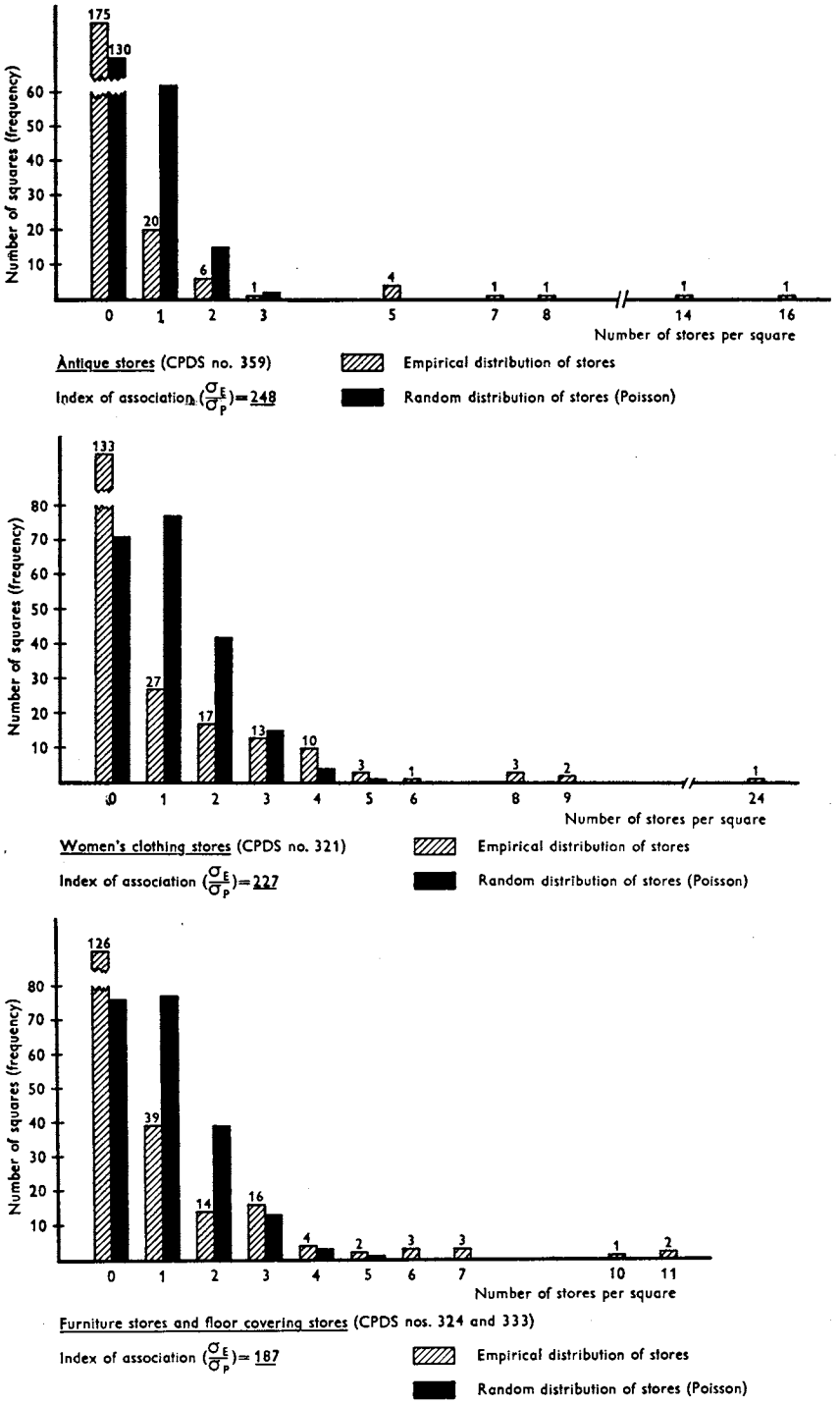
For each branch, an *index of association* is given in the chart, which summarizes the findings. It is constructed as the quotient of the two standard deviations concerned, the standard deviation of the empirical distribution and the standard deviation of the Poisson distribution. If the stores of a particular branch were located completely at random, the index would be *100;* an index *higher* than 100 denotes a tendency toward clustering and a figure lower than 100 denotes a tendency toward mutual repulsion.

As can be seen from the chart, among the six branches here selected the strongest tendency toward clustering is found for »antique stores»; the random distribution tapers off very quickly, but the recorded distribution has a square which contains no less than 16 antique stores. As early as with five stores per square, the random distribution has a frequency which is no more than a fraction of one. Altogether there are 65 antique stores, out of 100, which are on the right side of the point where the random distribution has the higher frequency.

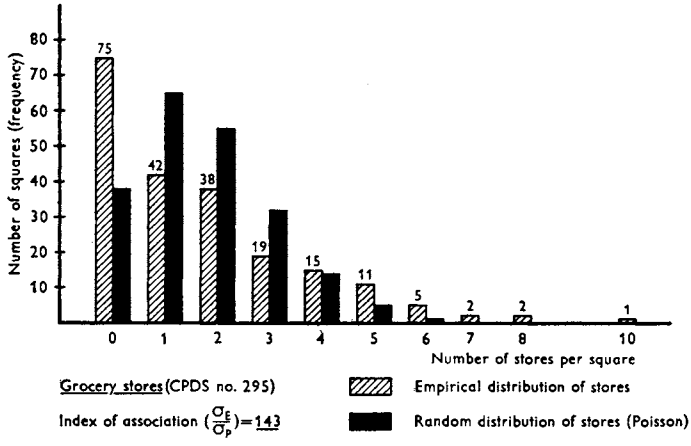
As can be seen further, the other two types of shopping-goods stores are also characterized by a strong tendency toward clustering.

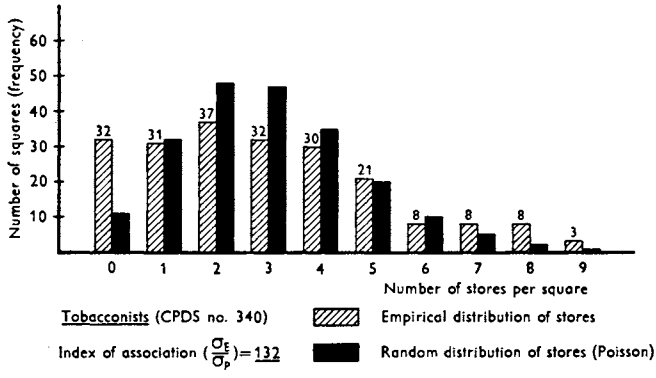
A little contrary to expectations, perhaps, is that the tail of the empirical distribution of »grocery stores», as well as that of »tobacconists», has considerably higher frequencies than the random distribution. This is reflected in the index of association, which for both types shows a tendency toward clustering. However, this finding should be seen in the light of the fact that both these trades are rather strongly

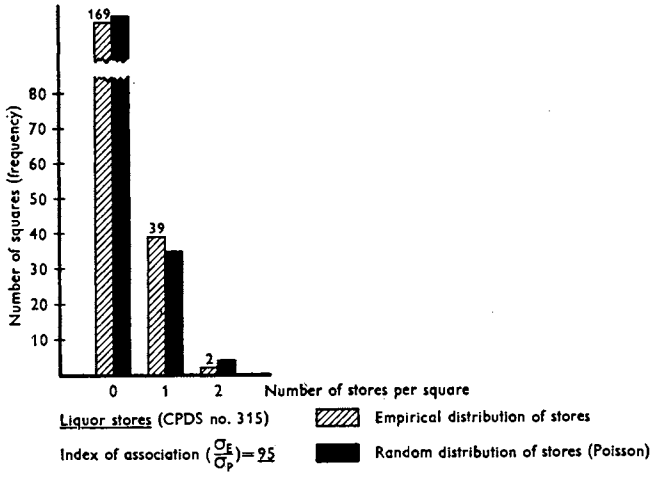
Chart 6.2. *The spatial distributions recorded for six different kinds of establishments*



and compared with the corresponding random distributions.







related to the spatial distribution of the population, which is also characterized by a tendency toward clustering.

As can be seen from the index of association, a tendency toward repulsion is registered for only one among the six types of stores, namely »liquor stores», and as expected the three types of shopping goods stores have by far the highest scores.

A weakness of this index, however, is that its range of variation is affected by the total number of establishments; it would be improved if the *size* of the squares were adapted so that for each particular trade the total number of squares would be equal to the total number of establishments.

The spatial arrangement of retail establishments and related activities has been analysed here with reference to two theoretical situations. One was that there should be no barriers whatsoever to transfer *within* the Stockholm area; in that case, the area would be completely homogeneous from the point of view of retail site selection. On the basis of this conception a descriptive measure of the spatial arrangement of establishments was devised. The other theoretical situation was used to form a simple theoretical model; as was shown this model really implied that there would be no significant trade in the goods and services concerned *between* squares.

This model was used to explore to what extent the spatial arrangement of establishments could be explained in terms of the spatial arrangement of the places of residence and employment, and in spite of the great simplicity of the model it appeared that rather strong linkages could be established. It was, emphasized, however, that the attempts so far were only exploratory; the explaining power of the model could probably be increased by accounting for variations between squares in the level of rent, and, above all, by accounting in a more realistic manner for the distance factors.

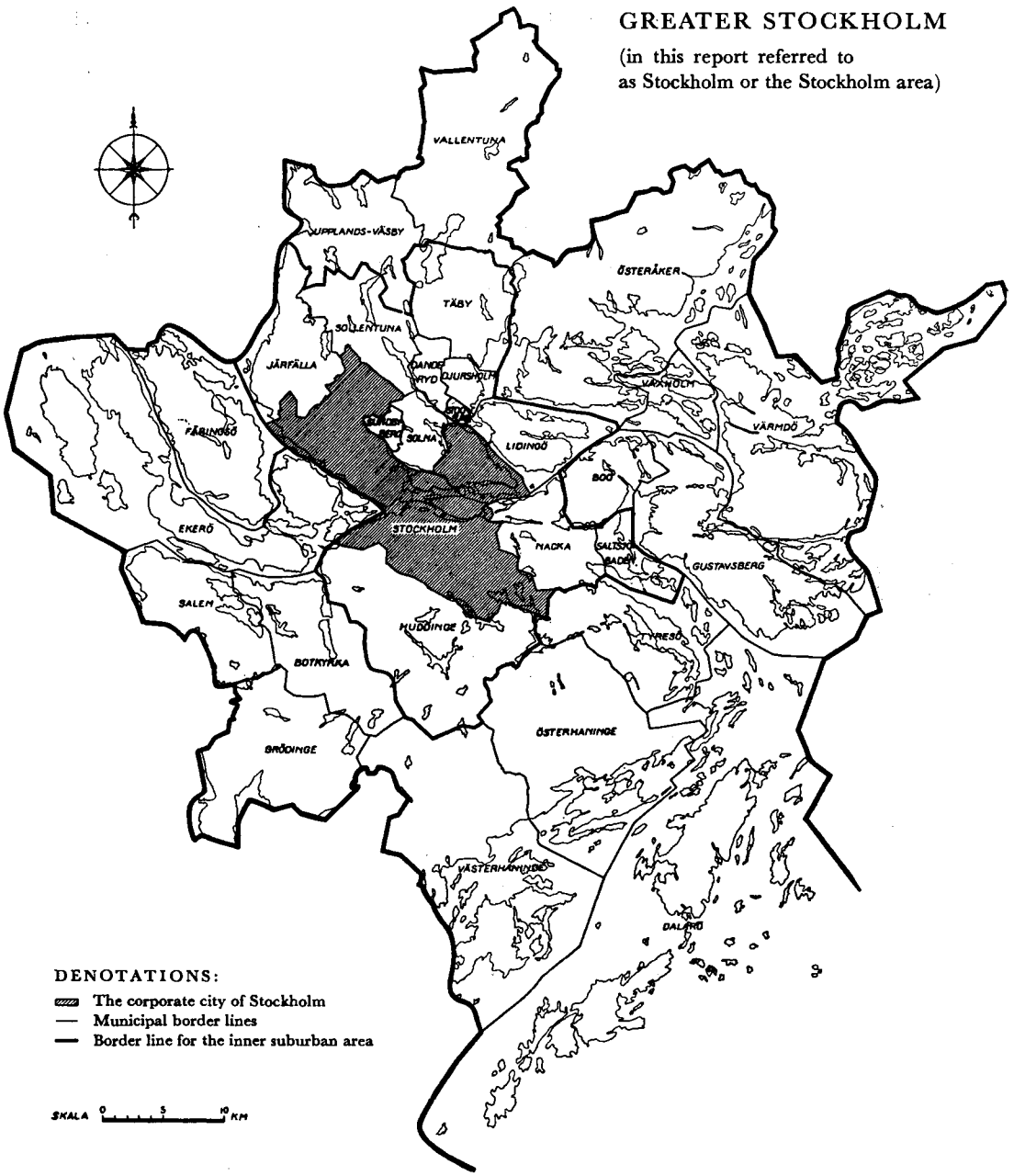
APPENDICES

APPENDIX 1

Definition of the Stockholm area

Stockholm, as defined in this report, includes the following municipalities:

	Number of inhabitants (end of 1956)
The corporate city of Stockholm ..	794 100
Danderyd	9 700
Djursholm	7 700
Huddinge	24 900
Järfälla	13 000
Lidingö	25 300
Nacka	18 900
Saltsjöbaden	5 100
Sollentuna	21 500
Solna	45 300
Stocksund	5 200
Sundbyberg	26 300
Täby	13 800
Subtotal for the inner suburban area: 216 800	
Boo	6 100
Botkyrka	8 600
Dalarö	1 300
Ekerö	3 900
Färingsö	3 000
Grödinge	1 900
Gustavsberg	4 600
Salem	2 300
Tyresö	4 100
Upplands Väsby	7 500
Vallentuna	4 800
Vaxholm	3 700
Värmdö	2 000
Västerhaninge	5 000
Österhaninge	5 600
Österåker	4 700
Subtotal for the outer suburban area: 69 200	
Total number of inhabitants in the Stockholm area	1 080 100


GREATER STOCKHOLM
(in this report referred to
as Stockholm or the Stockholm area)
VALLENTUNA
UPPLANDS-VÄSBY
ÖSTERÅKER
TÄBY
SOLLENTUNA
JÄRFÄLLA
DANDERYD
DJURSHOLM
VÄXHOLM
VÄRMDÖ
FÄRINGSÖ
SOLNA
LIDINGÖ
BOO
EKERÖ
STOCKHOLM
NACKA
GUSTAVSBERG
SALEM
HUDDINGE
BOTKYRKA
TYRESÖ
ÖSTERHANINGE
SÖDERTÄLJE
VÄSTERHANINGE
DALARÖ
DENOTATIONS:
The corporate city of Stockholm
Municipal border lines
Border line for the inner suburban area
SKALA 0 5 10 KM

APPENDIX 2

The intersectoral flow datum table: definitional and computational procedures

The 1951 Census of Production, Distribution and Services was the most important source of the present study in the sense that it yielded a much larger amount of data to be fitted into the basic table, than any other single source of statistics. *In the following description of the definitional and computational procedures used in the construction of the basic table, the 1951 Census will be referred to as the CPDS.*

The CPDS was conducted by the *Kommerskollegium* (Board of Trade) and its final results were set out in a report published in 1955, titled »1951 års företagsräkning». The forms used for the collection of data were reproduced in the report, which also gave a detailed description of the scope of the Census and the methods of collection and analysis.

