

**METHODS OF
ANALYSING CENSUS DATA
ON ECONOMIC ACTIVITIES
OF THE POPULATION**



UNITED NATIONS

Department of Economic and Social Affairs

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ANALYSING CENSUS DATA
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CONTENTS

	<u>Page</u>
PREFACE	v
INTRODUCTION	1
A. Purpose and scope of the manual	1
B. Concepts, definitions and classifications of census statistics on economic activities	2
C. Evaluation of the quality of data	6
I. MEASURES OF THE DEMOGRAPHIC DIMENSIONS OF THE LABOUR FORCE	8
A. Measures of the absolute and relative size of the labour force	8
B. Dependency ratios	13
C. Sex-age specific activity rates	14
D. Tables of economically active life	19
1. Measures of the length of active life	24
2. Loss of active years by mortality	27
3. Entries into the labour force, retirements, losses by death, and related measures	29
E. Intercensal comparisons of cohort activity rates	34
II. STUDIES OF FACTORS AFFECTING THE SIZE, COMPOSITION, AND GROWTH OF THE LABOUR FORCE	40
A. Framework of demographic and other factors	40
B. Influences of the population age structure	40
1. Age-standardized activity rates	40
2. Interdependence and interaction of factors	43
C. Influences of fertility, mortality and migration	46
1. Analytical projections	46
2. Estimates of the effects of internal migration	50
D. Influences of the marital and maternal status of women	51
1. Marital status and activity rates	51
2. Maternal status and activity rates	52
3. Analysis by multiple standardization	55
E. Influences of school attendance and educational level	56
1. School attendance and activity rates	57
2. Educational level and activity rates of adults	59
F. Influences of economic factors	62

CONTENTS (continued)

	<u>Page</u>
III. STUDIES OF TYPES OF ECONOMIC ACTIVITIES	64
A. Introduction	64
B. Classifications and summary groupings of industry, occupation and status	66
C. Effects of varying definitions, errors and biasses	73
D. Dual economic activities	76
E. Regional and urban-rural patterns	78
F. Trends over a period of time	84
G. Cohort analysis of changes in the industry, occupation and status groups	93
H. Age distribution of the labour force in the industry, occupation and status groups	101
I. Types of activity of workers in various age groups	108
J. Interrelations of industry and occupation	110
K. Interrelations of status with industry and occupation	120
L. Other variables related to the industry, occupation and status distributions	127

ANNEX

A COMPLETE TABLE OF ECONOMICALLY ACTIVE LIFE, UNITED ARAB REPUBLIC, MALES, 1960	129
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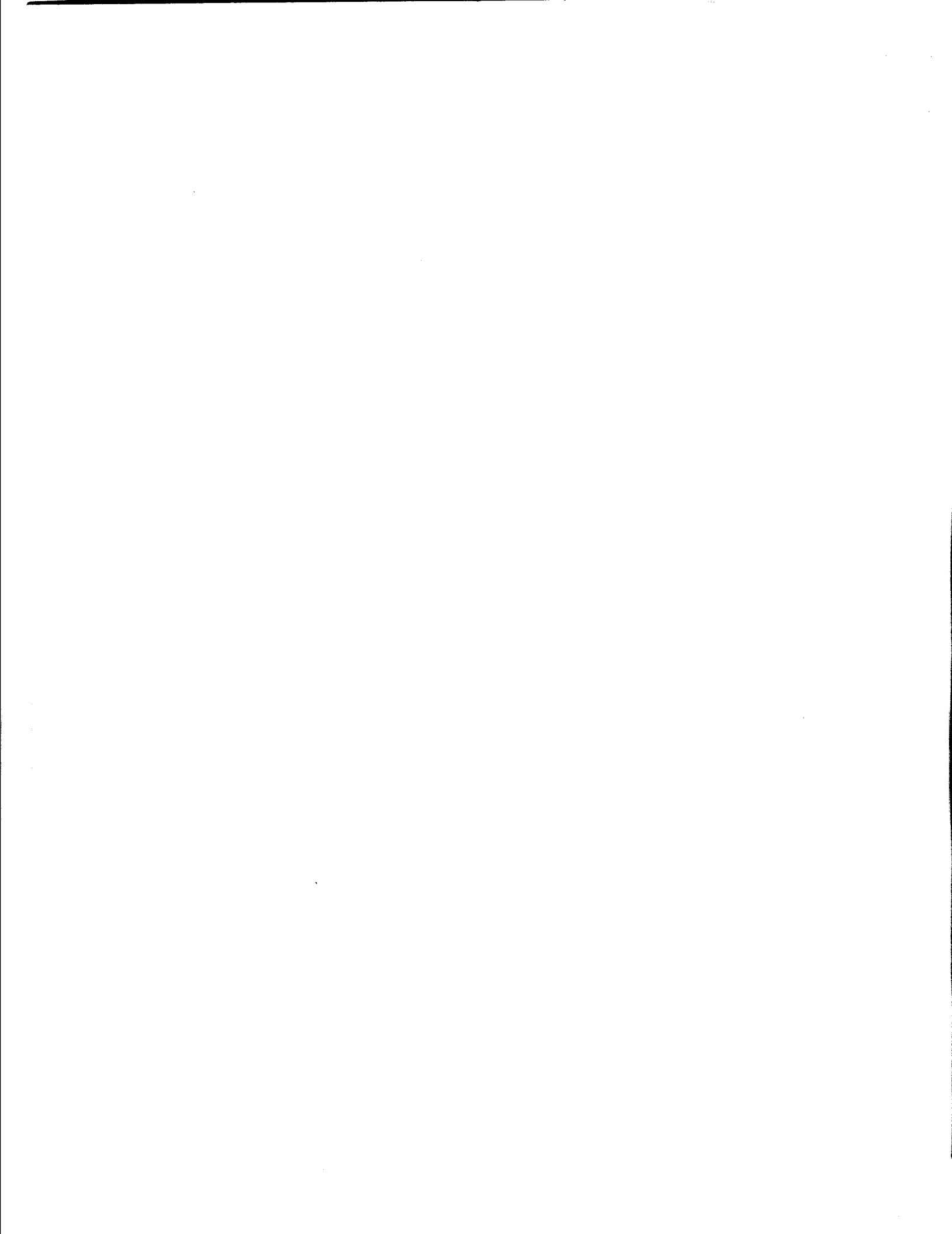
PREFACE

As part of the work programme developed by the Population Commission, the United Nations has during the past decade and a half published a series of manuals on demographic methodology. The first three manuals, which were issued in the 1950's, dealt with the following subjects: the methods of estimating the total population of countries for current dates (Manual I); the methods of evaluating the quality of basic data for population estimates (Manual II); and the methods of projecting the population by sex and age (Manual III). Manual IV, which appeared in 1967, presented methods of estimating basic demographic measures from incomplete data.

The present manual is the first to be issued in response to the Population Commission's recommendation that the United Nations prepare and publish technical manuals on methods of analysis and evaluation of population census results. It is concerned with methods of analysing data on economic activities and provides methodological guidelines for studies of the growth of the economically active population, its composition in terms of demographic characteristics and of industry, occupation and status (as, for example, employer or employee) and factors affecting these characteristics of manpower. The United Nations manuals on methods of analysing census data are intended as aids to policy-making and planning of economic and social development, with primary reference to developing countries.

This manual was prepared for the United Nations by John D. Durand and Ann R. Miller of the Population Studies Center of the University of Pennsylvania. The annex was contributed by Abdel-Fattah Nassef, also of the Population Studies Center. Materials prepared by Surinder Mehta of the University of Massachusetts were also drawn on by the authors.

The International Labour Office collaborated with the Population Division of the United Nations in reviewing and commenting on drafts of the manual.



INTRODUCTION

A. Purpose and scope of the manual

This manual is concerned with the use of population census statistics and related data for studies of the growth and composition of a nation's labour force, its distribution among categories of economic activities, and factors which influence these characteristics of manpower. The emphasis is on questions relevant to policy-making and planning for economic and social development, and the methods of research are considered primarily with regard to their applicability under conditions existing in developing countries.

The economic activities of the people are among the most important topics of investigation in censuses of population. In most countries the population census is the primary source of comprehensive data on manpower resources and their utilization, and in many countries, it is the only source of such data, although census-type sampling surveys have been developed in some countries as an important source of current and supplementary information. Statistics of this kind are used for many purposes: as guidelines for the work of public and private organizations, institutions, and enterprises and as material for research in various fields of social science. In many countries, however, little use has yet been made of the data the censuses have provided for studies of the kinds with which this manual is concerned. It is hoped that the manual will be helpful to analysts, especially in developing countries, in extending research in this field.

The uses of population census data for research in various fields, as an aid to developmental planning and policy-making, have been outlined broadly in another publication of the United Nations. ^{1/} That publication has indicated the place of studies on economic activities, as well as on other topics, in national programmes of census-based research designed to serve such purposes. It serves as the starting point of the present manual, which is designed to explain and illustrate methods for such studies relating to economic activities of the population.

It is not the purpose here to provide comprehensive blue-prints and specifications for studies in any one country. The selection of questions to be investigated and details of the methods must, of course, be adapted to the needs and conditions of each country. Indeed, one should not expect the scope and methods of any such study to be specified fully in advance. As the work progresses, the analyst adapts and re-adapts his research plan to his findings, extending or curtailing the planned investigation of various questions, looking into new questions posed by the findings, and devising methods for dealing with analytical problems as they arise.

^{1/} National Programmes of Analysis of Population Census Data as an Aid to Planning and Policy-Making (United Nations publication, Sales No.: 64.XIII.4).

The aims of the manual are to present some of the main questions that are likely to be found important and that it is feasible to study in the circumstances of many countries, to outline principles of some relevant analytical methods, and to illustrate their application with simple examples. Studies are cited in which some of these methods have been applied, and to which the user of the manual may refer for additional illustrations and explanations of methodological details. In this way, it is hoped to give some assistance in planning and carrying out studies in this field, especially to analysts who have not already had long experience of the study of census statistics on economic activities. 2/

B. Concepts, definitions and classifications of census statistics on economic activities

It is not necessary in this manual to consider the details of the methodological problems of census enquiries relating to economic activities. Other publications of the United Nations and the International Labour Office have dealt with concepts, definitions and classifications of census data on this as well as other topics, presenting internationally recommended standards for these statistics and dealing with the problems that arise when these standards are applied in national censuses. 3/ It will be assumed here that a census has been taken and the tabulations of results upon which analytical studies are to be based are given (although it is worth emphasizing that the use of the data for analytical studies as well as for other purposes should be considered as fully as possible beforehand, when the census questionnaire, the definitions, and the programme of tabulations are being formulated). As an introduction to the discussion of analytical methods, it is appropriate merely to review some principal features of the internationally recommended standards and note some of the most important variations of national census practices with regard to the data on economic activities.

2/ Users of this manual are referred also to the following works which contain more or less extensive discussions of methods of analysing census data in this field: George Barclay, Techniques of Population Analysis (New York and London, 1958), chap. 9; A.J. Jaffe and Charles D. Stewart, Manpower Resources and Utilization. Principles of Working Force Analysis (New York, 1951); Mortimer Spiegleman, Introduction to Demography (Chicago, Society of Actuaries, 1955), chap. 11.

3/ Principles and Recommendations for National Population Censuses (United Nations publication, Sales No.: 58.XVII.5), paras. 414-418, 501-503; Principles and Recommendations for the 1970 Population Censuses (United Nations publication, Sales No.: 67.XVII.3), paras. 222, 247, 281, 288-297, 313; Handbook of Population Census Methods, Volume 2: Economic Characteristics of the Population (United Nations publication, Sales No.: 58.XVII.6/vol. 2); International Standard Industrial Classification of all Economic Activities (United Nations publication, Sales No.: 58.XVII.7); Application of International Standards to Census Data on the Economically Active Population (United Nations publication, Sales No.: 51.XIII.2); International Labour Office, International Standardization of Labour Statistics (Geneva, 1959); International Labour Office, The International Standard Classification of Occupations (Geneva, 1958).

The "labour force", in the terminology used for the sake of simplicity in this manual, is the equivalent of "economically active population" in the terminology of the internationally recommended standards. ^{4/} According to those standards, the measure of the labour force should comprise "all persons of either sex who furnish the supply of labour available for the production of economic goods and services", including employers, self-employed persons, and those who assist without pay in a family economic enterprise as well as employees. It further includes unemployed persons, as well as those employed during the period to which the data refer. ^{5/} The category of employed persons should comprise both full-time and part-time workers, provided that the latter "work at least a minimum period (to be set ... sufficiently low to exclude those whose contributions are negligible)," while the unemployed should be defined (with some exceptions) as persons who are not at work and are seeking work for pay or profit during the period of reference. On the other hand, the category of persons not in the labour force (economically inactive population) should comprise persons engaged only in activities which do not contribute directly to the production of economic goods and services; this includes housewives and students as well as disabled, retired, and other inactive persons. It should be noted that housewives occupied only with domestic duties are to be excluded from the measure of the labour force because the goods and services which they produce are not considered as "economic", just as the value of their products is excluded from the measure of income in national accounts.

Members of the labour force should be classified, according to the internationally recommended standards, by types of economic activities in terms of the classifications of industry, occupation and status. The industry classification refers to the activity of the establishment or enterprise in which the individual works, the occupation classification to the type of work done by the individual, and the status classification (in which the principal categories are employees, employers, own-account workers, and unpaid family workers) to the individual's position in relation to other workers, if any, in the enterprise. ^{6/}

^{4/} On the terminology of statistics and analytical measures in this field, see Multilingual Demographic Dictionary (United Nations publication, Sales No.: 58.XIII.4), paras. 350-360.

^{5/} The definitions quoted here are excerpts from the recommendations of the United Nations Statistical Commission for 1960 censuses Principles and Recommendations for National Population Censuses (United Nations publication, Sales No.: 58.XVII.5), para. 414. There are some differences between these and the definitions recommended for the 1970 censuses Principles and Recommendations for the 1970 Population Censuses (United Nations publication, Sales No.: 67.XVII.3) as well as those recommended by the Eighth International Conference of Labour Statisticians, International Standardization of Labour Statistics (Geneva, 1959).

^{6/} Neither the internationally recommended classifications nor those applied in the censuses of various countries adhere strictly to these concepts, especially as regards the classification of occupations. For example, the International Labour Office, The International Standard Classification of Occupations (Geneva, 1958) includes several major divisions which refer primarily to the activity of the enterprise or establishment rather than to that of the individual. The revision being prepared at present represents a step towards a stricter definition of categories with regard to the kind of work done by the individual.

The internationally recommended standards also include specifications for certain tabulations of the results, including a set of "first priority" tabulations regarded as "of most general importance and practicability" and a set of "second priority" tabulations "which are of generally recognized value, but which serve somewhat more specialized purposes or involve somewhat more elaborate and expensive compilation procedures". As noted in the recommendations, "the first and second priority tabulations together constitute a modest tabulation programme and many additional useful and practicable tabulations can be included in the census programme of any country with sufficient resources to undertake a more ambitious tabulation scheme". 7/ In this manual, while attention is focussed mainly upon analytical methods which are applicable to tabulations in the first and second-priority recommended lists, some attention is also given to analytical uses of other tabulations, found in the publications of some national censuses, which are of special value for the study of certain questions.

In recent censuses of most countries the methods of compiling data on economic activities have conformed fairly well, on the whole, to the internationally recommended standards; yet the possibilities of comparing the statistics of one nation with those of another are severely limited, for two reasons. First, the standards are rather elastic in some important respects, so that they accommodate variations of national practices which appreciably affect the measures of size and composition of the labour force. Second, even where the concepts, definitions and classifications are formally the same or closely similar, they may be interpreted very differently by census field-workers and respondents in different countries; and reporting errors and biases may seriously reduce the possibility of comparison.

As regards the formal definitions, one important factor limiting comparisons is the variation in the length of the periods to which the census questions on economic activities refer. In some censuses, the period is one week; in others, one month; and in still others, several months or a year. These variations affect measures of the size of the labour force, since the longer the period of reference, the greater will be the number of persons found to have been engaged in economic activities at least to some extent during the period. The measures of labour force composition also are affected, since the longer the period, the greater will be the proportionate representation in the labour force total of persons who work only intermittently or seasonally, and of those having entered into or retired from economic activities during the period. Sex, age, occupation, industry, status and other groupings of the labour force are likely to be affected.

It is often useful in the study of the statistics of one country to make comparisons with those of other countries, and in doing so, the analyst must pay careful attention to limitations in the extent to which they may be compared. Even more important so far as national studies are concerned is the question of whether historical series of national census statistics may be compared, and in this connexion the variations of time reference of the data often assume major importance. Formerly, it was common practice in population censuses to record the "usual" activity of each individual without reference to any specific period

7/ Principles and Recommendations for National Population Censuses (United Nations publication, Sales No.: 58.XVII.5), paras. 501-503.

of time; questions with a specified time reference have been introduced in most countries only during the last few decades. Although it seems in some cases that this change may not have affected the measures of labour force totals very greatly, the effect upon the totals in other cases appears likely to have been quite substantial, and in any case there is a strong likelihood of appreciable effects upon the data for certain sex, age, occupation, industry and status categories and for certain areas within the country.

Another factor limiting the possibility of comparison is the variation in the extent to which persons engaged both in economic and non-economic activities are classified as economically active and included in the labour force measures. This is especially important in developing countries where a large share of all economic activities (particularly in the agricultural sector) is carried on in family enterprises, in which housewives and school children may play a more or less important part. Provisions for the classification of persons having such dual activities vary in the definitions adopted for the censuses of different countries, and even with the same definitions, the analyst is not certain of being able to compare the classifications actually obtained. In fact, it is extremely difficult in a census to achieve a consistently accurate classification, under any definition, of persons who combine domestic duties or attendance at school with economic activities. ^{8/} The extent to which the economic activities of such persons are reported may vary not only between the censuses of different countries and between censuses taken at different dates in the same country, but also within the data of the same census - in different parts of the country, between different ethnic groups, among various industry and occupation categories and so forth.

There are also variations in the criteria whereby unemployed persons belonging to the labour force are distinguished from economically inactive persons not in the labour force. According to the recommended international standards, this distinction should be made primarily on the basis of the question, whether or not the individual was seeking work for pay or profit during the reference period; but this criterion may not be very suitable for use under the conditions of narrowly limited opportunities for employment which prevail in many developing countries, particularly in rural communities. Other criteria are sometimes substituted, such as the question, whether the individual wants work, or would accept a job under certain stated conditions. Also, variations in the enumeration and classification of members of the armed forces may greatly affect the measures of certain sex-age groups of the labour force even where their effect on the labour force totals is not very important. Armed forces are excluded,

^{8/} For this reason, it has been the practice in some censuses to classify persons in certain population categories (such as women in farm households) as economically active or inactive merely on the basis of such criteria as age, sex and family relationships, without regard to their actual activities.

wholly or in part, from the population enumerated in some censuses, while in other censuses they may be classified either as members of the labour force or in an economically inactive category. 2/

Variations of the forms of classifications, especially of industry and occupation, also pose major problems for international comparisons and historical studies of national statistics on economic activities of the population. Problems resulting from the varying forms of industry and occupation classifications are discussed further in chapter III.

C. Evaluation of the quality of data

As implied by what has been said above, the data relating to economic activities obtained in population censuses are subject to important errors and biases due to carelessness and preconceptions on the part of both field-workers and respondents and to ignorance and forgetfulness, if not unwillingness to give accurate information, on the part of the latter. Errors and biases are generally most important in the data for marginal categories of the labour force, including women, children and youths, men near or beyond the normal age of retirement, and unpaid family workers of any sex-age category. It behoves the analyst to be wary in his interpretations of all census data in this field and especially so in dealing with the statistics for these marginal categories.

The quality of analysis depends to a large extent upon the quality of the analyst's judgement of the reliability of the data and the nature and importance of errors and biases in them. He must constantly maintain a critical attitude toward the data, considering how the figures for each category of the labour force may have been affected by the factors of error and bias, phrasing and arrangement of the census questions, details of instructions to field-workers and respondents, and field procedures, as well as by the formal definitions. An essential part of sound analytical work is scrutiny of the statistics and probing of their internal consistency as well as their consistency with information from other sources (such as population sample surveys, establishment reports on employment, social security records etc.) and with the analyst's knowledge of conditions in various industries

2/ This discussion by no means exhausts the types of variations in census practices which may affect the measures of labour force size and composition. For further discussion, see Handbook of Population Census Methods, Volume 2: Economic Characteristics of the Population (United Nations publications, Sales No.: 58.XVII.6/vol. 2); Application of International Standards to Census Data on the Economically Active Population (United Nations publication, Sales No.: 51.XIII.2); Jaffe and Stewart, op. cit.; United States President's Committee to Appraise Employment and Unemployment Statistics, Measuring Employment and Unemployment (Washington, 1962); "Growth and structure of the labour force in the countries of Asia and the Far East", Report of the Asian Population Conference and Selected Papers (United Nations publication, Sales No.: 65.II.F.11).

occupations, and areas of the country. Sample field checks on reliability of responses to the census questions are helpful in the evaluation, 10/ and when field checks on accuracy of the head count are undertaken, it is helpful to design them in such a way as to provide information about the effects of omissions and double counting upon the measures of the labour force and its components, as well as other population characteristics. As the analyst evaluates the data, he should also evaluate the census concepts, definitions and classifications, with a view to improvements which would enhance the quality and utility of results in future censuses.