When the present study was being planned, it became evident that the tabulations of the primary data that were to be made by the Kommerskollegium would be far from adequate for present purposes. Professor Folke Kristensson then negotiated with the Kommerskollegium and thanks to their cooperation it was agreed that the Business Research Institute at the Stockholm School of Economics should get a full and easily accessible material regarding all the establishments, covered by the CPDS, in the Stockholm area. This material has since been arranged in the form of a register with the information punched on punch-cards. The register contains one main card for every establishment in the Stockholm area. A very large number of tabulations, based on this material, have been carried out by the *Stockholms stads statistiska kontor* (the Stockholm office of statistics) for present purposes.

The register was also supplemented by data obtained through special investigations. One provided information about the site of each establishment (street, building, block, district, etc.), about the use to which the premises were put, and, where available, about rent. This work was led by Mr. Helge Edgren at the *Mantalsverk*. Another investigation collected information about establishments not covered by the Census (particularly concerning government administration and related activities). A third investigation covering manufacturing and wholesale firms, provided information about the size of sales to manufacturers, to wholesalers, to retailers and to the general public, and also about the distribution of total sales to the customers in the Stockholm area, the rest of Sweden and abroad. This information was collected through a form which was sent together with the Census forms in September 1951. The questionnaire is reproduced on p. 165, in this appendix.

The different types of supplementary information mentioned above were also punched on the punch-cards.

Most of this work on the register of establishments was organized and led by Mrs. Margareta Härnqvist.

To prevent duplication, the following description is arranged by *columns,* that is to say, the comments refer to the entries in the columns (starting with column no. 1 and ending up with column no. 86—87). For short, the International Standard Industrial Classification is referred to as the »ISIC».

Unless otherwise stated, the salaries and wages estimated for each sector are based upon data reported in the CPDS and augmented to cover, also, the salaries of active proprietors and pensions paid out (or payable). The salaries of active proprietors have been estimated, throughout, at 150 percent of the average wages or salaries of the employees.

Unless otherwise stated, also, it has been assumed here, due to lack of data, that no changes in inventories occurred.

It is not possible in this report to attempt to acquaint the reader with all the many details of computations that were necessary to construct the basic table. A very large number of sources of different types and quality were used, but in this report only the main sources can be specified. (To indicate the round-about ways in which estimates or checks in many instances had to be made, let me just mention that the entry in row no. 1, column no. 4, was checked by means of data on the number of cows in the Stockholm area in relation to the total number of cows in Sweden.)

1. Agriculture and fishing

Branches according to the CPDS: This sector is covered only in part by the CPDS. Supplementary data from the 1950 Census of Population and from the official annual publication »Fiske» (Fishing) have been adhered to.

In 1950/51 the branches covered by the CPDS employed some 40 percent of the total personnel of the sector. They comprised Gardening (Horticulture) and Forestry, that is, *CPDS nos. 1—6.*

Corresponding branches in the ISIC: 01—04

Procedure of estimating the Grand Total: The first step was to obtain an estimate of the number of persons engaged in agriculture and fishing (referring to establishments in the Stockholm area). The primary tables (the »raw» tables) of the 1950 Census of Population in Sweden were analysed, and, counting family members and part-time employees as half persons, it was estimated that the total number of full-time workers should be close to *8 800* in 1950/51.

According to the CPDS, the total value of production in gardening and related activities amounted to some 28 million Sw. Cr. The number of persons gainfully employed in that field, recalculated as full-time workers, amounted to some 2 700. This gave an average value of production, per full-time worker, of 10 400 Sw. Cr. Available data indicated that the corresponding figure for persons engaged in farming, exclusive of gardening, and in fishing should come to 8 500 Sw. Cr., on the average. Applying this figure to the total number of persons thus employed, namely 6 100, I estimated the value of production at some 52 million Sw. Cr. The total value of production of the sector was then obtained by adding the two subtotals, which after rounding off gave a value of *80 million* Sw. Cr. It was estimated that about four percent of this value consisted of subsidies.

Main sources used in estimating the allocations of receipts (the data of column no. 1): Jordbruksekonomiska Meddelanden 1953: 1 and 7; Jordbrukskalkylerna (annual calculations regarding Agriculture's total income and costs; see Kungl. Maj:ts prop. no. 224/1953); Lönestatistisk årsbok 1950, pp. 11—66; Fiske 1950; Handel 1950: part III; Skattetaxeringarna samt fördelningen av inkomst och förmögenhet taxeringsåret 1951; interviews with representatives of the Agricultural Research Institute.

2. Beverage industries and tobacco manufactures

Branches according to the CPDS: 133—140

Corresponding branches in the ISIC: 21, 22

Procedure of estimating the Grand Total: The total sales of the sector amounted to some 494 million Sw. Cr. in 1950, according to the CPDS. By means of data in the annual reports of the »AB Vin & Spritcentralen» and the »AB Svenska Tobaksmonopolet», supplemented by data in »Riksräkenskapsverkets Årsbok», 1952 (p. 43), and »Accispliktiga näringar», 1950 (p. 19), it was estimated that the total value of production in terms of producer's values, that is to say, exclusive of sales taxes and similar duties, amounted to *130,3 million* Sw. Cr.

Main sources used in estimating the allocations of receipts (the data of column no. 2): The annual reports of a) AB Svenska Tobaksmonopolet, b) AB Vin- & Spritcentralen, and c) the largest breweries and manufacturers of soft drinks in the Stockholm area; Accispliktiga näringar; Industri 1950; Handel 1950: III; the CPDS.

3. Manufacture of cocoa, chocolate and sugar confectionary

Branches according to the CPDS: 113, 114

Corresponding branches in the ISIC: 208, part of 202 (manufacture of ice cream)

Procedure of estimating the Grand Total: The total sales of the sector amounted to 109,5 million Sw. Cr., according to the CPDS. By means of data in »Accispliktiga näringar», 1952 (p. 21), it was estimated that the total value of production in terms of producer's values, that is to say, exclusive of sales taxes, amounted to *65,7 million* Sw. Cr.

Main sources used in estimating the allocations of receipts (the data of column no. 3): Industri 1950; Handel 1950: III; Företagens intäkter, kostnader och vinster 1950—1953; the CPDS.

4. Manufacture of dairy products

Branch according to the CPDS: 1711

Corresponding branches in the ISIC: 202 (excluding manufacture of ice cream), part of 612 (bottling of milk)

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 4): Industri 1950—1953; Kommersiella Meddelanden 1954: 1; Företagens intäkter, kostnader och vinster 1950—1953; interview with a representative of the Mjölkcentralen; the CPDS.

5. Other food manufacturing: consumers' goods

Branches according to the CPDS: 106—108, 111, 118—119, 121—125, 127, 131—132

Corresponding branches in the ISIC: 201, 203, 204, 206—207, part of 209 (except for prepared feed for animals and fowls; and yeast and starch manufacture)

Procedure of estimating the Grand Total: The total sales of the sector amounted to 380 million Sw. Cr., according to the CPDS. By means of data in »Accispliktiga näringar», 1951 (p. 25), and »Riksräkenskapsverkets Årsbok», 1952, it was estimated that the total value of production in terms of producer's values, that is to say, exclusive of sales taxes and other duties, amounted to *375 million* Sw. Cr. Available data indicated that a slight increase in the volume of inventories took place in 1950. It was assumed that this increase occurred entirely to the customers of the sector.

Main sources used in estimating the allocations of receipts (the data of column no. 5): Industri 1950; Kommersiella Meddelanden 1954: 1; Handel 1950: part III; Företagens intäkter, kostnader och vinster 1950; the CPDS.

6. Other food manufacturing: industrial goods

Branches according to the CPDS: 105, 1713, 1716, 1722, 1724

Corresponding branches in the ISIC: 205, part of 209 (manufacture of prepared feeds for animals and fowls and manufacture of yeast)

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 6): Kommersiella Meddelanden 1954: 1; Företagens intäkter, kostnader och vinster 1951; interviews with representatives of the sector (mostly from the grain mills); the CPDS.

7. Wholesale trade: food products

Branches according to the CPDS: 232—244

Corresponding branch in the ISIC: part of 611

Procedure of estimating the Grand Total: The receipts of this industry are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of data reported by the Wholesalers' Research Institute.

Main sources used in estimating the allocations of receipts (the data of column no. 7): Svensk grosshandel (1947); af Trolle, U., (1955) Distributionsekonomi; Pris och prestation i handeln (SOU 1955: 16); interviews with Professor Törnqvist of the Stockholm School of Economics, and with representatives of the Wholesalers' Research Institute; Företagens intäkter, kostnader och vinster 1950—1951; the CPDS.

8. Retail trade: food products (including beverages)

Branches according to the CPDS: 295—305, 308—317, 368—371, 375—377, 379—380

Corresponding branch in the ISIC: part of 612

Procedure of estimating the Grand Total: The receipts of this industry are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producers' values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of the knowledge available regarding the relative size of total costs and of individual cost items of the sector. Additional gross margins have been estimated to account for the services rendered to the sector by wholesalers.

Main sources used in estimating the allocations of receipts (the data of column no. 8): Larsson, I., (1952) Detaljhandelslära; Persson, L., (1955) Självbetjäningsbutiker kontra traditionella butiker; Pris och prestation i handeln (SOU 1955: 16); various reports of the Retailers' Research Institute; interviews with Professor Törnqvist of the Stockholm School of Economics; Företagens intäkter, kostnader och vinster 1950—1951; income tax returns; a special investigation regarding rents in the Stockholm area; the CPDS.

9. Manufacture of wearing apparel (except custom tailoring)

Branches according to the CPDS: 164—168

Corresponding branch in the ISIC: part of 243 (excluding millinery and hats)

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS. Available data indicated that a slight increase in the volume of inventories took place in 1950. It was assumed that this increase occurred entirely to the customers of the sector.

Main sources used in estimating the allocations of receipts (the data of column no. 9): Kommersiella Meddelanden 1954: 1; Industri 1950—1953; Företagens intäkter, kostnader och vinster 1950—1951; Handel 1950: III; Kristensson, F., (1946) Studier i svenska textila industriers struktur; the CPDS.

10. Other textile manufacturing (including sewing and custom tailoring)

Branches according to the CPDS: 142—161, 169—178

Corresponding branches in the ISIC: 231—233, part of 239 (excluding manufacture of hard-surfaced floor coverings, artificial leather etc.), part of 243 (hats and caps, millinery, walking sticks, umbrellas), 244.

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS. Available data indicated that a slight increase in the volume of inventories took place in 1950. It was assumed that this increase occurred entirely to the customers of the sector.

Main sources used in estimating the allocations of receipts (the data of column no. 10): Kommersiella Meddelanden 1954: 1; Industri 1950—1953; Företagens intäkter, kostnader och vinster 1950—1951; Handel 1950: III; Kristensson, F., (1946) Studier i svenska textila industriers struktur; the CPDS.

11. Wholesale trade: apparel and dry goods

Branches according to the CPDS: 245—253

Corresponding branch in the ISIC: part of 611

Procedure of estimating the Grand Total: The receipts of this industry are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producers' values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of data reported by the Wholesalers' Research Institute.

Main sources used in estimating the allocations of receipts (the data of column no. 11): Svensk grosshandel (1947); Roostal, I., (1951) Distributionen av textilvaror; Pris och prestation i handeln (SOU 1955: 16); interviews with Professor Törnqvist of the Stockholm School of Economics, and with representatives of the Wholesalers' Research Institute; Företagens intäkter, kostnader och vinster 1950—1951; the CPDS.

12. Retail trade: apparel and dry goods

Branches according to the CPDS: 318—323, 325—329, 372

Corresponding branch in the ISIC: part of 612

Procedure of estimating the Grand Total: The receipts of this industry are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producers' values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of the knowledge available regarding the relative size of total costs and of individual cost items of the sector. Additional gross margins have been estimated to account for the services rendered to the sector by wholesalers.

Main sources used in estimating the allocations of receipts (the data of column no. 12): Larsson, I., (1952) Detaljhandelslära; Pris och prestation i handeln (SOU 1955: 16); interviews with Professor Törnqvist of the Stockholm School of Economics; Företagens intäkter, kostnader och vinster 1950—1951; income tax returns; a special investigation regarding rents in the Stockholm area; the CPDS.

13. Manufacture of tinware, castings and forgings

Branches according to the CPDS: 15—18, 26, 33

Corresponding branches in the ISIC: 341—342, 35

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 13): Kommersiella Meddelanden 1954: 1; Industri 1950; Företagens intäkter, kostnader och vinster 1951; Handel 1950: III; the CPDS.

14. Manufacture of insulated wire and cable

Branch according to the CPDS: 42

Corresponding branch in the ISIC: Part of 37

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 14): Kommersiella Meddelanden 1954: 1; Industri 1950; Företagens intäkter, kostnader och vinster 1951; Handel 1950: III; the CPDS.

15. Manufacture of electrical lamps

Branch according to the CPDS: 41

Corresponding branch in the ISIC: part of 37

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 15): Kommersiella Meddelanden 1954: 1; Industri 1950—1953; the annual reports of the largest companies; the CPDS.

16. Manufacture of electrical equipment, n.e.c.: plants with more than 200 employees

Branches according to the CPDS: part of 38—40

Corresponding branch in the ISIC: part of 37

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 16): Kommersiella Meddelanden 1954: 1; Industri 1950—1953; Företagens intäkter, kostnader och vinster 1950—1951; the annual reports of the largest companies; Handel 1950: III; the CPDS.

17. Manufacture of electrical equipment, n.e.c.: plants with not more than 200 employees

Branches according to the CPDS: part of 38—40

Corresponding branch in the ISIC: part of 37

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 17): Kommersiella Meddelanden 1954: 1; Industri 1950—1953; Företagens intäkter, kostnader och vinster 1950—1951; Handel 1950: part III; the CPDS.

18. Ship building and repairing

Branch according to the CPDS: 37

Corresponding branch in the ISIC: 381

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 18): Kommersiella Meddelanden 1954: 1; Industri 1950—1953; Företagens intäkter, kostnader och vinster 1950—1951; Handel 1950: part III; the CPDS.

19. Manufacture of automobiles and automobile bodies

Branch according to the CPDS: 27

Corresponding branch in the ISIC: part of 383

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 19): Handel 1950: III; the annual reports of the largest companies; Kommersiella Meddelanden 1954: 1; the CPDS.

20. Manufacture of engines, turbines, and other equipment, n.e.c.: plants with more than 200 employees

Branches according to the CPDS: part of 19—21, part of 28—29, part of 34—35

Corresponding branches in the ISIC: part of 36, part of 370 (armature), part of 383, part of 385, part of 389

Procedure of estimating the Grand Total: Sales reported in the CPDS were adjusted for a slight increase in inventories, which occurred to the sector according to available data.

Main sources used in estimating the allocations of receipts (the data of column no. 20): Kommersiella Meddelanden 1954: 1; Industri 1950—1953; Företagens intäkter, kostnader och vinster 1950—1951; the annual reports of some of the largest companies; Handel 1950: III; the CPDS.

21. Manufacture of engines, turbines and other equipment, n.e.c.: plants with not more than 200 employees

Branches according to the CPDS: part of 19—21, part of 28—29, part of 34—35

Corresponding branches in the ISIC: part of 36, part of 370 (armature), part of 383, part of 385, part of 389

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS. Available data indicated that a slight increase in the volume of inventories took place in 1950. It was assumed that this increase occurred entirely to the customers of the sector.

Main sources used in estimating the allocations of receipts (the data of column no. 21): Kommersiella Meddelanden 1954: 1; Industri 1950—1953; Företagens intäkter, kostnader och vinster 1950—1951; Handel 1950: III; the CPDS.

22. Repair of motor vehicles, cycles and electrical appliances

Branches according to the CPDS: 30—32, 36, 43

Corresponding branches in the ISIC: part of 370, 384

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 22): Industri 1950—1953; Handel 1950: III; the CPDS.

23. Other metal manufacturing

Branches according to the CPDS: 22—24, 25, 44—45

Corresponding branches in the ISIC: 391—396

Procedure of estimating the Grand Total: The total sales of the sector amounted to 130 million Sw. Cr., according to the CPDS. By means of data in »Accispliktiga näringar», 1951 (pp. 22—23), it was estimated that the total value of production

in terms of producer's values, that is to say, exclusive of sales taxes, amounted to *124 million* Sw. Cr.

Main sources used in estimating the allocations of receipts (the data of column no. 23): Industri 1950—1953; Kommersiella Meddelanden 1954: 1; Företagens intäkter, kostnader och vinster 1950—1951; Handel 1950: III; the CPDS.

24. Manufacture of non-metallic mineral products

Branches according to the CPDS: 47—65

Corresponding branches in the ISIC: 140, 33

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 24): Industri 1950; Kommersiella Meddelanden 1954: 1; Företagens intäkter, kostnader och vinster 1950—1951; interview with a representative of the largest individual company of the sector; the CPDS.

25. Manufacture of articles of paper and paperboard

Branches according to the CPDS: 92—96

Corresponding branch in the ISIC: 272

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 25): Industri 1950; Kommersiella Meddelanden 1954: 1; Företagens intäkter, kostnader och vinster 1950—1951; the CPDS.

26. Manufacture of wood, cork, paper and paperboard

Branches according to the CPDS: 66—86, 89—90

Corresponding branches in the ISIC: 25—26

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 26): Industri 1950; Kommersiella Meddelanden 1954: 1; Företagens intäkter, kostnader och vinster 1950—1951; the CPDS.

27. Printing and publishing

Branches according to the CPDS: 98—99

Corresponding branches in the ISIC: part of 280

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 27): Industri 1950; Kommersiella Meddelanden 1954: 1; Handel 1950: III; Företagens intäkter, kostnader och vinster 1950—1951; Grafisk industri (published by Industriens Upplysningstjänst, serie A: 4); the annual reports of some of the largest companies in the sector; the CPDS.

28. Bookbinding, commercial photographing and publishing, not combined with printing

Branches according to the CPDS: 97, 100—104

Corresponding branches in the ISIC: part of 280, 846

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 28): Industri 1950; Kommersiella Meddelanden 1954: 1; Handel 1950: III; Företagens intäkter, kostnader och vinster 1950—1951; the CPDS.

29. Manufacture of leather, rubber and fur products

Branches according to the CPDS: 180—193

Corresponding branches in the ISIC: 241—242, part of 243, 29—30

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 29): Industri 1950; Kommersiella Meddelanden 1954: 1; Handel 1950: III; Företagens intäkter, kostnader och vinster 1950—1951; the CPDS.

30. Manufacture of dyes, paints and varnishes

Branch according to the CPDS: 204

Corresponding branches in the ISIC: part of 311, part of 319

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 30): Industri 1950; Kommersiella Meddelanden 1954: 1; Handel 1950: III; Företagens intäkter, kostnader och vinster 1950—1951; Elshult, A., & Svennilson, I., (1955) Kemisk industri; the CPDS.

31. Manufacture of perfumes, washing and cleaning compounds, candles

Branches according to the CPDS: 205—207

Corresponding branch in the ISIC: part of 319

Procedure of estimating the Grand Total: The total sales of the sector amounted to nearly 76 million Sw. Cr., according to the CPDS. By means of data in Accispliktiga näringar 1950, it was estimated that the total value of production in terms of producer's values, that is to say, exclusive of sales taxes, amounted to *67 million* Sw. Cr.

Main sources used in estimating the allocations of receipts (the data of column no. 31): Industri 1950; Kommersiella Meddelanden 1954: 1; Handel 1950: III; Företagens intäkter, kostnader och vinster 1950—1951; Elshult, A., & Svennilson, I., (1955) Kemisk industri; the CPDS.

32. Manufacture of plastic materials and plastic products

Branch according to the CPDS: 209

Corresponding branches in the ISIC: part of 311, part of 399

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 32): Industri 1950—1953; Kommersiella Meddelanden 1954: 1; Handel 1950: III; Företagens intäkter, kostnader och vinster 1950—1951; Elshult, A., & Svennilson, I., (1955) Kemisk industri; the CPDS.

33. Manufacture of other chemicals and chemical products

Branches according to the CPDS: 194—202, 211—215

Corresponding branches in the ISIC: part of 239, part of 311, 312, part of 319, 321—322, 329

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 33): Industri 1950; Kommersiella Meddelanden 1954: 1; the annual reports of some of the largest companies in the sector; Handel 1950: III; Företagens intäkter, kostnader och vinster 1950—1951; Elshult, A., & Svennilson, I., (1955) Kemisk industri; the CPDS.

34. Electricity, gas and water services

Branches according to the CPDS: 216—219

Corresponding branches in the ISIC: 511—512, 521

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 34): Industri 1950; Kommersiella Meddelanden 1954: 1; Handel 1950: III; Statistisk Årsbok för Stockholms Stad 1953; data obtained from the electricity works of Stockholm proper; the CPDS.

35. Building construction

Branches according to the CPDS: 220—229

Corresponding branch in the ISIC: part of 40

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 35): data obtained from the Konjunkturinstitut; the annual reports of some of the largest building companies; the CPDS.

36. Construction other than building

Branches according to the CPDS: 230—231

Corresponding branch in the ISIC: part of 40

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 36): data obtained from the Konjunkturinstitut; Statistisk Årsbok för Stockholms Stad 1953; the CPDS.

37. Wholesale trade: hardware, lumber, construction materials

Branches according to the CPDS: 259—263, 266

Corresponding branch in the ISIC: part of 611

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of data reported by the Wholesalers' Research Institute.

Main sources used in estimating the allocations of receipts (the data of column no. 37): Svensk grosshandel (1947); Holm, P., (1955) Värme- och sanitetsbranschen (SOU 1955:49); Pris och prestation i handeln (SOU 1955:16); interviews with Professor Törnqvist of the Stockholm School of Economics, and with representatives of the Wholesalers' Research Institute; Företagens intäkter, kostnader och vinster 1950—1953; the CPDS.

38. Wholesale trade: fuels

Branches according to the CPDS: 264—265

Corresponding branch in the ISIC: part of 611

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of data reported by the Wholesalers' Research Institute.

Main sources used in estimating the allocations of receipts (the data of column no. 38): Svensk grosshandel (1947); interviews with Professor Törnqvist of the Stockholm School of Economics, and with representatives of the Wholesalers' Research Institute; Företagens intäkter, kostnader och vinster 1950—1953; the CPDS.

39. Wholesale trade: shop and office fittings

Branch according to the CPDS: 267

Corresponding branch in the ISIC: part of 611

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of data reported by the Wholesalers' Research Institute.

Main sources used in estimating the allocations of receipts (the data of column no. 39): Svensk grosshandel (1947); interviews with Professor Törnqvist of the Stockholm School of Economics, and with representatives of the Wholesalers' Research Institute; the CPDS.

40. Wholesale trade: machinery, equipment and supplies

Branch according to the CPDS: 268

Corresponding branch in the ISIC: part of 611

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the estimated gross margins in 1950, defined as the excess of

net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of data reported by the Wholesalers' Research Institute.

Main sources used in estimating the allocations of receipts (the data of column no. 40): Svensk grosshandel (1947); Pris och prestation i handeln (SOU 1955: 16); interviews with Professor Törnqvist of the Stockholm School of Economics, and with representatives of the Wholesalers' Research Institute; Företagens intäkter, kostnader och vinster 1950—1953; the CPDS.

41. Wholesale trade: pulp, paper and paper products

Branches according to the CPDS: 278—281

Corresponding branch in the ISIC: part of 611

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of data reported by the Wholesalers' Research Institute.

Main sources used in estimating the allocations of receipts (the data of column no. 41): Svensk grosshandel (1947); interviews with Professor Törnqvist of the Stockholm School of Economics, and with representatives of the Wholesalers' Research Institute; Företagens intäkter, kostnader och vinster 1950—1953; the CPDS.

42. Wholesale trade: other kinds of business

Branches according to the CPDS: 254—258, 269—277, 282—294

Corresponding branch in the ISIC: part of 611

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of data reported by the Wholesalers' Research Institute.

Main sources used in estimating the allocations of receipts (the data of column no. 42): Svensk grosshandel (1947); interviews with Professor Törnqvist of the Stockholm School of Economics, and with representatives of the Wholesalers' Research Institute; Företagens intäkter, kostnader och vinster 1950—1953; the CPDS.

43. Retail trade: motor vehicles

Branch according to the CPDS: 339

Corresponding branch in the ISIC: part of 612

Procedure of estimating the Grand Total: The receipts of this industry are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of the knowledge available regarding the relative size of total costs and of individual cost items of the sector. Additional gross margins have been estimated to account for the services rendered to the sector by wholesalers (including agents).

Main sources used in estimating the allocations of receipts (the data of column no. 43): Företagens intäkter, kostnader och vinster 1950—1953; interviews with Professor Törnqvist of the Stockholm School of Economics; Pris och prestation i handeln (SOU 1955: 16); data obtained from the Pris- och Kartellnämnd; the CPDS.

44. Retail trade: other consumers' durables

Branches according to the CPDS: 324, 330—336, 338, 341, 343, 347—351, 359—360

Corresponding branch in the ISIC: part of 612

Procedure of estimating the Grand Total: The receipts of this industry are measursed in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of the knowledge available regarding the relative size of total costs and of individual cost items of the sector. Additional gross margins have been estimated to account for the services rendered to the sector by wholesalers.

Main sources used in estimating the allocations of receipts (the data of column no. 44): Företagens intäkter, kostnader och vinster 1950—1953; interviews with Professor Törnqvist of the Stockholm School of Economics; Pris och prestation i handeln (SOU 1955: 16); income tax returns; the CPDS.

45. Retail trade: department stores and variety stores

Branches according to the CPDS: 356—358

Corresponding branch in the ISIC: part of 612

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of the knowledge available regarding the relative size of total costs and of individual cost items of the sector. Additional gross margins have been estimated to account for the services rendered to the sector by wholesalers.

Main sources used in estimating the allocations of receipts (the data of column no. 45): Företagens intäkter, kostnader och vinster 1950—1953; interviews with Professor Törnqvist of the Stockholm School of Economics; the CPDS.

46. Retail trade: all other stores (including tobacco)

Branches according to the CPDS: 306—307, 337, 340, 342, 344—346, 352—355, 364—367, 373—374, 378, 381—382

Corresponding branch in the ISIC: part of 612

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the estimated gross margins in 1950, defined as the excess of net sales over the producer's values of merchandise purchased for resale. These gross margins have been derived on the basis of the CPDS and by means of the knowledge available regarding the relative size of total costs and of individual cost items of the sector. Additional gross margins have been estimated to account for the services rendered to the sector by wholesalers.

Main sources used in estimating the allocations of receipts (the data of column no. 46): Företagens intäkter, kostnader och vinster 1950—1953; interviews with Professor Törnqvist of the Stockholm School of Economics; income tax returns; Larsson, I., (1952) Detaljhandelslära; the CPDS.

47. Railway transport

Branch according to the CPDS: 383

Corresponding branch in the ISIC: 711

Procedure of estimating the Grand Total: The total value of sales of this sector amounted to 185 million Sw. Cr., according to the CPDS. By means of data in »Allmän järnvägsstatistik», 1950, it was estimated that the total value of output in terms of producer's values, that is to say, exclusive of sales taxes, amounted to *178 million* Sw. Cr.

Main sources used in estimating the allocations of receipts (the data of column no. 47): Allmän järnvägsstatistik 1950; Statens Järnvägar 1950; Budgetredovisning 1949/50 and 1950/51; Riksräkenskapsverkets årsbok 1951 and 1952; the CPDS.

48. Urban and suburban tramway and omnibus operators

Branch according to the CPDS: 384

Corresponding branch in the ISIC: part of 712

Procedure of estimating the Grand Total: Sales reported in the CPDS amounted to 89 million Sw. Cr. Additional items have been estimated to account for the loss incurred by the sector in 1950 and for certain special receipts accruing to the sector. These adjustments resulted in a total value of receipts of *101,8 million* Sw. Cr.