10/ For example, see United States Bureau of the Census, The Post-Enumerative Survey, 1950. An Evaluation Study of the 1950 Censuses of Population and Housing (Washington, 1960), Technical Paper No. 4.

Chapter I

MEASURES OF THE DEMOGRAPHIC DIMENSIONS OF THE LABOUR FORCE

A. Measures of the absolute and relative size of the labour force

The labour force statistics provided by a population census can be viewed as an inventory of a nation's supply of labour engaged in or available for income-producing activities. As a measure of labour supply, however, the number of persons in the labour force is only a first approximation since it does not take into account how much work members of the labour force are willing and able to do. The quantity of labour supply corresponding to a given number of workers may vary widely, depending to a large extent on the customary weekly hours of work and the numbers of workers available only for part-time, seasonal, or irregular employment, and also on such factors as the frequency of holidays, the worker's state of health and incidence of disabilities. On account of the trend towards a shorter working week which has for a century been observed generally in countries undergoing industrialization, measures of labour force growth derived from the censuses of such countries are likely to exaggerate long-term increases of the labour supply. Numbers of persons in the labour force can be converted into estimates of labour supply in terms of man-hours per week, year or other period, if sufficient information is available on the number of hours worked and the willingness and ability of individuals to work more. ^{1/} Such measures are still only approximate, though, since inexactness is inherent in the information relating to economic activities obtained in population censuses.

Another point which should not be forgotten in interpreting the statistics is that the supply of labour may be influenced by the demand, that is, by the volume of employment opportunities, including opportunities for self-employment and unpaid family work as well as paid employment. In general, demand conditions are likely to be more influential in shaping the distribution of the labour force among industries, occupations, and areas within a country than in determining its total size, but their influence in the latter connexion is not to be neglected.

In proportion to the size of the population, the size of the labour force is measured by the crude activity rate, that is, the percentage of the total population classified in the census as economically active. For example, in the 1961 census of Indonesia, 34,578,234 persons were classified in the labour force out of the total population of 96,318,829; thus the crude activity rate was 35.9 per cent. ^{2/} Crude activity rates may also be calculated with reference to

^{1/} For example, see James N. Morgan, Ismael A. Siragelden and Nancy Baerwaldt, Productive Americans (Ann Arbor, Survey Research Center, Institute for Social Research, University of Michigan, 1966), Monograph 43; also Clarence D. Long, The Labor Force under Changing Income and Employment (Princeton, 1958), Appendix E.

^{2/} Unless otherwise noted, statistics quoted in this manual are taken from the national statistical publications or the United Nations, Demographic Yearbook, 1956, 1964, and 1965 (Sales Nos.: 56.XIII.5, 65.XIII.1 and 66.XIII.2).

the male and female population separately, showing to what extent the two sexes contribute to the body of income-producing workers, as illustrated below with the data of the 1961 Indonesian census:

	<u>Male</u>	<u>Female</u>
Population	47 493 854	48 824 975
Labour Force	25 008 797	9 569 437
Crude activity rate	52.7	19.6

The crude activity rate has an obvious economic significance: the higher this rate (if it is measured accurately according to a given definition of the labour force), the higher is the level of income per head that can be achieved under given conditions of productivity and extent of employment of the labour force. But income is not everything; there are many workers not included in the concept of the labour force because what they produce is not considered as income, although it contributes materially to the well-being of the population. In most countries, the great majority of adults not classified in the labour force are housewives; they produce domestic services and goods for home consumption, the value of which may amount, in the aggregate, to quite a sizeable fraction of the total value of goods and services of all kinds produced by the nation, although the housewives' products are not included in the conventional accounting of national income. ^{3/} So the apparent advantage of a high crude activity rate is partly illusory if it is achieved by many women being engaged in paid employment instead of unpaid work in the home.

In most censuses, questions relating to economic activities are limited to persons above some specified minimal age, usually in the range of ten to fifteen years. In some cases, the age limitation may exclude a considerable number of children engaged to some extent in economic activities, and although their contributions to production may be relatively minor as a rule, the analyst should take account of the understatement of the size of the labour force if the minimal age appears to have been placed too high. It is useful to calculate refined activity rates by relating the labour force totals to the population above the specified minimal age, in addition to the crude activity rates related to the population of all ages. For example, with the data of the 1961 Indonesian census, where the minimal age for the labour force enumeration was set at ten years, the calculation is made as follows:

	<u>Both Sexes</u>	<u>Males</u>	<u>Females</u>
Population, 10 years and over . .	63 953 563	31 348 371	32 605 192
Labour force, 10 years and over .	34 578 234	25 008 797	9 569 437
Refined activity rate	54.1	79.8	29.3

^{3/} On the hours worked by housewives and the value of their products, see Colin Clark "The economics of house-work", Bulletin of the Institute of Economics and Statistics of Oxford University (Oxford) May 1958, No. 2; Alain Girard, "Le budget-temps de la femme mariée dans les agglomérations urbaines", Population (Paris), vol. 13, 1958 and "Le budget-temps de la femme mariée à la campagne", Population (Paris), vol. 14, 1959; Morgan, Siragelden and Baerwaldt, op. cit.

Unlike crude activity rates, the refined rates are true rates, that is to say, measures of participation in economic activities in the population "at risk". ^{4/} They are free, from the distortion produced by the presence, in varying proportions in the population, of children too young to be classified as economically active. Variations of the refined rates may differ appreciably from those of crude activity rates where the age structures of the populations involved in comparisons differ (as a result of age-selective migratory movements, variations of birth rates and the like). An example is provided by the following comparison of activity rates for urban and rural areas of Indonesia derived from the data of the 1961 census:

	<u>Activity rates, both sexes</u>	
	Crude rates (as a percentage of total population)	Refined rates (as a percentage of population aged 10 years and over)
Total Indonesia	35.9	54.1
Urban areas	32.7	47.1
Rural areas	36.5	55.4
Ratio of urban to rural rate (rural = 100) . .	90	85

The analyst must beware of the spurious variations in the measures of labour force dimensions which result from differing definitions or differing interpretations and applications of the same definitions in census operations. Caution is required above all in comparing the statistics of different countries, but it is needed also in comparing data from successive censuses of the same country and data for different areas and population groups within a country. For example, in the following comparison of crude activity rates for regions of Indonesia (1961 census), the figures for both sexes imply an appreciable relative advantage in size of the labour force for Kalimantan and Djogjakarta and a relative disadvantage for Sulawesi and West Java. However, the observation that the variations are mainly in the female rates signals the need for investigating the consistency of application of the census concepts in the different regions before the apparent differences are accepted as representative of reality.

^{4/} In some censuses, certain segments of the population above the specified minimal age are excluded by definition from the labour force enumeration (inmates of institutions and military personnel, for example). If such excluded groups are numerically very small, their inclusion in the base population figures on which the activity rates are calculated is of little consequence. On the other hand, where they constitute a sizeable proportion of the population (as they may in some localities or categories of the population if not in the national total) it may be advisable to subtract them from the population base figures before computing refined rates, age-specific rates and others.

Crude activity rates

	<u>Both sexes</u>	<u>Males</u>	<u>Females</u>
Djakarta	34.0	52.9	14.4
West Java.	32.7	51.2	14.8
Central Java	35.0	51.8	19.1
Djogjakarta.	41.0	50.1	32.4
East Java.	39.4	56.5	23.3
Sumatra.	36.0	50.3	21.5
Kalimantan	41.7	54.9	28.3
Sulawesi	30.7	50.1	11.8
Other islands. . . .	35.9	54.1	17.8
Total, Indonesia	35.9	52.7	19.6

Some pitfalls in the measurement of differences between activity rates of different countries and changes in the rates for the same country over a period of time can be illustrated with reference to the following data from censuses of Peru and Turkey:

Crude activity rates

	<u>Both sexes</u>	<u>Males</u>	<u>Females</u>
Peru: 1940.	39.9	52.1	27.9
1961.	31.5	49.6	13.6
Turkey: 1955.	50.7	56.8	44.5
1960.	46.8	54.3	39.0

These figures make Turkey's situation appear much more favourable than Peru's as regards the numerical relationship between labour supply and population, but the difference is probably to a great extent a reflection of different practices in reporting the economic activities of women in the censuses of the two countries. In the Turkish censuses, the practice has been to classify almost all women in farm households as economically active (in the category of unpaid helpers on the farm if not self-employed or wage-workers), whereas relatively few women in the farm population have been so classified in the censuses of Peru. To be sure, it is possible that Turkish women do take a greater part in farm work than Peruvian women do; but the difference, if any, is almost certainly exaggerated by the census statistics.

For Peru, the statistics indicate a pronounced decrease in the crude activity rate between the censuses of 1940 and 1961, but the amount of the actual decrease, if any, is almost certainly exaggerated as a result of a change of definitions. At the 1940 census, the labour force was defined in terms of a "usual occupation" concept, whereas a definition referring to activities during a specified week was adopted for the 1961 census. The observation that the apparent reduction of the activity rate is much greater on the female than on the male side accords with the generalization that varying definitions, as well as reporting errors and biases, are likely to have more effect on measures of the female than of the male labour force.

Difficulties of comparison of recent census data referring to activities during a specified period of time and earlier data referring to usual activities are encountered very often in studies of historical series of census data. It is of course desirable if possible in such cases to make adjustments in order to put the series on a more nearly comparable basis, but such adjustments require information which may not be easy to obtain.