Main sources used in estimating the allocations of receipts (the data of column no. 48): Statistisk Årsbok för Stockholms Stad 1951 and 1953; the annual report of the tramway company; the CPDS.

49. Ocean transport

Branch according to the CPDS: 392

Corresponding branch in the ISIC: 715

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 49): Företagens intäkter, kostnader och vinster 1951—1953; Sjöfart 1950; the annual reports of all the large shipping companies; reports of the International Monetary Fund; the CPDS.

50. Other transport activities

Branches according to the CPDS: 385—388, 390—391, 393—396, 400

Corresponding branches in the ISIC: part of 712, 713—714, 716—717

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 50): Handel 1950: III; Företagens intäkter, kostnader och vinster 1953; Statistisk Årsbok för Stockholms Stad 1951 and 1953; the CPDS.

51. Services incidental to transport (including storage and warehousing)

Branches according to the CPDS: 389, 397—399, 401

Corresponding branches in the ISIC: 718, 72

Procedure of estimating the Grand Total: Directly in accordance with sales reported in the CPDS.

Main sources used in estimating the allocations of receipts (the data of column no. 51): the CPDS; data obtained from the Pris- och Kartellnämnd.

52. Communication services

Branches according to the CPDS: 402—404

Corresponding branch in the ISIC: 730

Procedure of estimating the Grand Total: The data on sales reported in the CPDS could not be used for present purposes, since they implied that, of the total amount of communication services rendered in Sweden as a whole, some 85 percent had been rendered by establishments in the Stockholm area; such a conclusion would have been contradicted by other available data. Instead, by means of »Postverket», 1950, and »Telegraf, telefon och radio», 1949/50 and 1950/51, the share rendered by establishments in Stockholm was estimated at a little less than 30 percent. Due to the uncertainty in this estimate, the absolute amount was rounded off to the nearest ten millions.

Main sources used in estimating the allocations of receipts (the data of column no. 52): Postverket 1950; Telefon, telegraf och radio 1949/50 and 1950/51; Riksräkenskapsverkets årsbok 1952.

53. Banking and insurance

Branches according to the CPDS: 405—418

Corresponding branches in the ISIC: 62—63

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of estimated operating expenses, defined to include dividends but to exclude payments to policy holders (resulting from claims). The operating expenses of the sector have been estimated by means of the sources specified below. Due to the uncertainty in this estimate, the amount was rounded off to the nearest ten millions.

Main sources used in estimating the allocations of receipts (the data of column no. 53): Sveriges Riksbank 1950; Allmän sparbanksstatistik 1950; Uppgifter om bankerna (publ. by Kungl. Bank- och Fondinspektionen); Postverket 1950; the annual reports of the main banks; Enskilda Försäkringsanstalter 1950; Uppgifter från Försäkringsinspektionen om livbolagen; data obtained from the Konjunkturinstitut; interviews with representatives of the three largest banks; the CPDS.

54. Lessors of real property

Branches according to the CPDS: 419—425

Corresponding branch in the ISIC: 640

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of contract rent paid on tenant-occupied dwellings and of the corresponding nonresidential rents paid by private business and the government, *plus imputed* space rental of owner-occupied dwellings and nonresidential property. Further, a small amount covering the estimated gross margins of real estate agencies is included (estimated at less than two percent of the total receipts of the sector). The receipts of the sector do not include equipment rent paid by private business and the government. For farms and establishments belonging to some service industries, where the distinction betwen enterprise and household may at times be hard to make, the general principle has been to try to estimate the share of rent (paid or imputed) which has been related to the use of farm service buildings, etc., and vice versa for dwellings. Since the Grand Total has been obtained by aggregating the receipts estimated for the individual sectors, it has not been possible to round off the total arrived at.

Main sources used in estimating the allocations of receipts (the data of column no. 54): Statistisk Årsbok för Stockholms stad 1951—1953; Årsbok för Sveriges kommuner 1952; Handel 1950: III; the annual reports of large housing companies and associations; Bildmark, K., (1954) Underhållskostnader för hyresfastigheter i Stockholm; data obtained from the Konjunkturinstitut; the CPDS.

55. Drinking and eating places, hotels and other lodging places

Branches according to the CPDS: 440—446

Corresponding branches in the ISIC: 842—843

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the sales reported in the CPDS plus the estimated tips earned by restaurant personnel, room service employees, etc., and minus the estimated sales taxes. The total sales reported in the CPDS amounted to 317 million Sw. Cr. The tips have been estimated somewhat roughly at ten percent of 200 millions; the remaining 117 millions have been considered to provide no tipping opportunities. The sales taxes (including entertainment duty) have been estimated at 13 million Sw. Cr. Due to the uncertainty involved in these estimates, the Grand Total thus obtained has been rounded off to the nearest ten millions.

Main sources used in estimating the allocations of receipts (the data of column no. 55): Adler, L., (1958) Storstaden och färskvaruförsörjningen (manuscript available in 1956); Riksräkenskapsverkets årsbok 1951—1952; data obtained from the Konjunkturinstitut; the CPDS.

56. Motion pictures and other amusements (except theatres)

Branches according to the CPDS: 450—451, 453, 455—458

Corresponding branches in the ISIC: 831, part of 833

Procedure of estimating the Grand Total: The entertainment duties, estimated by means of data in »Riksräkenskapsverkets Årsbok», 1952, and the CPDS, have been deducted from the sales reported in the CPDS (105 million Sw. Cr.). The remaining value, 95 million Sw. Cr., is the Grand Total estimated.

Main sources used in estimating the allocations of receipts (the data of column

no. 56): Gustafsson, S., (1950) Den svenska filmproduktionens ekonomi; interview with a representative of the Sveriges Biografägares Förbund; the annual reports of the main companies belonging to the sector; the CPDS.

57. Laundries and laundry service (cleaning and dyeing included); barber and beauty shops

Branches according to the CPDS: 162—163, 459—461

Corresponding branches in the ISIC: 844—845

Procedure of estimating the Grand Total: Sales reported in the CPDS amounted to a little more than 60 million Sw. Cr. Somewhat roughly, it has been estimated that the tips accrued to the personnel of the sector amounted to ten percent of the sales reported by barber and beauty shops. In this way, the Grand Total has been estimated at 63 million Sw. Cr.

Main sources used in estimating the allocations or receipts (the data of column no. 57): A special investigation regarding rents; the CPDS.

58. Business services (including legal services)

Branches according to the CPDS: 426—439, 469, 472

Corresponding branches in the ISIC: 825—826

Procedure of estimating the Grand Total: Sales reported in the CPDS amounted to 188 million Sw. Cr. Since space rent in newspapers and magazines was included among the receipts obtained by the sector Printing and Publishing (no. 27), the net value of the space supplied through advertising agencies has been excluded from the above figure, to prevent duplication. The necessary estimates have been based upon data in the CPDS and in »Annonsbyråernas struktur».

Main sources used in estimating the allocations of receipts (the data of column no. 58): Wärneryd, K. E., (1952) Annonsbyråernas struktur; the CPDS.

59. Medical and other health services

Branches according to the CPDS: This sector is covered only in part by the CPDS. Mainly, data from other sources have been adhered to.

Corresponding branch in the ISIC: 822

Procedure of estimating the Grand Total: The receipts of this sector are measured in terms of the estimated operating expenses of public hospitals, the fees received by doctors, dentists, etc., and the operating revenues of private hospitals and rest homes. Only the last mentioned category of receipts was reported in the CPDS (nearly 16 million Sw. Cr.). The operating expenses of public hospitals (including estimated rents and depreciations taken on equipment) have been estimated by means of data in »Allmän hälso- och sjukvård», 1950 (at some 120 million Sw. Cr.). The professional fees received by doctors and dentists have been estimated by means of data obtained from the Konjunkturinstitut and data in »Statistisk Årsbok för Stockholms stad», 1951 (at some 95 million Sw. Cr.). Somewhat roughly, it has been estimated that the fees of nurses in private service, veterinary surgeons, chiropractors and other professionals referred to this sector amounted to five million Sw. Cr. Due to the uncertainty involved in these estimates, the Grand Total obtained has been rounded off to the nearest five millions.

Main sources used in estimating the allocations of receipts (the data of column no. 59): Allmän hälso- och sjukvård, 1950; Statistisk årsbok för Stockholms stad; Stockholms stads utgifts- och inkomststat, 1952; the CPDS.

60. Educational and research services; religious and art activities

Branches according to the CPDS: This sector is covered only in part by the CPDS. Mainly, data from other sources have been adhered to.

Corresponding branches in the ISIC: part of 821, 823, part of 829, 832

Procedure of estimating the Grand Total: Sales reported in the CPDS refer to theatres, music and concert halls and similar activities. For all other institutions, comprising elementary and secondary schools, universities, correspondence schools, music and art schools, religious institutions, scientific research agencies, etc., and for painters, authors and related professions, the total receipts have been roughly estimated at 190 million Sw. Cr. by means of data in the 1950 Census of Population, »Statistisk årsbok för Stockholms stad», 1952, »Stockholms stads utgifts- och inkomststat», 1952, and »Skattetaxeringarna samt fördelningen av inkomst och förmögenhet», 1951—1952. Due to a mistake of inadvertence, the Grand Total obtained (208 million Sw. Cr.) was not rounded off.

Main sources used in estimating the allocations of receipts (the data of column no. 60): Statistisk årsbok för Stockholms stad 1952—1953; Stockholms stads utgifts- och inkomststat 1952; the CPDS.

61. Labor and political organizations, trade associations and welfare institutions

Branches according to the CPDS: This sector is not covered by the CPDS.

Corresponding branches in the ISIC: 824, 827, part of 829

Procedure of estimating the Grand Total: On the basis of the 1950 Census of Population it has been estimated that this sector employed about 4 800 people in 1950. By means of data obtained from the labor organizations and some other institutions and from »Lönestatistisk årsbok», 1950, the total wages and salaries of this personnel have been estimated at 40 million Sw. Cr. Very roughly, it has then been assumed that this figure represented about two thirds of the total operating revenues of the sector. Measuring the Grand Total in terms of such operating revenues, we have obtained a figure of 60 million Sw. Cr.

Main sources used in estimating the allocations of receipts (the data of column no. 61): Data obtained from the labor organizations and other institutions; Lönestatistisk Årsbok 1950; Statistisk årsbok för Stockholms stad 1952 and 1953.

62. Other economic activities in Stockholm

Branches according to the CPDS: 9, 448, 462—468, 470—471, 473—475

Corresponding branches in the ISIC: 522, part of 821, part of 833, 849, 900

Procedure of estimating the Grand Total: Excluding lotteries and football pools, the receipts reported in the CPDS amounted to some 43 million Sw. Cr. The receipts of lotteries and football pools, measured in terms of their operating expenses, have been estimated at some 17 million Sw. Cr., bringing the Grand Total up to 60 million Sw. Cr.

Main sources used in estimating the allocations of receipts (the data of column no. 62): Data obtained from the Konjunkturinstitut (regarding lotteries and football pools); Stockholms stads utgifts- och inkomststat 1952 (regarding street cleaning and related activities); the CPDS.

63. Industries in the rest of Sweden: Agriculture

Corresponding branch in the ISIC: 01

Procedure of estimating the Grand Total and the entries of column no. 63: Data obtained from the Konjunkturinstitut have been adjusted so as to *exclude* the receipts obtained by sector no. 1 and to *include* certain receipts not accounted for by the Konjunkturinstitut (representing certain subsidies). The figure thus obtained has been rounded off to the nearest 100 millions, to provide an estimate of the Grand Total. In the course of estimating the distribution of the sales of the 62 production sectors, the entries nos. 1—62 have been obtained. Very rough estimates have been made to obtain the entries nos. 63, 65—70, 71—72 and 74—87. The largest entry representing the wages and salaries accrued (no. 86), has been estimated at 60 percent of the Grand Total, by means of data provided in the annual Agricultural Calculus. The entry no. 64 is a residual item.

64. Industries in the rest of Sweden: Other industries

This sector comprises all industries in the Rest of Sweden, except agriculture.

Procedure of estimating the Grand Total and the entries of column no. 64: The general procedure has been to estimate for each of the 62 production sectors in the Stockholm area the *corresponding* production or output for Sweden as a whole; the corresponding output for the Rest of Sweden has then been obtained by subtraction. By adding the outputs thus calculated, an estimate of the Grand Total has been obtained. The CPDS has been the major source for these estimates. Due to the shortcomings of available data, the activity of hospitals, schools and other educational institutions, research agencies, religious organizations and related institutions that is financed by national and local government, has been accounted for in columns nos. 78—80 and 77, respectively, and *not* in column no. 64. On the other hand, fishing and forestry (in the Rest of Sweden) are comprised by the present sector. Thus the sector Other Industries does not quite correspond to production sectors nos. 2—62, in Stockholm. The Grand Total arrived at has been rounded off to the nearest 500 millions.

The entries nos. 1—62 have been obtained in the course of estimating the distribution of the sales of the 62 production sectors. The entries nos. 74, 79—80 and 84—85 have been roughly estimated, partly on the basis of the data obtained for the 62 production sectors and partly on the basis of data obtained from the Konjunkturinstitut. All remaining entries are residual items. Thus, for instance, the entry representing the wages and salaries accrued (no. 86), 11 869,9 million Sw. Cr., has been obtained by subtracting from the Grand Total of row no. 86 (15 700 millions) the sum of all other entries along the row. The entry no. 71—72 is a column residual. It has been obtained by subtracting from the Grand Total of column no. 64 (36 000 millions) the sum of all other entries in the column.

65—70. Foreign countries: Export of goods and services

Procedure of estimating the Grand Totals: The Grand Total of column no. 65—70 and the Grand Totals of the corresponding rows (nos. 65—70) have been estimated by means of data obtained from the Konjunkturinstitut and the International Monetary Fund (the »Balance of Payments Yearbook»).

Main sources used in estimating the entries of column no. 65—70: The special investigation regarding the manufacturing industry and wholesale trade in Stockholm; Sveriges Riksbank 1950—1951; data obtained from the Konjunkturinstitut; the Balance of Payments Yearbook 1950—1951 (IMF); Kommersiella Meddelanden 1956: 4; Turisttrafiken från utlandet (SOU 1951: 49); Statistisk Årsbok för Stockholms stad 1952—1953 (regarding exports through the port of Stockholm); Postverket 1950 (pp. 49 and 75—77); Budgetredovisningen 1949/50 and 1950/51; Handel 1950: II.

71—73. Gross domestic capital formation

The gross domestic capital formation (inventories excluded) in Sweden in 1950 has been estimated by the Konjunkturinstitut at 8 535 million Sw. Cr. (See, e.g., the report A: 27, pp. 248—251). By subtracting the expenditure for maintenance and repair and all the military expenditure on capital goods, an estimate has been obtained for present purposes which corresponds to the current international standard usage of the concept of gross domestic capital formation. The figure thus arrived at amounts to 5 310 millions. To estimate the share which the capital formation in the Stockholm area constituted, the methods used by the Konjunkturinstitut for calculating the national data (see report B: 13, pp. 124—144) have as far as possible been applied. A special analysis had to be made of data obtained by the Kommerskollegium (the Board of Trade) regarding the investments of manufacturing industry and related activities, in Stockholm. For companies having establishments in Stockholm as well as in other parts of Sweden, special investigations have been made in order to find out where the investments actually occurred. The data obtained in this way have been recalculated so as to apply to the total manufacturing industry of the Stockholm area (including also small establishments), by methods similar to those used by the Konjunkturinstitut. The investments in dwellings have been estimated on the basis of the national data, which indicated that the net investments in 1950 amounted to 1 305 millions. Stockholm's share in the total number of units in newly built houses has been calculated at nearly 19 percent. This figure has been applied to the national data on investments in dwellings, to give an estimate of the corresponding investments in the Stockholm area. Since the building costs are higher in Stockholm than in the rest of Sweden, on the average, the figure thus arrived at may appear to underestimate the investments in Stockholm. However, the units in the newly built houses were smaller in Stockholm than in the rest of Sweden, and, due to the lack of the necessary data, it has been necssary to assume here that these two factors have counterbalanced completely. The investments of local authorities have been estimated by means of data obtained from the City of Stockholm. For other categories of investment rough estimates have been made. The main sources will appear from the specification below.

The investments in the Rest of Sweden have been obtained by subtracting the Stockholm figures. The entries nos. 1—62 have been obtained in the course of estimating the distribution of the sales of the 62 productions sectors.

The column representing inventory increase (column no. 73) has been commented upon before.

Main sources: Data obtained from the Konjunkturinstitut; primary data of the Kommerskollegium; data obtained from the Arbetsmarknadsstyrelsen; Kommersiella Meddelanden 1952: 2; Bostadsbyggandet i Sverige 1949/50; Statistisk Årsbok för Stockholms Stad 1951—1953; Stockholms stads investeringar samt driftutgifter och driftinkomster (Stadskollegiets Utlåtanden och Memorial, bihang nr. 53, 1955); Budgetredovisningen 1949/50 and 1950/51; Riksräkenskapsverkets årsbok 1952; Handel 1950: III.

74. Losses, deficits, etc.

There is only one entry in this column and that is based on data obtained from the AB Svenska Tobaksmonopolet. The loss incurred by the tramway and urban omnibus company in Stockholm proper is indicated in the basic table as a transfer from the City of Stockholm (column no. 82) to the sector Urban and suburban tramway and omnibus operators (row no. 48).

75—83. Government purchases on current account and government transfers

The Grand Totals of the columns have been estimated by means of data obtained from the Konjunkturinstitut and the City of Stockholm. The same sources have been used to form the Grand Totals of the corresponding rows — with the important modification, however, that the present estimates are on an accrual basis.

Main sources used in estimating the entries of columns nos. 75—83: Budgetredovisningen 1949/50 and 1950/51; data obtained from the Konjunkturinstitut; data obtained from the City of Stockholm; Stockholms stads utgifts- och inkomststat 1950 and 1952; Statistisk årsbok för Stockholms stad 1951—1952; Årsbok för Sveriges Kommuner 1950—1952; Kommunernas finanser 1950; Skattetaxeringarna samt fördelningen av inkomst och förmögenhet 1951; Svenska Aktiebolag 1955—1956; Riksräkenskapsverkets årsbok 1952; Handel 1950: III.

84—87. Households

Data on total private consumption in Sweden in 1950 have been obtained from the Konjunkturinstitut. The differences in consumption patterns between Stockholm and the Rest of Sweden have been accounted for on the basis of data from consumers surveys, published in »Levnadskostnaderna år 1952». Data from the 1950 Census of Population have served as weights in the calculations. The number of adults in Stockholm in relation to the total number of adults in Sweden has been used in the weighting procedure for the following items of consumption: Meals in restaurants, bars, etc.; Alcoholic beverages, wines and tobacco; Telephone, telegraph and postal expenditure; Entertainments; Motor vehicles; Travelling fares. For all other items, children have been counted as half consumption units. By means

of the data from the consumers surveys, each particular item of private consumption has been calculated per unit of consumption (adult) for Stockholm, Gothenburg and Malmö, on the one hand, and as a total for Sweden, on the other. In this way, an estimate has been obtained of the private consumption per unit in Stockholm in relation to the corresponding consumption per unit in Sweden as a whole, for each item of private consumption. Then, Stockholm's share in the total number of consumption units (or adults) times the relative consumption per unit in Stockholm has been applied to the total consumption of the country, per item, to give estimates on Stockholm's consumption in absolute values. Private consumption in the Rest of Sweden has been obtained through subtraction from the national data.

The data thus arrived at have been reconciled with the corresponding data obtained in the course of estimating the distribution of the sales of the 62 production sectors.

The direct and indirect taxes and other payments to the national and local governments have been estimated by means of the following sources: Skattetaxeringarna samt fördelningen av inkomst och förmögenhet 1951; Statistisk årsbok för Stockholms stad 1952; Årsbok för Sveriges kommuner 1950 and 1951; Kommunernas finanser 1950, part II; Budgetredovisningen 1949/50 and 1950/51; Riksräkenskapsverkets årsbok 1952; data obtained from the Konjunkturinstitut. In the tabulations the direct taxes levied upon the estimated income from trades and professions have been subtracted from the direct taxes of individuals and added to the direct taxes payable by the production sectors.

The procedure indicated above yielded estimates, too, regarding the value of paid domestic services (rows 84 and 86, respectively) and the value of consumption in kind (rows 85 and 87, respectively). Finally, the household purchases from the Rest of Sweden and from abroad have been estimated.

The Grand Total of column 84—85 has been obtained by adding the entries nos. 1—85. The Grand Total of column 86—87 has been obtained through an estimate of the savings of households in the Rest of Sweden. The figure thus obtained has been subtracted from the sum of the Grand Totals of rows 86 and 87, to get an estimate of the Grand Total of column 86—87.

The sum of the Grand Totals of columns nos. 84 and 85 has been checked by means of independent estimates of the total income of the households in the Stockholm area (including income not assessed for taxation purposes). The deviation has been found to lie within very narrow limits.

The special form sent to all manufacturing and wholesale firms in the Stockholm area together with the CPDS form

The 1951 Census of Production, Distribution and services
(This form should no later than the 18th of September 1951 be sent to the »County Labor Board» concerned.)

Strictly confidential information

The following returns are intended to form part of an investigation concerning the industry of Greater Stockholm, which is to be carried out by the Investment Committee of the City of Stockholm.

A. How were the sales (see the question no. 8. 9., the main form) of this establishment distributed with regard to the following categories of customers? (If the information is not directly available in your accounts, please make a percentage estimate first and assess then the amount in Sw. Cr.)

	Percent	Thousands of Sw. Cr.
Sales within Sweden:		
1. To manufacturing industries, institutions etc. (also to your own plants). Besides sales to manufacturing industries and handicrafts, sales to hotels, restaurants, railway companies, hospitals, government authorities, etc., should be included here. Also sales to retailers and wholesalers of shop and office fittings, etc., to be used in their own business, should be included here		
Total sales to your own manufacturing plants or plants belonging to the same concern as your establishment should be specified below.		
2. To wholesalers (also to your own sales offices, etc.).....		
Total sales to your own sales offices or to sales companies that belong to the same concern as your establishment should be specified below.		
3. To retailers (also to your own shops)		
Total sales to your own shops and to shops which belong to the same concern as your establishment should be specified below.		
4. To households.....		
Sales to foreign countries:		
5. Sales direct (or through agents) to customers abroad		
Total (1—5)	100 %	

B. How were the sales (the sum of 1—5, above) of this establishment distributed over the following areas?

	Percent	Thousands of Sw. Cr.
1. Customers within Greater Stockholm (the municipalities included were specified in the questionnaire)		
2. Customers in the rest of Sweden		
3. Customers abroad		
Total (1—3)	100 %	

.....
(Name of establishment and signer)

Questions regarding this form may be addressed to

.....
(Name)

Telephone.....

APPENDIX 3

Special estimates and computations

The margins of error assigned to the data on manpower and floor space (Tables 4.1. and 4.6.)

Attempts have been made at assigning margins of error to the data presented in Tables 4.1. and 4.6. The margins assigned are based on subjective judgment, and are as follows:

Sector No.	Margins of error:	
	In the manpower data (number of persons)	In the floor space data (thousands of square metres)
1.	± 200	± 20
8.	± 150	± 10
12.	± 100	± 10
35.	± 100	± 10
36.	± 100	± 10
42.	± 100	± 10
46.	± 100	± 10
50.	± 100	± 10
54.	± 2 000	± 10
55.	± 100	± 20
56.	± 50	± 20
57.	± 100	± 10
58.	± 100	± 10
59.	± 1 000	± 50
60.	± 1 000	± 150
61.	± 200	± 10
62.	± 100	± 10
Government administration	± 2 000	± 50
Domestic services	± 1 000	—
Dwellings	—	± 250

For all other sectors it is believed that the errors in the manpower data are at most ± 50, and the errors in the floor space data at most ± 10.

If it is assumed that the rules of probability theory are applicable, we can estimate the errors in the totals by means of the usual error formula (see, for instance, YATES, pp. 196—197): $u_T = \sqrt{u_1^2 + u_2^2 + u_3^2 + \ldots}$ where u_T is the error in the sum; and u_1, u_2, u_3, etc., are the errors in the individual entries. In this way, the total number of gainfully employed can be estimated at 497 700 ± *3 400* and the total amount of floor space at 32 900 ± *320* thousand square metres.

Specification of the data used to construct Tables 5.1. and 5.2.

Sector No.	a)	b)	c)	d)	e)	f)
1.	60,1	137	100	160	85	— 1 300
2.	110,9	124	110	150	91	— 250
3.	82,3	133	115	150	102	+ 50
4.	214,6	135	110	150	99	0
5.	431,5	147	105	150	104	+ 350
6.	54,3	143	105	150	100	0
7.	6,7	146	105	150	102	+ 100
8.	226,5	144	105	150	101	+ 150
9.	146,6	116	105	150	81	— 1 100
10.	86,3	119	105	150	83	— 1 000
11.	6,6	143	100	140	102	+ 100
12.	153,5	125	105	140	95	— 500
13.	17,2	147	110	158	102	+ 150
14.	236,5	182	115	160	131	+ 950
15.	23,5	156	115	160	112	+ 200
16.	451,8	170	115	160	122	+ 2 800
17.	137,4	151	115	160	109	+ 450
18.	74,9	147	110	159	102	+ 50
19.	148,0	185	110	159	134	+ 400
20.	327,0	134	110	159	93	— 650
21.	206,7	139	110	159	96	— 300
22.	82,1	145	110	160	100	0
23.	117,2	138	110	158	96	— 300
24.	39,1	156	100	165	95	— 200
25.	24,0	126	110	150	92	— 100
26.	43,6	142	110	150	104	+ 150
27.	170,2	147	100	155	97	— 350
28.	200,2	122	100	155	80	— 1 950
29.	61,7	132	110	155	94	— 200
30.	30,1	141	120	150	113	+ 200
31.	70,9	133	120	150	106	+ 100
32.	26,7	198	100	150	132	+ 400
33.	44,6	142	100	150	95	— 150
34.	98,2	156	110	150	114	+ 700
35.	730,3	162	100	165	98	— 650
36.	648,4	168	100	160	105	+ 750
37.	80,8	157	100	145	108	+ 700
38.	0,9	153	100	145	106	+ 200
39.	39,8	147	100	145	101	0
40.	121,4	153	100	145	106	+ 250
41.	45,0	153	100	145	106	+ 150
42.	61,5	149	100	145	103	+ 350
43.	61,0	218	95	150	138	+ 750
44.	103,1	115	105	140	87	— 900
45.	70,8	123	105	140	92	— 500
46.	115,9	142	105	140	106	+ 650
47.	114,5	131	100	155	85	— 1 050
48.	166,7	164	100	155	106	+ 400
49.	640,0	162	100	155	105	+ 400
50.	228,1	143	100	155	92	— 1 100
51.	76,7	148	100	155	95	— 150
52.	188,6	159	100	150	106	+ 650
53.	310,7	171	100	150	114	+ 2 700
54.	794,7	153	100	140	109	+ 1 100
55.	475,5	151	100	140	108	+ 1 100
56.	107,2	121	100	140	86	— 500
57.	83,6	136	100	140	97	— 300
58.	62,8	157	100	145	108	+ 750
59.	387,8	173	100	145	119	+ 2 850
60.	326,2	158	100	145	109	+ 1 450
61.	71,8	167	100	145	112	+ 600
62.	81,0	147	100	145	101	+ 50
Totals	10 406,3	150				+ 9 650

Here, *column a*) gives the data on final demand in 1955. For a further specification into different categories of final demand, see Table II, inside the back cover of: ARTLE (1958). As a rule, the same sources have been used to obtain these figures, as were used to obtain the 1950 figures. However, only preliminary data for 1955 were available at the time of the investigation. Further comments on the procedure for obtaining the data and on the sources used, are given in ARTLE (1958, pp. 309—311).

Column b) states the calculated changes in the production values between 1950 and 1955 (1950 = 100), the calculations being based on the assumption of invariant structural relations. These data were combined to form Table 5.1.

Column c) indicates the changes in the personal income coefficients between 1950 and 1955 (1950 = 100). The statistical basis for these calculations was extremely limited, and the figures must be checked when more data become available. Pending such checks, all figures have been rounded off.

Column d) indicates the changes in the average income per gainfully employed person (full-time worker) between 1950 and 1955 (1950 = 100). These figures have been based upon official statistics regarding wages and salaries in different industries. The data were, however, not sufficiently detailed for the present purpose, so the entries inserted in column d) are uncertain.