Shifting from a usual activity question to one on activity during a relatively brief period is likely to reduce the numbers of persons in certain categories reported as economically active: those, for example, who normally work during the greater part of the year but are inactive in the season in question, and possibly persons who have recently retired or become disabled. On the other hand, the shift may have the opposite effect in some other categories: for instance, persons who work during the season in question but not normally at other times of the year, those who work occasionally or irregularly and who happen to have been employed or seeking work during the period in question, new entrants into the labour force seeking their first jobs, and possibly housewives and students who normally work only part-time in economic activities. In order to estimate the net effect of a shift in the basis of the questions, one needs at least to have some information about the relative numbers of persons in these various categories; and such information is not sufficient for a thoroughly reliable estimate unless there is also some basis for gauging the effect within each category. The kind of information needed might be obtained by conducting sampling surveys in such a manner as to estimate the numbers of persons in various categories who would be classified as economically active under each concept.

The form of the questions has to be considered as well as the time reference. In the earlier censuses of many countries, where the enquiry referred to usual activities, there was often no specific question as to whether each individual was usually economically active or not. Rather, there was a question on the usual occupation (with or without separate questions referring to industry and status), and labour force totals were obtained by counting persons who reported an economic activity as the usual occupation. Thus persons who failed to report any occupation would be omitted from the labour force count although they might have been usually economically active. In recent censuses where a specific time reference has been adopted, a common practice has been to introduce a separate question (or questions) for determining whether or not each individual was economically active (employed or unemployed) during the specified period, in addition to questions on occupation, industry, and status; thus economically active persons whose occupation (industry, status) is not reported are not on that account omitted from the enumeration of the labour force. This difference in the form of the questions is a factor making for a larger measure of the labour force in the more recent censuses, and some indication of its possible

effect is given by the numbers of persons reported as economically active with occupation (industry, status) not reported. 5/

Because the statistics for females are likely to be much more affected than those for males by variations of definition, errors, and biases, sometimes only the statistics for males are considered in international and historical comparisons. While this solution may be justified in some circumstances, there is a risk of serious misrepresentation of real variations in the dimensions of the labour force. In many cases, variations of the female component are more important than those of the male component, and variations on the female side cannot be expected to parallel those on the male side. For example, in the comparison of statistics for regions of Indonesia shown above, if attention is confined to the figures for males, Djogjakarta appears as a region with one of the smallest labour forces in proportion to its population, yet it ranks near the top of the list for its crude activity rate when the admittedly dubious statistics for females are also taken into account. A similar objection also applies to the subtraction of the statistics for unpaid family workers from labour force totals, a technique which is also sometimes used in order to minimize the effects of variations of definition, reporting errors and biases. 6/

B. Dependency ratios

Persons not in the labour force may be regarded from a social point of view as dependants in the sense that they consume but do not produce income, although they may be independent financially (receiving personal incomes in the form of pensions, rents, dividends and so on) and, as already mentioned, they may produce goods and services not considered as income. A crude measure of the burden of those who produce no income upon the shoulders of income-producers is given by the dependency ratio, defined as the number of persons not in the labour force per 100 of the labour force. This merely restates in different form the same relationship expressed by the crude activity rate. For example, from the 1961 Indonesian census totals of 61,740,595 persons not in the labour force and 34,578,234 in the labour force, one obtains a dependency ratio of 178.6 per 100. The ratio is higher in the urban areas (205.5) than in the rural areas of Indonesia (174.3).

5/ For an example of an attempt to estimate the effect of a change from questions on usual occupation, industry, and status, to questions on activities during a specified week, see United States Bureau of the Census, "Estimates of Labor Force, Employment and Unemployment in the United States, 1940 and 1930" Sixteenth Census of the United States, 1940, Population (Washington). For additional examples of the treatment of various problems of comparison in historical series of labour force statistics, see G.F. Cumper, "A comparison of statistical data on the Jamaican labour force 1953-61", Social and Economic Studies (Jamaica), December 1964; Avner Hovne, The Labour Force in Israel (Jerusalem, 1961); B.R. Kalra, "A note on working force estimates, 1901-61", Census of India (1961), Paper No. 1 of 1962. Final Population Totals (New Delhi, 1962), Appendix I.

6/ For example, see Demographic Aspects of Manpower. Sex and Age Patterns of Participation in Economic Activities (United Nations publication, Sales No.: 61.XIII.4).

Of course, the weight of the dependency load is not only a matter of the number of dependants but also of their sex-age distribution and, even more important, of standards for their maintenance, education for the children, housing and health services for the elderly. Dependency ratios may give a badly biased measure of relative loads especially in comparisons between urban and rural communities and between areas which differ greatly in levels of social and economic development. Given data on average values of consumption according to age and sex, including outlays for education and other socially provided services, the analyst would be in a position to calculate refined measures of dependency with varying weights for different categories of the economically inactive population in different areas. Such data are not widely available, though, and many complications arise in their use for this purpose. Without adequate data, it is doubtful whether it is advisable to attempt refinements by applying arbitrary weights, by assuming, for example, that the needs of an adult dependant in the central age groups are represented by a weight of unity, those of a pre-school child by, say, one-fourth, and so on for other categories.

Because of the uncertainties in census data on the economic activities of females and because the dependency of housewives not in the labour force is not comparable to that of economically inactive men, studies of the variations of dependency ratios are sometimes confined to the statistics for the male population. The findings are then subject to the kinds of reservations noted in the preceding section as regards the use of activity rates of males alone to measure differences in relative size of the labour force in various populations. Another common practice is to calculate dependency ratios from statistics of population age-groups without regard to actual participation in economic activities - for example, considering all persons between the ages of fifteen and sixty or sixty-five as producers and all those in younger and older age groups as dependants. ^{7/} Needless to say, there is some lack of realism in measures calculated on this basis.

C. Sex-Age specific activity rates

Economic activity is, of course, not distributed at random within either the male or the female population of potentially employable age. The proportion of economically active persons differs in different categories of the population, ranging from near 100 per cent in some categories down to zero in others. These variations are measured by specific activity rates or "labour force participation rates", as they are sometimes called. A specific activity rate is calculated by the formula:

$$r = \frac{P_e}{P_t} \times 100$$

where P_e is the number of economically active persons in the specified category of the population and P_t is the total number of persons in the same category.

^{7/} Among many examples, see F.W. Notestein, Irene B. Taeuber, Dudley Kirk, A.J. Coale and L.K. Kiser, The Future Population of Europe and the Soviet Union (Geneva, League of Nations, 1944).

Specific activity rates may be calculated for population categories defined in terms of various characteristics, including sex, age, marital status, educational level, urban-rural residence, ethnic groupings and others if the relevant classifications of population and the labour force are provided in the census tabulations. The uses of various kinds of specific rates for studying demographic, economic and social factors which affect the size, growth and composition of the labour force will be considered in the next chapter. The discussion here is confined to activity rates specific for sex and age, which are fundamental in the measurement of labour force dimensions.

An example of the calculation of sex-age specific activity rates, using the statistics of the 1960 census of Panama (without the Canal Zone), is given in table 1. The Panamanian rates are charted in figure I and some examples of sex-age specific rates for other countries are shown in table 2. ^{8/}

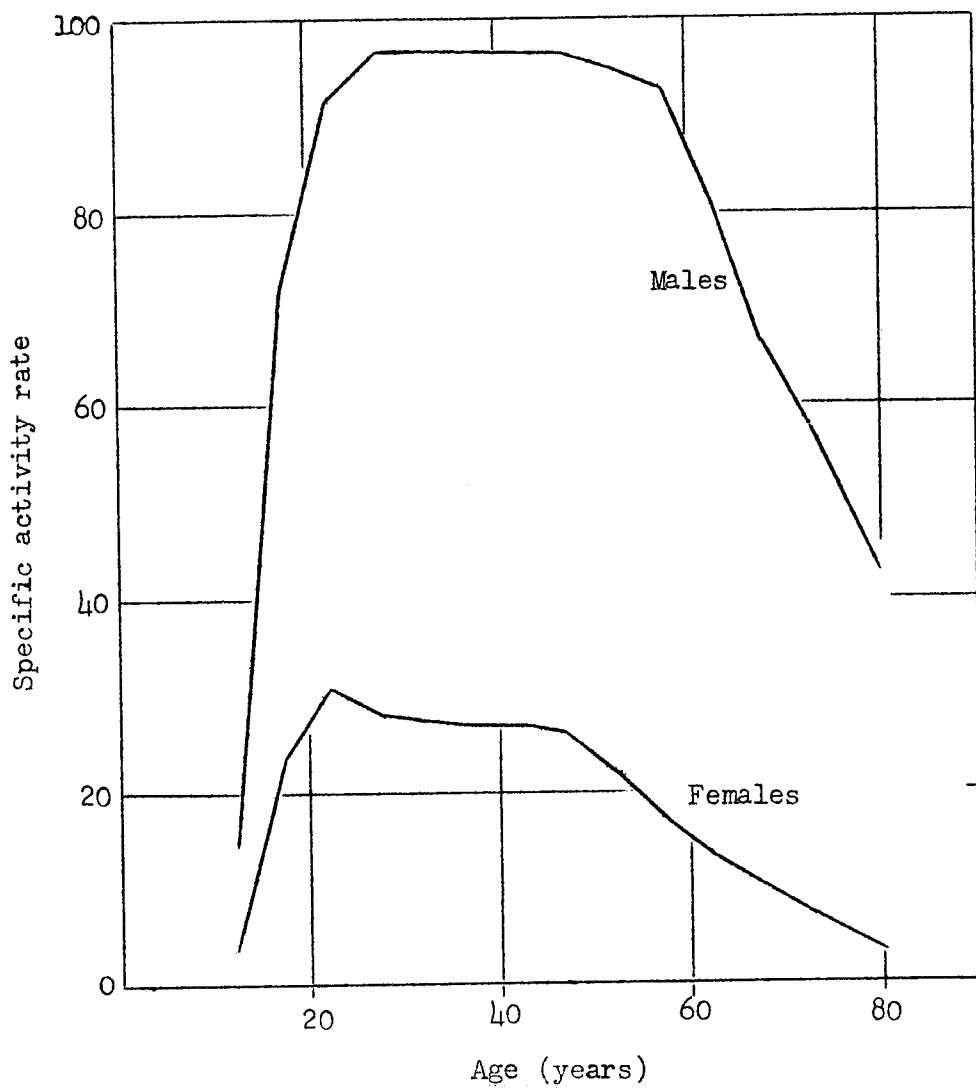
Table 1

Panama, 1960: population, labor force and specific activity rates by sex and age

Age (years)	Population	Males		Females		
		Labour force	Activity rate	Population	Labour force	Activity rate
Total,						
10 and over	356 487	265 020	74.3	342 137	71 949	21.0
10-14	62 485	8 953	14.3	60 414	2 312	3.8
15-19	50 506	31 928	63.2	51 127	12 003	23.5
20-24	42 770	39 476	92.3	42 242	13 191	31.2
25-29	35 605	34 357	96.5	34 839	9 874	28.3
30-34	31 688	30 753	97.0	30 156	8 364	27.7
35-39	28 573	27 747	97.1	26 995	7 312	27.1
40-44	25 415	24 678	97.1	22 789	6 151	27.0
45-49	22 013	21 219	96.4	19 685	5 146	26.1
50-54	16 338	15 517	95.0	14 328	3 118	21.8
55-59	12 010	11 102	92.4	11 578	2 019	17.4
60-64	10 541	8 626	81.8	9 789	1 260	12.9
65-69	6 955	4 792	68.9	6 562	633	9.6
70-74	5 678	3 283	57.8	5 072	338	6.7
75 and over	5 910	2 589	43.8	6 561	228	3.5

^{8/} A broad international compilation of such measures is found in the United Nations Demographic Yearbook, 1956, 1964 and 1965, chap. II, note 2; the patterns of variation are analysed in Demographic Aspects of Manpower, Sex and Age Patterns of Participation in Economic Activities (United Nations publication, Sales No.: 61.XIII.4).