Column e) gives the relative changes in the number of persons gainfully employed by the production sectors, between 1950 and 1955 (1950 = 100), the changes being calculated by means of the data in columns b)—d). The changes thus arrived at are expressed in absolute numbers in *column f*).

Procedure for estimating the size of the population per 250-metre square

As regards the *resident* population, the Stockholm office of statistics provided data on the number of resident persons per block, for the central districts of Stockholm at the end of 1950. As a practical approximation, in the course of relating these data to the net of squares, it was assumed that within each square the population was evenly distributed. The work was carefully executed by the Department of Geography at the Stockholm School of Economics. The population data were plotted on a map to the scale of 1:12 000, a dot being used to represent every 25 persons. This map covered the "town within the toll-gates". It was preferred to the land-use map (to the scale of 1 : 10 000), because it was more suitable for plotting (among other things, it gave the names of the streets and the numbers of the houses). In the form of a translucent overlay, the net of squares (adapted to the scale and extension of the map) was then used as a reference system, to which all the dots were referred. In this way it was possible to estimate the number of persons resident per square.

As regards the *working* population, the register of establishments (mentioned in Appendix 2) was used as a basis. By means of the information on the punch-cards, each establishment was represented on the map, together with a figure indicating

the size of its personnel (including working proprietors). One map was used for each particular trade or branch, specified in the CPDS; similarly, separate maps were used to represent the local distribution of "branches" not covered by the CPDS, such as government administration and doctors and dentists. As mentioned, maps to the scale of 1 : 12 000 were used. As above, the net of squares was used as a reference system, and by adding the personnel data for all the branches per square, we arrived at an estimate of the working population per square.

Regrettably, it was not possible to cover the total working population. First and foremost, certain categories of the working population could not meaningfully be referred to individual squares, although data were available regarding their "registered" place of work. This applies to taxi-drivers, tram and omnibus operators, builders and other categories of operatives who shift their place of work quite often. Altogether, data regarding a little more than 40 000 persons had to be omitted for this reason. Second, the information available regarding certain categories of personnel was too limited to be useful in the present context. This applies to domestic workers and a few categories of government personnel (including a part of the military personnel). Altogether, there were about 20 000 persons in these categories within the area investigated, bringing the total number of persons not covered by the present investigation up to more than 60 000. This means that only a little more than 80 percent of the total working population within the area investigated has been covered.

It is seen that the chain of operations which produced the local distribution of the establishments and the working population, over squares, is quite long. To mention only a few, the records of the observations of the phenomena concerned were translated into punch-card form, the information on the punch-cards was used to produce the local distribution of the establishments on the maps, and on the basis of the maps and the translucent overlay, the local distribution of the establishments and their personnel over squares was recorded on work-sheets, for each particular branch. The personnel figures for the individual branches were then added for each particular square, to form the data on the distribution over squares of the working population.

Obviously, this procedure implied a heavy risk of making mistakes and errors. It was therefore considered worthwhile to carry out a separate investigation to appraise the accuracy of the data.

A random sample was drawn from the register of establishments, consisting of some 300 punch-cards. The way in which these punch-cards, each of which represented an establishment, had been plotted on the maps, was then carefully examined. It was found that mistakes had been committed in *15* cases: 15 of the establishments could not be found on their correct addresses on the maps concerned. Two of them had been plotted under the wrong address, and the other 13 could not be found at all. It may be that they had been plotted on the wrong maps, but that could not be investigated into. Consequently, the inference to be drawn from this sample must be that mistakes had been committed in about five percent of the cases, the standard error of the estimate being 0.013.

To appraise the accuracy of the "translation" from the maps to the work-sheets,

the operations involved were *repeated* on a sampling basis. That is to say, a reliability test was performed. The 400 branches were classified into six strata, according to the number of establishments per branch. Within each stratum a simple random sample of *branches* was selected. Since each branch was represented on a different map, the procedure really implied that we sampled a set of maps. A simple random sample of squares was then drawn, and for each of the squares selected the number of establishments, and their personnel, was recorded for all the branches in the sample. The data thus found were then compared to the corresponding data of the previous investigation, and all the deviations found were recorded.

It was considered appropriate to distinguish between two types of deviation. One was the border-line cases and the other was the pure mistakes. In some cases it was found that an establishment could have been referred to either of two squares (or in extreme cases to one of four squares); that is to say, the instrument used to refer establishments to squares was not sufficiently refined to result in a unique decision in all cases. When a particular deviation could not be explained by an analysis of the records of the adjacent squares, it was concluded that a pure mistake had been committed. The results of this post investigation were as follows:

Pure mistakes had been committed in the recording of *1.4* percent of all establishments (the standard error of this estimate was 0.003). Expressed in the corresponding personnel data, the figure was *1.9* percent (with a standard error of 0.008).

The deviations which could be referred to as border-line cases, arose in the recording of *5.3* percent of all establishments (with a standard error of 0.016). Expressed in the corresponding personnel data, the figure was *3.3* percent (with a standard error of 0.008).

The inverse of the matrix (I—A) — where I is the identity matrix and

	1	2	3	4	5	6	7	8	9	10
1	1,00507	0,00070	0,00596	0,07038	0,02995	0,01013	.....	.....	.....	.....
2	0,00004	1,01524	0,00003	0,00001	0,00006	0,00001	0,00002	0,00004	0,00001	0,00011
3	0,00007	.....	1,00528	0,00503	0,00028	.....	.....	.....	.....	.....
4	0,01307	0,00130	0,05133	1,00117	0,05580	0,00024	.....	.....	.....	.....
5	0,00003	0,02440	0,09456	0,00048	1,04514	0,00210	.....	.....	.....	.....
6	0,01310	0,00197	0,00766	0,00096	0,08417	1,00230	.....	.....	.....	.....
7	0,00144	0,00238	0,00616	0,00013	0,00796	0,02711	1,08109	0,12012	.....	.....
8	.....	.....	.....	.....	.....	.....	.....	1,01010	.....	.....
9	.....	.....	.....	.....	.....	.....	.....	0,00001	1,00064	0,02138
10	0,00002	.....	0,00001	0,00001	0,00001	.....	0,00009	0,00003	0,03207	1,06906
11	.....	.....	.....	.....	.....	.....	.....	.....	0,01660	0,02301
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	0,00072	0,00011	0,00021	0,00016	0,00025	0,00019	0,00077	0,00076	0,00005	0,00007
14	0,00015	0,00011	0,00020	0,00006	0,00011	0,00009	0,00006	0,00011	0,00004	0,00013
15	0,00007	0,00002	0,00005	0,00002	0,00004	0,00003	0,00006	0,00106	.....	0,00002
16	0,00026	0,00026	0,00046	0,00011	0,00029	0,00018	0,00045	0'00082	0,00015	0,00021
17	0,00005	0,00004	0,00008	0,00002	0,00006	0,00003	0,00013	0,00016	0,00002	0,00003
18	0,00001	.....	.....	.....	.....	.....	0,00004	0,00001	.....	.....
19	0,00003	.....	0,00001	0,00002	0,00002	.....	0,00016	0,00008	.....	.....
20	0,00020	0,00003	0,00008	0,00004	0,00009	0,00006	0,00021	0,00013	0,00002	0,00002
21	0,00023	0,00003	0,00008	0,00005	0,00010	0,00006	0,00028	0,00016	0,00002	0,00002
22	0,00344	0,00045	0,00125	0,00188	0,00206	0,00089	0,01626	0,00818	0,00007	0,00012
23	0,00001	.....	.....	.....	.....	.....	0,00003	0,00003	.....	.....
24	0,00244	0,00038	0,00059	0,00038	0,00066	0,00062	0,00060	0,00093	0,00019	0,00025
25	0,00004	0,00214	0,00336	0,00005	0,00228	0,00107	0,00122	0,00127	0,00005	0,00007
26	0,00078	0,00086	0,00143	0,00018	0,00103	0,00057	0,00068	0,00093	0,00014	0,00017
27	0,00021	0,00341	0,00760	0,00217	0,00417	0,00222	0,00199	0,01101	0,09288	0,00309
28	0,00006	0,00019	0,00607	0,00011	0,00136	0,00009	0,00035	0,00041	0,00243	0,00258
29	0,00025	0,00007	0,00013	0,00009	0,00012	0,00007	0,00044	0,00032	0,00003	0,00005
30	0,00096	0,00047	0,00061	0,00034	0,00065	0,00033	0,00059	0,00117	0,00024	0,00053
31	0,00002	0,00004	0,00006	0,00002	0,00004	0,00002	0,00008	0,00010	0,00002	0,00003
32	0,00002	0,00014	0,00053	.....	0,00582	0,00001	.....	0,00113	.....	0,00009
33	0,00280	0,00028	0,00058	0,00034	0,00164	0,00024	0,00042	0,00039	0,00046	0,01285
34	0,01439	0,01045	0,01962	0,00628	0,01078	0,00852	0,00490	0,00963	0,00334	0,01268
35	0,04991	0,00708	0,00987	0,00741	0,01121	0,01245	0,00582	0,01664	0,00355	0,00460
36	0,00350	0,00038	0,00341	0,00038	0,00447	0,00101	0,01085	0,00249	0,00017	0,00021
37	0,00297	0,00028	0,00046	0,00036	0,00056	0,00050	0,00049	0,00069	0,00014	0,00018
38	0,00152	0,00193	0,00328	0,00167	0,00178	0,00139	0,00119	0,00210	0,00048	0,00173
39	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
41	0,00003	0,00010	0,00243	0,00108	0,00123	0,00007	0,00120	0,00131	0,00006	0,00007
42	0,00028	0,00011	0,00018	0,00010	0,00020	0,00010	0,00058	0,00908	0,00003	0,00013
43	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
44	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
45	.....	0,00001	0,00001	.....	.....	.....	0,00004	0,00002	.....	.....
46	0,00069	0,00011	0,00016	0,00011	0,00018	0,00018	0,00021	0,00038	0,00005	0,00007
47	0,00077	0,00076	0,01228	0,00026	0,01659	0,00335	0,04154	0,00755	0,00024	0,00031
48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
50	0,01096	0,00267	0,00676	0,00604	0,00484	0,00450	0,04242	0,01381	0,00023	0,00035
51	0,00007	0,00319	0,00324	0,00003	0,00113	0.00005	0,00114	0,00017	0,00107	0,00115
52	0,00357	0,00396	0,00655	0,00153	0,00423	0,00256	0,00741	0,01428	0,00253	0,00275
53	0,00396	0,00913	0,00668	0,00172	0,00443	0,00416	0,02884	0,01080	0,00270	0,00306
54	0,01443	0,03243	0,03635	0,02095	0,01516	0,01186	0,03274	0,07715	0,01687	0,02346
55	.....	.....	0,00001	.....	.....	.....	0,00001	0,00002	.....	.....
56	.....	0,00003	0,00523	0,00003	0,00007	.....	.....	.....	.....	.....
57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
58	0,00116	0,00474	0,00621	0,00042	0,00180	0,00046	0,00276	0,00236	0,00244	0,00261
59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	0,00005	.....	0,00001	.....	.....	.....	.....	.....
61	0,00011	0,00010	0,00026	0,00105	0,00118	0,00010	0,00230	0,00141	0,00109	0,00117
62	0,00008	0,00005	0,00006	0,00003	0,00004	0,00003	0,00008	0,00516	0,00002	0,00003

A is the matrix of structural coefficients as calculated from the basic table of 1950

11	12	13	14	15	16	17	18	19	20	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
0,00001	0,00005	0,00001	0,00002	0.00002	0,00005	0,00009	0,00010	0,00011	0,00005	2
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
.....	.....	.....	.....	.....	.....	.....	.....	0,00004	.....	7
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
.....	0,00004	.....	.....	.....	.....	.....	.....	.....	.....	9
.....	0,00108	.....	.....	.....	.....	.....	.....	.....	0,00001	10
1,06045	0,17141	.....	.....	.....	.....	.....	.....	.....	.....	11
.....	1,01010	.....	.....	.....	.....	.....	.....	.....	.....	12
0,00009	0,00039	1,04956	0,00121	0,18236	0,03032	0,04314	0,02722	0,00118	0,08620	13
0,00004	0,00019	0,00012	1,00010	0,00010	0,00009	0,00012	0,00012	0,00005	0,00019	14
0,00002	0,00006	0,00003	0,00003	1,00003	0,00003	0,00003	0,00203	0,00001	0,00004	15
0,00023	0,00097	0,00013	0,01559	0,03646	1,01467	0,01929	0,02205	0,01056	0,00392	16
0,00003	0,00012	0,00003	0,01052	0,03667	0,00747	1,03770	0,02200	0,01050	0,00372	17
.....	.....	.....	.....	.....	.....	.....	1,00000	.....	.....	18
.....	.....	.....	.....	.....	.....	.....	0,00001	1,00003	0,00005	19
0,00003	0,00012	0,00005	0,00222	0,01069	0,00333	0,00891	0,20402	0,00320	1,01628	20
0,00003	0,00012	0,00007	0,00055	0,00202	0,00714	0,02134	0,06127	0,00060	0,09653	21
0,00012	0,00034	0,00009	0,00011	0,00028	0,00038	0,00072	0,00143	0,00320	0,00523	22
.....	0,00001	0,00109	0,00029	0,00628	0,00654	0,01760	0,00575	0,00027	0,00844	23
0,00033	0,00144	0,00063	0,00059	0,00057	0,00051	0,00061	0,00039	0,00026	0,00041	24
0,00110	0,00129	.....	0,00003	0,00010	0,00108	0,00011	0,00032	0,00007	0,00118	25
0,00051	0,00111	0,00021	0,00020	0,00031	0,00056	0,00028	0,00229	0,00020	0,00056	26
0,00245	0,01124	0,00008	0,00018	0,00552	0,00337	0,00250	0,00095	0,00501	0,00234	27
0,00019	0,00046	0,00004	0,00005	0,00020	0,00014	0,00014	0,00085	0,00244	0,00358	28
0,00006	0,00023	0,00006	0,00005	0,00006	0,00006	0,00008	0,00008	0,00330	0,00016	29
0,00045	0,00179	0,00037	0,00036	0,00048	0,00140	0,00265	0,00282	0,00347	0,00148	30
0,00004	0,00015	0,00002	0,00002	0,00002	0,00002	0,00003	0,00003	0,00002	0,00002	31
.....	.....	.....	.....	.....	.....	0,00002	0,00002	0,00002	0,00001	32
0,00012	0,00048	0,00025	0,00143	0,00036	0,00148	0,00290	0,00315	0,00273	0,00180	33
0,00397	0,01710	0,01205	0,00950	0,00917	0,00806	0,01150	0,01153	0,00444	0,01898	34
0,00561	0,02713	0,01300	0,01200	0,01096	0,00992	0,01129	0,00717	0,00499	0,00755	35
0,00104	0,00114	0,00014	0,00071	0,00166	0,00133	0,00238	0,00116	0,00052	0,00139	36
0,00024	0,00105	0,00157	0,00050	0,00075	0,00151	0,00271	0,00252	0,00024	0,00051	37
0,00088	0,00338	0,00152	0,00035	0,00073	0,00146	0,00173	0,00297	0,00151	0,00168	38
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
0,00005	0,00014	.....	.....	0,00006	0,00005	0,00003	0,00005	0,00008	0,00009	41
0,00007	0,00238	0,00119	0,00009	0,00039	0,00133	0,00154	0,00064	0,00038	0,00163	42
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	44
0,00002	0,00001	.....	.....	.....	.....	.....	0,00002	0,00001	0,00001	45
0,00010	0,00042	0,00017	0,00016	0,00016	0,00014	0,00017	0,00012	0,00008	0,00012	46
0,00344	0,00164	0,00020	0,00237	0,00589	0,00454	0,00886	0,00368	0,00147	0,00478	47
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49
0,00032	0,00102	0,00018	0,00023	0,00049	0,00148	0,00257	0,00158	0,00039	0,00493	50
0,00001	0,00005	0,00002	0,00002	0,00002	0,00003	0,00003	0,00003	0,00209	0,00002	51
0,00411	0,01716	0 00128	0,00235	0,00396	0 00472	0,00274	0,00589	0,00380	0,00404	52
0,01674	0,00681	0,00251	0,00242	0,00514	0,00463	0,00293	0,01749	0,01069	0,00800	53
0,03294	0,10488	0,01638	0,01093	0,01483	0,01206	0,01819	0,02036	0,01656	0,01421	54
.....	0,00002	.....	.....	.....	.....	.....	.....	.....	.....	55
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	56
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	57
0,00064	0,00339	0,00033	0,00034	0,00054	0,00155	0,00064	0,00143	0,00049	0,00393	58
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	59
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60
0,00112	0,00137	0,00004	0,00006	0,00013	0,00108	0,00116	0,00038	0,00008	0,00117	61
0,00006	0,00219	0,00003	0,00003	0,00003	0,00003	0,00004	0,00005	0,00003	0,00003	62

The inverse of the matrix (I—A) — where I is the identity matrix

	21	22	23	24	25	26	27	28	29	30
1	.....	.....	.....	.....	.....	.....	0,00002	.....	.....	0,00002
2	0,00005	0,00012	.....	0,00001	0,00002	0,00006	0,00014	0,00006	0,00003	0,02691
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	.....	.....	.....	.....	.....	.....	0,00007	0,00002	.....	0,00004
5	.....	.....	.....	.....	.....	.....	0,00011	0,00003	.....	0,00065
6	.....	.....	.....	.....	.....	.....	0,00002	.....	.....	0,00005
7	.....	0,00023	.....	.....	.....	.....	0,00002	0,00002	0,01150	0,00006
8	.....	.....	.....	.....	.....	.....	0,00001	.....	.....	.....
9	.....	.....	.....	.....	.....	.....	0,00001	.....	.....	.....
10	0,00001	.....	.....	0,00007	0,00008	0,00003	0,00004	0,00003	.....	.....
11	.....	0,00005	.....	.....	.....	.....	.....	.....	0,00226	.....
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	0,06454	0,03819	0,07814	0,00035	0,00021	0,00011	0,00032	0,00030	0,00013	0,00010
14	0,00023	0,00010	0,00011	0,00022	0,00010	0,00011	0,00010	0,00017	0,00005	0,00005
15	0,00004	0,00002	0,00002	0,00003	0,00002	0,00002	0 00006	0,00004	0,00002	0,00002
16	0,00581	0,00038	0,00036	0,00026	0,00028	0,00018	0,00077	0,00045	0,00022	0,00019
17	0,00574	0,00230	0,00232	0,00006	0,00005	0,00003	0,00013	0,00008	0,00003	0,00003
18	.....	.....	.....	0,00003	0,00004	0,00002	0,00002	0,00002	.....	.....
19	0,00005	0,01017	0,00009	0,00007	0,00004	0,00002	0,00003	0,00003	0,00002	.....
20	0,01114	0,00121	0,00864	0,00007	0,00007	0,00004	0,00014	0,00009	0,00003	0,00003
21	1,07666	0,00894	0,01867	0,00009	0,00006	0,00003	0,00014	0,00010	0,00004	0,00003
22	0,00517	1,01659	0,00865	0,00728	0,00419	0,00181	0,00349	0,00338	0,00179	0,00084
23	0,01141	0,00123	1,03344	0,00001	.....	.....	0,00001	.....	.....	.....
24	0,00051	0,00025	0,00027	1,11136	0,00015	0,00013	0,00062	0,00065	0,00022	0,00023
25	0,00115	0,00112	0,00111	0,00006	1,01083	0,00208	0,00737	0,00568	0,00113	0,00136
26	0,00055	0,00046	0,00048	0,00014	0,31819	1,01593	0,01816	0,01128	0 00047	0,00076
27	0,00134	0,00134	0,00228	0,00238	0,00023	0,00013	1,01995	0,30559	0,00236	0,01635
28	0,00012	0,00009	0,00011	0,00008	0,00008	0,00004	0,01520	1,13457	0,00009	0,00030
29	0,00016	0,02169	0,00021	0,00018	0,00011	0,00005	0,00017	0,00136	1,06389	0,00005
30	0,00149	0,00248	0,00026	0,00022	0,00086	0,00223	0,00264	0,00121	0,00021	1,04285
31	0,00002	0,00002	0,00002	0 00002	0,00002	0,00001	0,00007	0,00005	0,00002	0,00002
32	0,00001	0,00005	.....	.....	.....	.....	.....	.....	0,00002	0,00041
33	0,00186	0,00761	0,00032	0,00055	0,00035	0,00039	0,00044	0,00045	0,00263	0,06147
34	0,02267	0,01020	0,01091	0,02204	0,00970	0,01126	0,00843	0,01592	0,00414	0,00489
35	0,00977	0,00471	0,00517	0,00469	0,00232	0,00231	0,00870	0,01170	0,00390	0,00427
36	0,00130	0,00073	0,00073	0,00053	0,00089	0,00041	0,00711	0,00264	0,00113	0,00085
37	0,00159	0,00025	0,00032	0,00019	0,00011	0,00010	0,00051	0,00051	0,00018	0,00018
38	0,00163	0,00144	0,00149	0,00265	0,00042	0,00021	0,00192	0,00240	0,00134	0,00145
39	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
41	0,00003	0,00003	0,00003	0,00003	0,00594	0,00214	0,00878	0,01444	0,00005	0,00016
42	0,00162	0,03003	0,00709	0,00025	0,02192	0,00023	0,00044	0,00034	0,01156	0,05653
43	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
44	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
45	.....	.....	.....	.....	.....	.....	0,00002	0,00001	.....	.....
46	0,00014	0,00007	0,00008	0,00010	0,00008	0,00005	0,00018	0,00019	0,00006	0,00007
47	0,00468	0,00243	0,00243	0,00133	0,00258	0,00114	0,02615	0,00922	0,00390	0,00284
48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
50	0 00476	0,00053	0,00038	0,03414	0,03612	0,01572	0,01807	0,01521	0,00403	0,00446
51	0,00003	0,00012	0,00002	0,00002	0,00003	.....	0,00003	0,00003	0,00223	0,00237
52	0,00169	0,00265	0,00260	0,00266	0,00442	0,00236	0,01374	0,00694	0,00378	0,00321
53	0,00183	0,00277	0,00266	0,00285	0,00686	0,00340	0,00424	0,00538	0,00289	0,00321
54	0,01352	0,01066	0,01070	0,01164	0,01327	0,00653	0,02488	0,03196	0,00823	0,00951
55	.....	.....	.....	.....	.....	.....	0,00102	0,00031	.....	0,00002
56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
58	0,00378	0,00029	0,00040	0,00050	0,00060	0,00029	0,01136	0,00512	0,00042	0,00073
59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
61	0,00116	0,00010	0,00110	0,00006	0,00010	0,00004	0,00114	0,00155	0,00113	0,00121
62	0,00003	0,00002	0,00002	0,00002	0,00002	0,00001	0,00005	0,00005	0,00002	0,00002

and A is the matrix of structural coefficients as calculated from the basic table of 1950

31	32	33	34	35	36	37	38	39	40	
0,00012	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
0,03175	0,00689	0,00889	0,00015	0,00051	0,00018	0,00003	0,00002	0,00003	0 00002	2
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
0,00005	.....	0,00001	.....	.....	.....	.....	.....	.....	.....	4
0,00079	0,00017	0,00021	.....	0,00001	.....	.....	.....	.....	.....	5
0,01014	0,00001	0,00002	.....	.....	.....	.....	.....	.....	.....	6
0,00035	0,00002	0,00002	.....	0,00005	.....	.....	.....	.....	.....	7
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
.....	.....	.....	.....	.....	.....	.....	.....	.....	0,00001	9
.....	.....	0,00002	.....	0,00002	0,00002	0,00002	0,00002	0,00002	0,00007	10
.....	.....	.....	.....	0,00002	.....	.....	.....	.....	.....	11
.....	.....	.....	.....	0,00003	0,00001	.....	.....	.....	.....	12
0,00008	0,00007	0,00014	0,00064	0,01449	0,00523	0,00041	0,00027	0,00028	0,00036	13
0,00006	0,00009	0,00009	0,01065	0,00018	0,00013	0,00008	0,00005	0,00008	0,00006	14
0,00002	0,00002	0,00002	0,00108	0,00132	0,00003	0,00004	0,00002	0 00003	0,00005	15
0,00022	0,00043	0,00020	0,00569	0,00037	0,00027	0,00043	0,00029	0,00034	0,00065	16
0,00003	0,00006	0,00003	0,00131	0,00015	0,00009	0,00008	0,00005	0,00005	0,00011	17
.....	.....	.....	.....	.....	.....	.....	0,00001	0,00001	0,00003	18
.....	.....	0,00002	0,00001	0,00003	0,00003	0,00006	0,00004	0,00003	0,00006	19
0,00003	0 00003	0,00003	0,00012	0 00405	0,00625	0,00009	0,00006	0,00007	0,00014	20
0,00003	0,00003	0,00004	0,00014	0,00457	0,00495	0,00013	0,00008	0,00008	0,00014	21
0,00063	0,00026	0,00227	0,00118	0,00338	0,00343	0,00643	0,00445	0,00332	0,00599	22
.....	.....	.....	0,00007	0,00011	0,00011	0,00001	.....	.....	0,00002	23
0,00019	0,00015	0,00017	0,00076	0,06016	0,02721	0,00066	0,00041	0,00067	0,00044	24
0,00134	0,00234	0,00129	0,00003	0,00013	0,00007	0,00004	0,00002	0,00306	0,00007	25
0,00078	0,00082	0,00051	0,00025	0,01842	0,01039	0,00030	0,00018	0,00124	0,00023	26
0,01740	0,00103	0,00285	0,00012	0,00095	0,00052	0,00155	0,00033	0,00036	0,00067	27
0,00377	0,00012	0,00010	0,00003	0,00021	0,00019	0,00026	0,00017	0,00020	0,00025	28
0,00005	0,00003	0,00007	0,00009	0,00421	0,00011	0,00025	0,00018	0,00021	0,00021	29
0,04233	0,04664	0,01891	0,00066	0,01909	0,00659	0,00089	0,00068	0,00116	0,00053	30
1,00504	0,00003	0,00002	0,00001	0,00004	0,00002	0,00008	0,00006	0,00010	0,00007	31
0,00340	1,11118	0,00785	0,00013	0,00002	0,00001	.....	.....	.....	.....	32
0,00619	0,00946	1,17783	0,01888	0,00304	0,00188	0,00028	0,00021	0,00027	0,00032	33
0,00592	0,00836	0,00842	1,06481	0,01727	0,01277	0,00678	0,00480	0,00736	0,00510	34
0,00335	0,00196	0,00318	0,01531	1,28521	0,00453	0,01092	0,00682	0,01170	0,00464	35
0,00086	0,00176	0,00051	0,00123	0,00623	1,01189	0,00305	0,00134	0,00092	0,00691	36
0,00015	0,00012	0,00013	0,00060	0,04790	0,02107	1,03142	0,00029	0,00046	0,00036	37
0,00148	0,00159	0,00157	0,00143	0,00207	0,00148	0,00176	1,02183	0,00240	0,00113	38
.....	.....	.....	.....	.....	.....	.....	.....	1,00000	.....	39
.....	.....	.....	.....	.....	.....	.....	.....	.....	1,00200	40
0,00022	0,00004	0,00004	.....	0,00015	0,00012	0,00005	0,00003	0,00004	0,00004	41
0,04561	0,00503	0,00874	0,00024	0,00387	0,00205	0,00027	0,00019	0,00026	0,00024	42
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	44
0,00002	.....	.....	.....	0,00004	0,00004	0,00002	0,00001	0,00001	0,00002	45
0,00006	0,00004	0,00006	0,00021	0,01680	0,00618	0,00019	0,00012	0,00018	0,00015	46
0,00285	0,00597	0,00149	0,00030	0,01373	0,00656	0,01073	0,00434	0,00234	0,02553	47
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49
0,00328	0,00061	0,00876	0 00032	0,00844	0,00812	0,00884	0,01067	0,01062	0,03117	50
0,00233	0,00358	0,00132	0,00005	0,00145	0,00109	0,00109	0,00422	0,00003	0,01035	51
0,00350	0,00752	0,00295	0,00129	0,00349	0,00286	0,00748	0,00502	0,00588	0,01165	52
0,00328	0,00626	0,00297	0,00041	0,01120	0,00949	0,01800	0,01352	0,01168	0,01160	53
0,01171	0,01317	0,01138	0,01142	0,01778	0,01146	0,06428	0,05318	0,09184	0,03518	54
0,00003	.....	.....	.....	.....	.....	.....	.....	.....	.....	55
0,00513	.....	.....	.....	.....	.....	.....	.....	.....	.....	56
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	57
0,01120	0,00042	0,00045	0,00036	0,02204	0,02966	0,00208	0,00078	0,00083	0,00444	58
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	59
0,00005	.....	.....	.....	.....	.....	.....	.....	.....	.....	60
0,00117	0,00009	0,00124	0,00006	0,00146	0,00113	0,00115	0,00010	0,00013	0,00212	61
0,00002	0,00002	0,00002	0,00003	0,00145	0,00109	0,00010	0,00008	0,00012	0,00006	62