Figure I
Age-specific activity rates of males and females,
Panama, 1960



Source: Table 1.

Table 2

Specific activity rates by sex and age, selected countries

Age (years)	Ghana, 1960		Colombia, 1951		Indonesia, 1961		Iran, 1956		Thailand, 1960		Turkey, 1960	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
10 and over	...	...	79.7	17.7	79.8	29.3	83.9	9.2	82.7 ^{a/}	77.2 ^{a/}	...	...
15 and over	89.1	56.6	93.3	20.0	88.9	31.2	93.4	9.4	89.5	81.4	93.6	65.3
10-14	...	...	16.9	6.2	22.6	15.6	29.7	8.2	40.5 ^{b/}	50.6 ^{b/}	...	...
15-19	61.5	53.7	84.8	23.6	66.7	30.6	80.7	12.1	76.9	84.7	78.9	66.2
20-24	91.0	52.3	95.4	23.9	87.2	27.4	94.2	9.3	88.2	86.6	94.3	65.8
25-29	96.5	51.5	97.3	20.2	94.4	27.2	98.3	8.6	96.0	85.0	97.4	66.6
30-34	97.5	57.0	97.9	19.0	94.4	27.2	98.3	8.6	97.5	85.2	98.2	65.2
35-39	97.5	59.3	98.0	19.2	96.8	33.3	98.9	9.7	97.8	86.6	98.4	63.3
40-44	97.3	65.4	97.7	19.1	96.8	33.3	98.9	9.7	97.6	87.6	98.4	68.5
45-49	96.9	67.0	97.3	18.2	95.6	39.8	97.8	10.1	94.5	80.9	97.9	68.2
50-54	96.0	69.6	96.4	17.7	95.6	39.8	97.8	10.1	94.5	80.9	96.8	62.5
55-59	93.7	70.6	94.8	15.9	89.6	39.1	93.7	8.7	94.0	40.0	94.0	66.8
60-64	89.1	64.0	90.5	15.5	89.6	39.1	93.7	8.7	64.4	40.0	85.6	60.0
65 and over	71.5	43.2	71.8	10.3	72.7	27.8	74.1	5.8	72.0	64.2	50.1	28.5
Unknown	...	...	...	...	82.2	53.2	61.9	11.1	...	...	...	...

a/ 11 years and over.

b/ 11-14 years.

The age-curve of specific activity rates of Panamanian males takes the form which is found almost universally in the statistics of countries throughout the world. Males come into the labour force at various ages, mostly before twenty and some between twenty and twenty-four years; nearly all are economically active by the age of twenty-five and remain so until about fifty-five, after which age there is a progressive attrition of the male labour force by voluntary or enforced retirement. Variations of this pattern in the statistics of different populations relate primarily to the age distribution of labour force entries below twenty-five years and of retirements above fifty-five years. It is useful to define these features as clearly as possible by computing specific activity rates in the finest age groupings which the census provides at the two extremes of the range of working ages - preferably by single years of age below twenty and five-year groups from fifty-five up to the age at which the number of men remaining in the labour force drops to a negligible figure.

For females, the age-curves of specific activity rates take more diverse forms, as illustrated by the foregoing tables and figure, and the female rates cannot be interpreted so simply in terms of ages of entry into and retirement from the labour force. The female activity rates for Panama, for example, rise to a maximum in the age group of twenty to twenty-four years and decline thereafter; but some women may enter the labour force for the first time in their thirties, forties, or even later, while others are retiring, and some women may move into and out of the labour force several times in the course of their lives. Thus the proportion of women who are economically active at some time during their lives may be much greater than the activity rate for any one age group.

Sex-age specific activity rates may sometimes be as interesting to the analyst for the questions which they raise as for the information which they give. For example, in studying the data for Thailand (table 2), the analyst would be struck by the observation that the female activity rates are far higher than those shown by the censuses of most other countries, and the explanation of this should be one of the first questions to which he would direct his investigation. Are Thai women really economically so much more active than the women of other countries, or was the reporting of their economic activities in the Thai census more liberal, and is it possible that many of those classified in the labour force were not really engaged in economic activities to any significant extent? Do the census returns show female activity rates at this high level prevailing throughout the country or only in certain areas? (Actually, lower female rates were recorded in urban than in rural areas.) On the other hand, the analyst working with the statistics of Iran would be led to enquire into the reasons for the very low female activity rates and the possibility of many economically active women not having been reported as such.

Referring again to the Thai statistics, the analyst would observe that higher activity rates are recorded for females than for males in the age groups under twenty, while the male rates are higher in the age groups from twenty years upward. The explanation of this anomaly, too, should be one of the objects of analysis, and in this connexion the analyst would wish to look into available information on school enrolments of males and females according to age groups or levels of education (see chapter II).

In a study of the statistics of Ghana or Indonesia, one of the questions which would come to the fore is the explanation of the pattern of rising female activity rates with increasing age over the range from the twenty-five to

twenty-nine year group to the forty-five to fifty-four year group in Indonesia and fifty-five to fifty-nine in Ghana. In this connexion, it would be pertinent to investigate the relationships of marital status, maternal status, age and economic activity of women in these countries (see chapter II). The Turkish data furnish a remarkable example of the effects of misreporting of ages in the census upon activity rates which accounts for the patently erratic see-saw pattern exhibited by the rates for Turkish women in successive age groups. This is probably the result of the "heaping" of age reports on multiples of ten years that occurs to a greater extent in rural communities (where female activity rates in Turkey are very high) than in the cities. ^{8/}

D. Tables of economically active life

The sex-age specific activity rates derived from a census together with a life-table representing contemporary conditions of mortality in the population are the materials for calculating tables of economically active life (also called "tables of working life", "labour force life-tables" and so forth). Such tables represent the life-cycle of economic activity in hypothetical cohorts, that is, generations of males or females subject at each period of their lives to given rates of mortality and of participation in economic activities. The tables provide measures of the average length of economically active life, and age-specific rates of entry into and retirement from the labour force and depletion of the labour force by death. They are useful in studying the processes of growth and structural change of the labour force, estimating such quantities as life-time expectations of earnings, evaluating returns from investments in human capital, assessing economic implications of changes in activity rates and age-structure of the population etc.

Table 3 is an example of an abridged table of economically active life referring to the male population of Malaya as of the 1957 census. This table has been constructed from data compiled and analysed by Saw Swee-Hock. ^{9/} The methods of deriving the various functions are explained below. An abridged table of this kind gives measures for age intervals of five years. Complete tables of

^{8a/} This inference is substantiated by the fact that erratic fluctuations in the activity rates for women in Turkey largely disappear when such rates are calculated separately for urban and rural areas.

^{9/} Swee-Hock Saw, "Malaya: Tables of male working life, 1957", Journal of the Royal Statistical Society (London), series A, vol. 128, No. 3, 1965.

Table 3

Abridged table of economically active life, male population of Malaya, 1957

Age interval (exact ages, x to x+5)	Specific activity rates		Survivors at age x of 10,000 born alive		Stationary population in age interval		Cumulated stationary population in ages x - ∞		Expectation of life at age x		
	In age interval	At beginning age (x)	Total (L _x)	Economically active (4x3)	Total (5L _x)	Economically active (6x2)	Total (T _x)	Economically active	Total years (e _x) (8+4)	Economically active years (9+4)	Inactive years (10-11)
	2	3	4	5	6	7	8	9	10	11	12
0-5	0	0	10 000	0	45 135	0	557 484	372 924	55.7	37.3	18.4
5-10	0	0	8 817	0	43 788	0	512 349	372 924	58.1	42.3	15.8
10-15	9.66	0	8 698	0	43 265	4 179	468 561	372 924	53.9	42.9	11.0
15-20	59.99	34.8	8 608	2 996	42 815	25 685	425 296	368 745	49.4	42.8	6.6
20-25	92.70	76.3	8 518	6 499	42 295	39 207	382 481	343 060	44.9	40.3	4.6
25-30	97.49	95.1	8 400	7 988	41 655	40 609	340 186	303 853	40.5	36.2	4.3
30-35	97.82	97.7	8 262	8 072	40 878	39 987	298 531	263 244	36.1	31.9	4.2
35-40	97.70	97.8	8 089	7 911	39 872	38 955	257 653	223 257	31.8	27.6	4.2
40-45	97.17	97.4	7 860	7 656	38 535	37 444	217 781	184 302	27.7	23.4	4.3
45-50	96.19	96.7	7 554	7 305	36 718	35 319	179 246	146 858	23.7	19.4	4.3
50-55	93.70	94.9	7 133	6 769	34 240	32 083	142 528	111 539	20.0	15.6	4.4
55-60	88.43	91.1	6 563	5 979	30 908	27 332	108 288	79 456	16.5	12.1	4.4
60-65	81.30	84.9	5 800	4 924	26 568	21 600	77 380	52 124	13.3	9.0	4.3
65-70	70.15	75.7	4 827	3 654	21 202	14 873	50 812	30 524	10.5	6.3	4.2
70-75	57.66	63.9	3 654	2 335	15 058	8 682	29 610	15 651	8.1	4.3	3.8
75-∞	47.89	52.8	2 369	1 251	14 552	6 969	14 552	6 969	6.1	2.9	3.2

Source: Columns 2, 4, 6, 8, 10 from Swee-Hock Saw, *op. cit.* Other columns computed as explained in text.