The inverse of the matrix (I—A) — where I is the identity matrix

	41	42	43	44	45	46	47	48	49	50	51
1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	0,00002	0,00001	0,00003	0,00003	0,00004	0,00004	0,00013	0,00010	0,00007	0,00005	0,00006
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	.....	.....	.....	.....	.....	.....	0,00001	.....	0,00001	.....	.....
7	.....	.....	.....	.....	.....	.....	0,00002	0,00003	0,00001	0,00003	.....
8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9	.....	.....	.....	.....	.....	0,00001	.....	.....	.....	0,00005	0,00002
10	0,00004	0,00001	.....	0,00002	0,00002	0,00003	.....	.....	.....	0,00218	.....
11	.....	.....	.....	.....	.....	0,00034	.....	.....	.....	0,00005	.....
12	.....	.....	.....	.....	.....	0,00202	.....	.....	.....	.....	.....
13	0,00024	0,00024	0,00030	0,00031	0,00031	0,00089	0,00221	0,00175	0,00009	0,00452	0,00066
14	0,00005	0,00006	0,00007	0,00007	0,00007	0,00013	0,00048	0,00045	0,00001	0,00005	0,00010
15	0,00002	0,00002	0,00002	0,00003	0,00003	0,00004	0,00106	0,00105	0,00001	0,00002	0,00005
16	0,00034	0,00034	0,00029	0,00025	0,00037	0,00068	0,00168	0,00251	0,00039	0,00030	0,00126
17	0,00005	0,00005	0,00005	0,00005	0,00006	0,00012	0,00122	0,00226	0,00006	0,00031	0,00017
18	0,00002	.....	.....	0,00001	.....	0,00001	.....	.....	0,00100	0,00102	.....
19	0,00004	0,00004	0,00004	0,00004	0,00003	0,00017	0,00011	0,00016	.....	0,00114	0,00011
20	0,00006	0,00004	0,00005	0,00009	0,00008	0,00011	0,00266	0,00270	0,00022	0,00143	0,00010
21	0,00007	0,00007	0,00008	0,00011	0,00010	0,00022	0,00255	0,00299	0,00008	0,00120	0,00017
22	0,00405	0,00402	0,00371	0,00406	0,00300	0,01697	0,01124	0,01575	0,00065	0,11401	0,01108
23	.....	.....	.....	.....	.....	0,00003	0,00010	0,00013	.....	0,00016	0,00003
24	0,00034	0,00031	0,00063	0,00069	0,00083	0,00088	0,00713	0,00488	0,00007	0,00056	0,00083
25	0,00215	0,00111	0,00021	0,00125	0,00116	0,00116	0,00114	0,00108	0,00103	0,00117	0,00005
26	0,00085	0,00049	0,00046	0,00073	0,00196	0,00079	0,00427	0,00241	0,00039	0,00059	0,00040
27	0,00242	0,00135	0,00715	0,00325	0,01674	0,00374	0,01121	0,00330	0,00173	0,00044	0,00305
28	0,00018	0,00014	0,00599	0,00251	0,00047	0,00033	0,00258	0,00012	0,00129	0,00019	0,00054
29	0,00015	0,00014	0,00021	0,00021	0,00022	0,00052	0,00137	0,00249	0,00109	0,00252	0,00040
30	0,00057	0,00042	0,00109	0,00092	0,00125	0,00135	0,00325	0,00291	0,00121	0,00108	0,00148
31	0,00005	0,00004	0,00009	0,00008	0,00011	0,00012	0,00105	0,00001	0,00102	0,00007	0,00014
32	.....	.....	.....	.....	.....	.....	0,00002	0,00002	0,00001	0,00002	0,00002
33	0,00020	0,00018	0,00024	0,00026	0,00026	0,00047	0,00263	0,00357	0,00141	0,00341	0,00279
34	0,00443	0,00502	0,00653	0,00628	0,00665	0,01153	0,04757	0,04453	0,00068	0,00495	0,00762
35	0,00565	0,00533	0,01113	0,01144	0,01447	0,01565	0,00720	0,00442	0,00105	0,00930	0,01442
36	0,00115	0,00086	0,00071	0,00295	0,00181	0,00126	0,25340	0,09180	0,00030	0,00241	0,00114
37	0,00024	0,00023	0,00044	0,00256	0,00059	0,00269	0,00654	0,00414	0,00006	0,00041	0,00059
38	0,00118	0,00082	0,00224	0,00183	0,00247	0 00267	0,00741	0,00243	0,00226	0,00273	0,00296
39	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
41	1,04173	0,00004	0,00016	0,00009	0,00123	0,00218	0,00017	0,00006	0,00007	0,00005	0,00015
42	0,00022	1,07545	0,12924	0,17765	0,00560	0,07592	0,00102	0,00085	0,00018	0,00356	0,00047
43	.....	.....	1,00000	.....	.....	.....	.....	.....	.....	.....	.....
44	.....	.....	.....	1,00000	.....	.....	.....	.....	.....	.....	.....
45	0,00002	0,00001	0,00003	0,00002	1,00002	0,00003	0,00002	.....	0,00002	0,00002	0,00007
46	0,00010	0,00009	0,00024	0,00019	0,00024	1,00044	0,00163	0,00062	0,00003	0,00117	0,00024
47	0,00346	0,00245	0,00174	0,01074	0,00582	0,00287	1,00227	0,00293	0,00030	0,00054	0,00101
48	.....	.....	.....	.....	.....	.....	.....	1,00000	.....	.....	.....
49	.....	.....	.....	.....	.....	.....	.....	.....	1,00000	.....	.....
50	0,01638	0,00581	0,00129	0,01157	0,00703	0,01146	0,00265	0,00117	0,00053	1,01886	0,00348
51	0,00001	0,00112	0,00119	0,00021	0,00004	0,00011	0,00032	0,00013	0,05157	0,00004	1,03096
52	0,00614	0,00611	0,00503	0,00397	0,00639	0,01211	0,00653	0,00277	0,00706	0,00434	0,02396
53	0,00623	0,00718	0,01244	0,01258	0,00683	0,01255	0,00819	0,00324	0,01505	0,01070	0,03353
54	0,04388	0,03044	0,08565	0,06726	0,09280	0,10079	0,03492	0,00665	0,00772	0,05980	0,11272
55	0,00001	.....	0,00003	0,00001	0,00003	.....	0,00001	.....	.....	.....	0,00001
56	.....	.....	0,00002	.....	.....	.....	.....	.....	.....	.....	.....
57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
58	0,00607	0,00164	0,00649	0,00327	0,01140	0,01147	0,00893	0 00597	0,00478	0,00909	0,02797
59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
61	0,00217	0,00113	0,00527	0,00230	0,00217	0,00126	0,00036	0,00014	0,00014	0,00113	0,00227
62	0,00006	0,00004	0,00311	0,00010	0,00112	0,00814	0,00032	0,00011	0,00002	0,00009	0,00016

and A is the matrix of structural coefficients as calculated from the basic table of 1950

52	53	54	55	56	57	58	59	60	61	62	
.....	.....	.....	0,02269	0,00009	.....	.....	0,01283	0,00607	0,00009	.....	1
0,00008	0,00002	0,00036	0,07118	0,00016	0,00166	0,00002	0,00039	0,00008	0,00031	0,00001	2
.....	.....	.....	0,00337	.....	.....	.....	0,00011	0,00005	0,00001	.....	3
.....	.....	.....	0,07082	0,00018	.....	.....	0,02257	0,01067	0,00028	.....	4
.....	.....	.....	0,10134	0,00022	0,00004	.....	0,02739	0,01050	0,00041	.....	5
0,00001	.....	0,00001	0,02047	0,00005	0,00051	.....	0,00660	0,00294	0,00008	.....	6
.....	.....	0,00002	0,01547	0,00007	0,00002	.....	0,00274	0,00243	0,00006	.....	7
.....	.....	.....	0,01010	0,00002	.....	.....	0,00106	0,00101	0,00004	.....	8
0,00104	0,00004	.....	.....	0,00001	.....	0,00003	.....	.....	0,00006	.....	9
0,00009	0,00001	.....	0,00003	.....	0,00003	0,00004	.....	.....	0,00003	0,00001	10
0,00002	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0,00005	12
0,00386	0,00022	0,00147	0,00028	0,00062	0,00040	0,00027	0,00262	0,00011	0,00033	0,00345	13
0,00120	0,00010	0,00043	0,00017	0,00022	0,00011	0,00008	0,00017	0.00008	0,00012	0,00005	14
0,00110	0,00005	0,00017	0,00005	0,00108	0,00003	0,00005	0,00003	0,00002	0,00007	0,00002	15
0,05318	0,00197	0,00035	0,00034	0,00183	0,00139	0,00170	0,00040	0,00012	0,00285	0,00038	16
0,00593	0,00022	0,00008	0,00006	0,00015	0,00007	0,00020	0,00013	0,00002	0,00032	0,00006	17
0,00003	.....	.....	0,00001	.....	0,00002	0,00002	.....	.....	0,00001	.....	18
0,00010	.....	.....	0,00002	.....	0,00005	0,00002	0,00002	.....	0,00002	0,00006	19
0,00164	0,00008	0,00041	0,00008	0,00013	0,00008	0,00009	0,00031	0,00003	0,00012	0,00004	20
0,00093	0,00006	0,00046	0,00009	0,00013	0,00011	0,00007	0,00063	0,00004	0,00009	0,00007	21
0,00984	0,00082	0,00055	0,00201	0,00063	0,00496	0,00212	0,00182	0,00032	0,00187	0,00617	22
0,00047	0,00002	0,00001	.....	0,00002	0,00002	0,00002	0,03247	0,00003	0,00003	0,00001	23
0,00155	0,00034	0,00709	0,00082	0,00164	0,00075	0,00042	0 00042	0,00043	0,00042	0,00021	24
0,00029	0,00009	0,00005	0,00148	0,00020	0,00113	0,00006	0,00123	0,00112	0,00011	0,00007	25
0,00102	0,00031	0,00290	0,00083	0,00213	0,00071	0,00025	0,00058	0,00165	0,00035	0,00321	26
0,01825	0,00826	0,00177	0,00258	0,02252	0,00328	0,00349	0,00200	0,00434	0,00804	0,00336	27
0,00634	0,00502	0,00127	0,00148	0,00434	0,00042	0,00268	0,00136	0,01147	0,00637	0,00015	28
0,00034	0,00008	0,00149	0,00019	0,00252	0,00026	0,00013	0,00122	0,00010	0,00013	0,00017	29
0,00118	0,00046	0,00870	0,00132	0,00281	0,00354	0,00068	0,00127	0,00171	0,00066	0,00038	30
0,00113	0,00007	0,00101	0,00231	0,00025	0,05036	0,00009	0,00426	0,00106	0,00012	0,00004	31
0,00002	.....	0,00001	0,00171	.....	0,00241	.....	0,00154	0,00007	.....	.....	32
0,00189	0,00021	0,00166	0,00065	0,00061	0,00303	0,00024	0,03129	0,00032	0,00028	0,00018	33
0,01604	0,00638	0,04257	0,01698	0,02071	0,01022	0,00499	0,01635	0,00786	0,00643	0,00480	34
0,00911	0,00560	0,12702	0,01483	0,02937	0,01329	0,00684	0,00764	0,00778	0,00650	0,00371	35
0,03994	0,00158	0,00179	0,00129	0,00103	0,00051	0,00140	0,00055	0,00036	0,00227	0,00037	36
0,00234	0,00029	0,00476	0,00061	0,00113	0,00051	0,00032	0,00032	0,00031	0,00035	0,00021	37
0,00282	0,00091	0,02588	0,00363	0,00571	0,00276	0,00143	0,00121	0,00127	0,00138	0,00075	38
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
0,00133	0,00126	0,00007	0,00132	0,00033	0,00008	0,00224	0,00011	0,00020	0,00037	0,00010	41
0,00058	0,00016	0,00103	0,00047	0,00028	0,00259	0,00013	0,00087	0,00020	0,00013	0,00210	42
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	44
0,00001	0,00104	0,00002	0,00002	0,00004	0,00102	0,00104	0,00105	.....	0,00209	.....	45
0,00039	0,00113	0,00171	0,00125	0,00043	0,00025	0,00013	0,00116	0,00011	0,00012	0,02507	46
0,03243	0,00145	0,00160	0,00363	0,00133	0,00058	0,00119	0,00100	0,00053	0,00200	0,00041	47
.....	.....	.....	.....	0,00001	.....	.....	.....	0,00100	.....	.....	48
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49
0,02650	0,00461	0,00155	0,01258	0,00371	0,01603	0,01674	0,00214	0,00165	0,01311	0,00571	50
0,00007	0,00001	0,00028	0,00040	0,00007	0,00016	0,00002	0,00010	0,00003	0,00002	0,00001	51
1,04297	0,03796	0,00228	0,00477	0,01264	0,00622	0,03278	0,00612	0,00148	0,05516	0,00691	52
0,00310	1,01814	0,01482	0,00420	0,00583	0,00506	0,01148	0,00217	0,00196	0,00691	0,00487	53
0,05318	0,03224	1,00542	0,08704	0,21923	0,10328	0,05276	0,03961	0,04681	0,04915	0,02768	54
0,00002	0,00001	.....	1,00001	0,00105	.....	.....	.....	.....	0,00402	.....	55
.....	.....	.....	0,00014	1,02042	0,00026	.....	0,00005	0,00104	0,00307	.....	56
.....	.....	.....	0,00400	.....	1,00000	.....	.....	.....	0,00002	.....	57
0,00742	0,01739	0,00566	0,00450	0,03314	0,01166	1,02660	0,00058	0,00054	0,07807	0,00070	58
.....	.....	.....	.....	0,00001	.....	.....	1,04712	0,00105	.....	.....	59
.....	.....	.....	.....	0,01021	.....	.....	.....	1,00101	0,00003	.....	60
0,00024	0,00110	0,00119	0,00136	0,00137	0,00022	0,00113	0,00124	0,00111	1,00119	0,00108	61
0,00011	0,00107	0,00116	0,00118	0,00128	0,00213	0,00007	0,00007	0,00006	0,00008	1,00024	61

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AT THE STOCKHOLM SCHOOL OF ECONOMICS

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