Table 3 (continued)

Age interval (exact ages, x to x+5)	Average active years per active survivor of age x	Components of annual change in number of economically active persons during age interval												
		Net increase (+) or decrease (-)		Deaths of active persons		Net entries into economic activity		Net retirements into inactive status		Rate per 1,000 active (19:7)	Rate per 1,000 inactive (19:7)			
		Number	Rate per 1,000 active (15:7)	Number	Rate per 1,000 active	Number	Rate per 1,000 inactive	Number	Rate per 1,000 inactive					
13	14	15	16	17	18	19	20							
0-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-15	50.5	+2 996	9	2.2	3 005	76.9	-	-	-	-	-	-	-	-
15-20	46.0	+3 503	54	2.1	3 557	207.6	-	-	-	-	-	-	-	-
20-25	41.5	+1 489	110	2.8	1 599	517.8	-	-	-	-	-	-	-	-
25-30	37.0	+ 84	134	3.3	218	208.4	-	-	-	-	-	-	-	-
30-35	32.6	- 161	169	4.2	8	9.0	-	-	-	-	-	-	-	-
35-40	28.2	- 255	223	5.7	-	-	-	-	32	0.8	-	-	-	-
40-45	24.1	- 351	297	7.9	-	-	-	-	54	1.4	-	-	-	-
45-50	20.1	- 536	404	11.4	-	-	-	-	132	3.7	-	-	-	-
50-55	16.5	- 790	531	16.6	-	-	-	-	259	8.1	-	-	-	-
55-60	13.3	-1 055	673	24.6	-	-	-	-	382	14.0	-	-	-	-
60-65	10.6	-1 270	785	36.3	-	-	-	-	485	22.5	-	-	-	-
65-70	8.4	-1 519	821	55.2	-	-	-	-	498	33.5	-	-	-	-
70-75	6.7	-1 084	747	86.0	-	-	-	-	337	38.8	-	-	-	-
75-∞	5.6	-1 251	531	76.2	-	-	-	-	720	103.3	-	-	-	-

economically active life give the measures for each single year of age; an example is shown in the annex. 10/

The calculation begins with the age-specific activity rates (column 2) derived by Saw from the 1957 Malayan census. 11/ In addition to the rates for five-year age intervals, specific rates for the beginning age of each interval (column 3) are required in the calculation of some of the measures. In the present table, following Saw's procedure, these have been obtained by a simple interpolation formula, averaging the rates for successive pairs of five-year

10/ For other examples of tables of economically active life, see J.L. Sadie, Población y Mano de Obra en Chile, 1930-1975. (Santiago de Chile, United Nations, Centro Latino-Americano de Demografía, 1964, E/CN.CELADE/A.5); Agustín García and Nivia E. Castro V., Republica de Panama, volumen II. Proyección de la Población Económicamente Activa 1950-1975, y Tabla de Vida Activa Masculina para la República y el Distrito de Panamá, 1950 (Santiago de Chile, United Nations, Centro Latino-Americano de Demografía 1965 (E/CN.CELADE/C.24); Koya Azumi, "Length of working life of Japanese men, 1930 and 1955", Monthly Labor Review (Washington, D.C., United States Bureau of Labor Statistics), December 1958; S. Kono, Abridged Manpower Life Table for Males, 1960 (Tokyo, Institute of Population Problems, 1965), Research Report No. 1965 (In Japanese); New Zealand Census and Statistics Department, Table of Working Life, 1951: Male Population (including Maoris) (Wellington, 1955); Emil Pallós and Emil Valkovics, "A Gazdaságilag aktív és inaktív élettartam" (Length of economically active and inactive life) Demográfia (Budapest), vol. VIII, No. 1, 1965; P. Depoid, "Tables françaises concernant la population masculine (1906-1946)", Bulletin of the International Statistical Institute (The Hague) 1951, part IV; United Kingdom of Great Britain, Ministry of Labour. The Length of Working Life of Males in Great Britain (London, 1959); United States Bureau of Labor Statistics, Stuart Garfinkle, Tables of Working Life for Women, 1950 (Washington, 1957), Bulletin 1204; United States, Office of Manpower, Automation and Training, Stuart Garfinkle, The Length of Working Life for Males 1900-1960 (Washington, 1963); United States Department of Labor, Stuart Garfinkle, Work-Life Expectancy and Training Needs of Women (Washington, 1967), Manpower Report No. 12; United States Bureau of Labor Statistics, Tables of Working Life - Length of Working Life for Men (Washington, 1950), Bulletin No. 1001. Expectation of economically active life of males at birth is given for many countries in Demographic Aspects of Manpower. Sex and Age Patterns of Participation in Economic Activities (United Nations publication, Sales No. 61.XIII.4). On the significance of functions of such tables and their variations in time, see Seymour L. Wolfbein and A.J. Jaffe, "Demographic factors in labour force growth", American Sociological Review (Menasha, Wis.), August 1946.

11/ In the Malayan census, as in many others, the classifications of the labour force give no subdivision of the age group of sixty-five years and over, but activity rates for age groups at least up to seventy-five years are needed for satisfactory calculations of the tables of economically active life. Some kind of extrapolation therefore has to be used for estimating rates in age groups over sixty-five. Saw made the extrapolation of the Malayan rates with the help of data from the census of Singapore, which were given in five-year age groups up to seventy-five years.

intervals. For example, the activity rate for the exact age of fifteen years is estimated as the average of the rates for ten to fifteen and fifteen to twenty, and so forth. ^{12/}

Next, the life-table survival function, life-table stationary population, and expectation of life are inserted in the table (columns 4, 6, 8, and 10). ^{13/} In the present example, these are taken from Saw's abridged life-table for the male population of Malaya as of 1956-1958. The survival function (column 4) is the l_x function of the life table, representing the number of survivors that would remain alive at each exact age out of the hypothetical cohort of 10,000 persons subject to the given age-specific mortality rates. The stationary population in each age interval (column 6) is the ${}_5L_x$ function of the life table, representing the number of persons who would be alive within each age interval in a hypothetical population replenished annually by a constant number of 10,000 births and subject to the given age-specific rates of mortality. The stationary population above each given age (column 8) is the T_x function of the life table, derived by cumulating the ${}_5L_x$ values from each given age to the end of life; this represents the aggregate of years of life remaining for members of the hypothetical cohort having survived to each given age. The total expectation of life at each age (column 10) is the e_x function of the life table derived by dividing the cumulated stationary population (T_x) by the number of survivors at each age (l_x). This represents the average number of years of life remaining for survivors at each age.

The numbers of economically active survivors at various ages and economically active persons in the stationary population are obtained by multiplying the life-table values by the corresponding specific activity rates; thus, on each line of the table, column 5 is the product of columns 4 and 3, and column 7 the product of columns 6 and 2. The cumulated economically active stationary population (column 9) is derived by summing the values of column 7 from each age to the end of life.

^{12/} Various other interpolation formulae may be used, or the interpolation may be made graphically with a free-hand curve. The values obtained by any interpolation of five-year group rates for the youngest ages are dubious. Saw did not attempt the interpolation below the age of thirty-five years (it has been carried out by his method for the younger ages in order to complete the present methodological example). Better results can be obtained if the census data are classified in finer age groups below twenty years.

^{13/} On methods of deriving life-table functions and their interpretation, see Barclay op. cit., chap. 4; Roland Pressat, L'analyse Démographique, Méthodes - résultats - applications (Paris, Institut national d'études démographiques, 1961), Part II, chap. 3; Spiegleman, op. cit., chap. 5; United States Bureau of the Census, A.J. Jaffe, Handbook of Statistical Methods for Demographers (Washington, 1951), preliminary edition, chap. II.

1. Measures of the length of active life

Two measures of average length of economically active life are provided by the table, as shown in columns 11 and 13. The first (column 11) is that of expectation of active life, that is to say, the average number of economically active years to be lived per person in the hypothetical cohort at birth and among the survivors at each age. This is derived by a calculation analogous to that of the total expectation of life, the cumulated economically active stationary population (column 9) being divided by l_x , the total number of survivors at each age (column 4). The expectation of inactive life (column 12) at birth and at each age is then obtained by subtracting the expectation of active life from the total expectation of life. In the present example, out of the total expectation of life at birth of 55.7 years for males in Malaya, 37.3 years would be expected to be spent in economic activity and 18.4 years in an inactive state. The corresponding figures for survivors to the age of 10 are 53.9 total years of life, 42.9 active years and 11.0 inactive years. ^{14/}

The second measure of length of economically active life is that of average remaining years of active life per economically active person among the survivors of the cohort at each age (column 13). For ages above the point at which the specific activity rates reach their maximum (thirty-five years in the present example), the calculation of this measure is analogous to that of expectation of active life, except that the cumulated economically active stationary population (column 9) is divided by the number of economically active survivors (column 5) instead of the total number of survivors at each age (column 4). At ages below the point of the maximal activity rate, a modification of the method has to be introduced, as illustrated in table 4. Without this modification, the values of average remaining years of active life for the younger ages would be exaggerated, since the numbers of economically active survivors at the younger ages would not include persons expected to enter into economic activities later in life, while the active years of the latter would be included in the cumulated economically active stationary population figures. In order to get around this difficulty, the activity rates for the younger ages are replaced by "hypothetical activity rates" equal at each age to the maximal rate, as shown in column 2 of table 4. The economically active survivors at each age, economically active stationary population in each age-interval, and cumulated economically active stationary population above each age are then recalculated as illustrated in table 4, yielding the values of average remaining active years which are shown in column 8 of table 4 and column 13 of table 3. For instance, in this example, the average remaining years of active life for males who are active at age ten comes to 50.5 years, whereas the expectation of active life for all males at age ten is 42.9 years.

Calculations of the expectations of active and inactive life and related functions in table 3 (columns 2-12) can be made equally well with reference to the population of either sex in any country, area, ethnic group etc. for which the required activity rates and life-table functions are available. Of course

^{14/} If measures of average annual time worked per economically active person are available, by sex and age, they can be used for reducing the expectation of active life to the expectation of working time (in hours, equivalent years of full-time work and so on). For example, see Pallós and Valkovics, op cit.

Table 4

Calculation of average remaining years of active life for economically active survivors at ages under thirty-five years, male population of Malaya, 1957

Age interval (exact ages, x to x+5)	Hypothetical activity rate	Survivors at age x of 10,000 born alive		Stationary population in age interval		Cumulated economically active stationary population in ages x-∞	Average remaining active years per active survivor at age x (7:4)
		Total (l _x)	Economically active (3x2)	Total (5 ^L x)	Economically active (5x2)		
1	2	3	4	5	6	7	8
10-15	97.8	8 698	8 507	43 265	42 313	429 526	50.5
15-20	97.8	8 608	8 419	42 815	41 873	387 213	46.0
20-25	97.8	8 518	8 331	42 295	41 365	345 340	41.5
25-30	97.8	8 400	8 215	41 655	40 739	303 975	37.0
30-35	97.8	8 262	8 080	40 878	39 979	263 236	32.6
35-∞						223 257 ^{a/}	

Source: Swee-Hock Saw, op. cit., adapted.

a/ See table 3, column 9.

the validity of results depends on the accuracy of the data on economic activities and of the mortality data on which the life table is based. On the other hand, the validity of measures of average remaining years of active life for economically active persons (column 13 of table 3) depends on certain conditions which do not have to be satisfied for valid measures of the expectation of active life. These conditions are:

(a) That all persons who enter the labour force at any time in their lives do so prior to the age at which the activity rate reaches its maximum, and no survivors retire into inactive status prior to that age;

(b) That the ages at which individuals retire are independent of the ages at which they enter the labour force;

(c) That the rate of mortality at each age is the same for economically active and inactive persons.

Of course, none of these conditions can be expected to be perfectly satisfied in any case, but near satisfaction of them is necessary if the measures of average remaining years of active life are to be accepted as valid within tolerable margins of error. Clearly, the first condition is far from being satisfied in the female population of most countries, and therefore the method illustrated here will not in most cases yield satisfactory measures of average remaining years of active life of economically active females. Additional data on the frequencies of first entry, retirement, and re-entry of females into the labour force at various ages are generally needed for satisfactory measures, and such data are not generally available for developing countries. ^{15/}

The second condition stated above may not be very well satisfied in either the male or the female population of many countries. It is commonly found that males enter the labour force earlier and retire later in life, on the average, in rural areas than they do in urban areas of the same country. Where such urban-rural differences are pronounced and where neither the urban nor the rural population forms an overwhelming majority of the total, the measures of average remaining active years may be rather far off the mark at some ages. In particular, the measures for males in the labour force at the youngest ages would tend to be understated. A like bias is to be expected where correlated differences exist between average ages of labour force entrance and retirement in socio-economic or ethnic groups of the population.

The third condition, of equal mortality rates in the economically active and the inactive population at each age, is likely to be rather poorly satisfied in most cases, but the error on this account would be important only in countries and age groups where mortality rates are high. It seems likely that in most circumstances, mortality rates of persons in the labour force would be lower than those of inactive persons at the same age, since death is often preceded by

^{15/} For an example of the use of such supplementary data in calculating average remaining years of active life of females in the labour force and other functions of tables of working life for females, see Garfinkle, Tables of Working Life for Women, 1950, op. cit. and Work-Life Expectancy and Training Needs of Women, op. cit.

illness which forces retirement from economic activity. If so, the measures of average remaining active years for persons in the labour force would tend to be somewhat understated.

With these considerations in view, the analyst should be cautious in applying the methods described above for calculation of average remaining years of active life of active persons, and cautious in interpreting the results if he decides that they may usefully be included in the table of economically active life.

Some applications of calculations relating to the length of active life in the study of the economic implications of population changes may be noted briefly. Given data on average annual earnings of economically active persons by sex and age groups, one can convert the "stationary active population" figures in columns 7 and 9 of table 3 into amounts of earnings in each age interval and aggregates of the earning potential from each age to the end of active life; the aggregates can then be divided by the number of survivors of the hypothetical cohort at each age to obtain the expectation of earnings per person at each age. Likewise, given estimates of the annual value of consumption per person according to sex and age, aggregates and expected values of consumption can be computed. ^{16/} The results can be used for studying such questions as the effect of a change in age structure of the population or in age-specific activity rates upon the earnings and consumption functions, the losses of potential earnings and consumption resulting from mortality at various ages, the value of investments embodied in human capital, in terms of consumption by young people in the ages before they enter into economic activities (including costs of education) and relationships between these investments and expectations of earnings.

2. Loss of active years by mortality

It is interesting to estimate the reduction of the average length of active life as a result of death prior to the completion of the potentially active years. This is done by comparing the expectation of economically active life with gross years of active life, a measure derived from the age-specific activity rates alone, which shows what the average number of active years per person would be if there were no loss by premature mortality. The method of calculating gross years of active life is illustrated in table 5 with data from the 1961 census of Indonesia. Multiplying the specific activity rates for various age groups by the numbers of years in the groups and summing the products over the range of ten to seventy-five years, one obtains totals of 54.27 years for the gross years of active life of males and 20.77 for females in this age range, out of a potential maximum of sixty-five years if all persons were economically active from the age of ten to seventy-five. Some uncertainty is involved in continuing the calculation beyond the age of seventy-five because the age group of seventy-five

^{16/} For examples, see László Lengyel and Emil Valkovics, "Mennyit termel és fogyaszt az élete folyamán?" (How much is produced and consumed by a man?) Statisztikai Szemle (Budapest), 1965; Egon Szabady, "Basic economic life tables of Hungary's population", paper presented at the Annual Meeting of the Population Association of America, Cincinnati, 1967.

Table 5

Calculation of gross years of active life in ages of ten years and over and ten to seventy-five years, Indonesia, 1961

Age interval (exact ages)	Males			Females		
	Number of years in age interval	Specific activity rate	Average number of active years in age interval (3x2)	Specific activity rate	Average number of active years in age interval (5x2)	
	2	3	4	5	6	
0-10	10	22.6	1.13	15.6	0.78	0
10-15	5	66.7	3.34	30.6	1.53	
15-20	5	87.2	4.36	27.4	1.37	
20-25	5	94.4	9.44	27.2	2.72	
25-35	10	96.8	9.68	33.3	3.33	
35-45	10	95.6	9.56	39.8	3.98	
45-55	10	89.6	8.96	39.1	3.91	
55-65	10	78.0	7.80	31.5	3.15	
65-75	10	61.7	9.26	20.3	3.04	
75 +	15					
Total, 10-75	65		54.27		20.77	
Total, 10-∞	80		63.53		23.81	

a/ The Indonesian census data on economic activities are limited to the age group ten years and over. No doubt some children under ten years of age were economically active; thus the use of a zero activity rate for this age group makes for a slight understatement of gross years of active life for the synthetic cohorts at birth.

years and over is not subdivided in the Indonesian census classification. The choice of a number of years to represent the maximum length of active life in this age group is arbitrary; this number has been put at fifteen years for the purpose of the present calculation, on the assumption that no significant number of persons would continue in economic activity after the age of ninety. On this basis, the measure of gross years of active life over the whole range of ages from ten years upward comes to 63.53 for Indonesian males and 23.81 for females out of a potential maximum of eighty years.

The difference between gross years of active life and expectation of active life (or "net years of active life", as the latter measure is sometimes called when such comparisons are made) represents the loss by mortality. Although this may be calculated with reference to any age, the main interest is in effects of mortality on the expectation of active life at birth and at the beginning age of entries into the labour force. The calculation is illustrated below with the data for the male population of Malaya, 1957: 17/

	<u>Active years in all ages 10 and over</u>	<u>Active years in the ages between 10 and 75</u>
1. Gross years of active life . . .	59.2	52.0
2. Expectation of active life at birth	37.3	*36.6
3. Loss of active years by mortality (1-2)	21.9	15.4
4. Expectation of active life at age 10	42.9	*42.1
5. Loss of active years by mortality after age 10 (1-4)	16.3	9.9

*Calculated by subtracting the stationary active population in the age group 75 years and over from the cumulated total for ages 0 and 10 (column 9 of table 3) and dividing the result by the number of survivors in the cohort at age 0 or 10 (column 4 of table 3).

3. Entries into the labour force, retirements, losses by death and related measures

Table 6 illustrates the derivation of the components of change in number of economically active survivors during each age interval, which are shown in the table of economically active life (columns 14, 15, 17 and 19 of table 3). The survival functions and stationary population figures (columns 2-5 of table 6) are transcribed for convenience from table 3. Column 6 shows the increase or decrease

17/ The measures of gross and net years of active life in the age-range of fifteen to sixty-nine years are given for many countries in Demographic Aspects of Manpower. Sex and Age Patterns of Participation in Economic Activities (United Nations publication, Sales No.: 61.XIII.4), table A-7 and pp.18-19.

Table 6

Calculation of components of change in numbers of economically active survivors during five-year age intervals, table of economically active life, male population of Malaya, 1957

Age interval (exact ages, x to x+5)	Survivors at age x of 10,000 born alive		Stationary population in age interval		Increase (+) or decrease (-) of economically active survivors during age interval	Deaths of economically active persons during age interval		Net entries into economic activity (+) or net retirements (-) during age interval			
	Total (L _x)	Economically active	Total (L _x)	Economically active		Mortality rate (1000 ₅ x)	First estimate of deaths (7x5)	Adjusted estimate of deaths	Net entry or retirement rate	First estimate of net entries or retirements (10x4)	Adjusted estimate of net entries or retirements
	2	3	4	5	6	7	8	9	10	11	12
10-15	8 698	0	43 265	4 179	+ 2 996	2.08	9	9	+ 34.8	+ 3 011	+ 3 005
15-20	8 608	2 996	42 815	25 585	+ 3 503	2.10	54	54	+ 41.5	+ 3 554	+ 3 557
20-25	8 518	6 499	42 295	39 207	+ 1 489	2.79	109	110	+ 18.8	+ 1 590	+ 1 599
25-30	8 400	7 988	41 655	40 609	+ 84	3.31	134	134	+ 2.6	+ 217	+ 218
30-35	8 262	8 072	40 878	39 987	- 161	4.23	169	169	+ 0.1	+ 8	+ 8
35-40	8 089	7 911	39 872	38 955	- 255	5.74	224	223	- 0.4	- 32	- 32
40-45	7 860	7 656	38 535	37 444	- 351	7.94	297	297	- 0.7	- 54	- 54
45-50	7 554	7 305	36 718	35 319	- 536	11.47	405	404	- 1.8	- 132	- 132
50-55	7 133	6 769	34 240	32 083	- 790	16.65	534	531	- 3.8	- 260	- 259
55-60	6 563	5 979	30 908	27 332	- 1 055	24.69	675	673	- 6.2	- 383	- 382
60-65	5 800	4 924	26 568	21 600	- 1 270	36.62	791	785	- 9.2	- 489	- 485
65-70	4 827	3 654	21 202	14 873	- 1 319	55.32	823	821	- 11.8	- 500	- 498
70-75	3 654	2 335	15 058	8 682	- 1 084	85.34	741	747	- 11.1	- 334	- 337
75-∞	2 369	1 251	14 552	6 969	- 1 251	162.80	1 135	531	- 52.8	- 1 537	- 720

in number of economically active survivors during each age interval, derived by taking the differences between the figures for successive ages in column 3. The problem is to estimate two components of the increase or decrease during each age interval: (a) the number of deaths of economically active persons and (b) the net balance between entries of inactive persons into economic activity and retirements of active persons into inactive status. These two components are first estimated independently, and then the estimates are adjusted to force agreement with the increases and decreases shown in column 6.

For the first estimate of deaths of economically active persons (column 8), the life-table mortality rate ($1,000 {}_5m_x$) shown in column 7 is applied to the economically active stationary population in each age interval (column 5), according to the assumption of equal mortality rates for economically active and inactive persons. If the mortality rates of the economically active are lower, as seems likely to be the case in most circumstances, of course this estimate of deaths tends to be exaggerated. The life-table mortality rate used in this calculation represents the number of deaths in the cohort during each age interval (that is, the age-to-age difference in number of survivors, l_x) expressed as a quotient per 1,000 of the stationary population in the age interval (${}_5L_x$).

For the first estimate of the net balance between entries into economic activity and retirements (column 11), a net entry or retirement rate for each age interval (column 10) is applied to the total stationary population in the age interval (column 4). This net entry or retirement rate is obtained by taking differences between the specific activity rates for successive ages (column 3 of table 3). Since this is a five-year rate and it is applied to a five-year age group of the population, the result to be inserted in column 11 must be divided by five. Retirements, it should be noted, include involuntary as well as voluntary withdrawals into inactive status; disability is a major factor, and forced retirement on account of obsolescence of skills, discrimination in favour of employment of younger workers and for similar reasons, may also play an important part.

The adjustment of the first estimates is made on a pro-rata basis, so that the sums (with due regard to sign) of the numbers of deaths and net entries or retirements during each age interval are forced to agree with the corresponding increases and decreases in the number of economically active survivors during the age interval (column 6); and the adjusted estimates are inserted in columns 9 and 12. That the sums of the first estimates fail to agree with the independently determined increases or decreases is due to interaction between the factors of mortality and changing activity rates during the age intervals. The adjustment is minor for all age intervals except over seventy-five years, where both the mortality rate and the retirement rate are very high, so that their interaction becomes very important. Where such a large adjustment is required as is indicated in this example for the ages over seventy-five years, the estimates cannot be regarded as very satisfactory. More satisfactory results would be obtained by carrying out the calculations for five-year age groups up to the age at which the number of economically active survivors becomes negligible (age eighty-five would be far enough in most cases).

In table 3 (columns 16, 18, and 20), the adjusted estimates of deaths, net entries, and net retirements are expressed as age-specific rates, per 1,000 of the economically active stationary population for deaths and net retirements and per 1,000 of the inactive stationary population for net entries into active status.

In the case of males, there is ordinarily no great error in treating the net balances of entries and retirements as estimates of gross entries into economic activity in the younger age intervals and gross retirements in the older intervals. Such an interpretation is not ordinarily warranted in the case of females; additional data are required for estimating gross entries and retirements of females at various ages, in the circumstances existing in most countries.

Taking the net entry and retirement figures for males to represent approximately the gross figures, one can readily derive estimates of the median ages of entry into and retirement from economic activities. From the adjusted estimates in column 12 of table 6, median ages of about 16.5 years for entry and about sixty-six years for retirement of males in Malaya are obtained on the assumption of linear distribution of the figures within each five-year age interval. More precise values of the medians could be obtained if the age classifications were given in greater detail.

One of the principal applications of the results of these calculations is in estimating crude rates (for all age groups taken together) of replenishment of the labour force by entries and its depletion by deaths and retirements. These crude rates are derived by applying the age-specific rates from the table of economically active life to the figures for corresponding age groups in the actual labour force and inactive population of the country concerned, and summing up the results for all ages, as illustrated in table 7 with reference to the male population of Malaya. ^{18/} From the totals at the foot of the table, the following rates are obtained:

	Annual crude rate per 1,000 of the <u>labour force</u>
Entries	37.2
Retirements	4.2
Losses by death	9.9

The difference between the rate of entries and the sum of the rates of retirements and losses by death is known as the labour force replacement rate. In this example, it amounts to an annual increase of 23.1 per 1,000 of the male labour force. It is equally possible to calculate the replacement rate for the female labour force and the total for the two sexes, although valid separate estimates of the entry and retirement rates may not be feasible in the case of females; the net balance of female entries and retirements is then expressed as a rate per 1,000 of the female labour force, and the female replacement rate is obtained by subtracting the rate of losses by death. The replacement rate can be

^{18/} Such crude rates calculated within the context of the table of economically active life would have little meaning, since this table relates to the hypothetical, stationary population of the life-table, in which the labour force is stationary as well; in other words, entries must be balanced by retirements and deaths of economically active persons.

Table 7

Calculation of annual losses from labour force by death and retirement and gains by entries from the inactive population, male population of Malaya, 1957

Age (years)	Population (thousands)	Labour force (thousands)	Inactive population (thousands)	Annual losses from labour force by death		Annual entries into labour force		Annual retirements from labour force	
				Rate per 1,000 of labour force	Estimated number (thousands)	Rate per 1,000 of inactive population	Estimated number (thousands)	Rate per 1,000 of labour force	Estimated number (thousands)
1	2	3	4	5	6	7	8	9	10
10-14	353.3	34.1	319.2	2.2	0.1	76.9	24.5	-	-
15-19	307.3	184.3	123.0	2.1	0.4	207.6	25.5	-	-
20-24	257.6	238.8	18.8	2.8	0.7	517.8	9.7	-	-
25-29	216.0	210.6	5.4	3.3	0.7	208.4	1.1	-	-
30-34	187.5	183.4	4.1	4.2	0.8	9.0	0.0	-	-
35-39	173.5	169.5	4.0	5.7	1.0	-	-	0.8	0.1
40-44	157.0	152.6	4.4	7.9	1.2	-	-	1.4	0.2
45-49	152.5	146.7	5.8	11.4	1.7	-	-	3.7	0.5
50-54	129.3	121.2	8.1	16.6	2.0	-	-	8.1	1.0
55-59	98.7	87.2	11.5	24.6	2.1	-	-	14.0	1.2
60-64	64.5	52.4	12.1	36.3	1.9	-	-	22.5	1.2
65-69	41.2	28.8 ^{b/}	12.4	55.2	1.6	-	-	33.5	1.0
70-74	24.6	14.2 ^{b/}	10.4	86.0	1.2	-	-	38.8	0.6
75 and over	22.6	10.8 ^{b/}	11.8	76.2	0.8	-	-	103.3	1.1
Total,									
10 and over	2 185.6 ^{a/}	1 634.6	551.0		16.2		60.8		6.9

^{a/} Excluding the category of unknown age.

^{b/} Adjusted on a pro rata basis to add to given total for ages 65+.

interpreted as a sort of rate of natural increase of the labour force, i.e., the rate at which it would grow under conditions of constant age-specific activity rates with the existing population age-structure and the rates of mortality represented by the life-table. It serves as an index of potential growth of the labour force which can be derived from the data of a single census together with an appropriate life-table. Further information on the dynamics of the labour force can be obtained by comparing the data of successive censuses, if they are available; relevant methods will be discussed in the next section.

The labour force replacement ratio is defined as the annual number of entries into the labour force per 100 of the sum of retirements and losses by death. Using the example of table 7, this measure is calculated as follows:

$$\text{Replacement ratio} = \frac{60.8}{6.9 + 16.2} \times 100 = 263$$

The labour force replacement ratio may be interpreted as an index of the pressure on the labour market represented by the demands of entering workers for jobs, in proportion to the number of jobs being vacated by retirement and death.

E. Intercensal comparisons of cohort activity rates

The statistics of the labour force obtained in a census present a cross-sectional view of the working-life histories of many different cohorts, born at different times in the past, whose survivors are found in different age groups at the census date. In a table of economically active life, the age-specific activity rates derived from such a census cross-section are taken to represent the life-cycle of economic activity in a hypothetical cohort. Such an interpretation would be strictly valid only where the age-specific rates remained constant in time so that all cohorts would pass through the same cycle of activity rates in the course of their lives. Where the life-cycles of these rates vary in successive cohorts (as they may be expected to do at least to some extent in any country), producing time-trends in the specific rates for certain sex-age groups, the cross-section of activity rates at any date reflects these trends as well as the age-to-age changes of cohort rates. The result is some bias in the net rates of entry into and retirement from the labour force during various age intervals shown by the cross-sectional table of economically active life, and a related bias in the measures of length of active life (though this latter bias may not be so strong). Where the secular trends of age-specific activity rates are generally upward (as they have been in the female population of certain countries), cross-sectional measures of net rates of entry into the labour force during various age intervals tend to be understated while net rates of retirement during other age intervals are overstated. The directions of bias are opposite where the trends of age-specific rates are downward, as they have been in the case of males under twenty and over fifty-five years in many countries.

Given long historical series of census statistics on population and labour force by sex and age groups, it might be possible to calculate tables of economically active life with reference to the actual working-life histories of real cohorts traced in the tabulations of the successive censuses. For example, in a series of decennial census statistics over the period 1910 to 1960, the cohort of ten to fourteen years of age in 1910 would be identified with the age group twenty to twenty-four years in 1920, thirty to thirty-four years in 1930,

and so on up to the age of sixty to sixty-four years in the 1960 census. ^{19/} Tables of economically active life on this basis are not known to have been constructed with the statistics of any country. Even where such long historical series of census data are available with the required age classifications, the limited possibilities of historical comparison would present obstacles to their use for this purpose.

On the other hand, it is feasible and useful to make less ambitious studies of cohort activity rates where data are available in comparable form for even as few as two census dates. Table 8 shows an example of this, using the data of the 1950 and 1960 censuses of Panama. The 1960 age-specific activity rates for each sex are inscribed diagonally in the table, those for the age group ten to fourteen years in 1960 referring to the cohorts born during 1945-1950, for age group fifteen to nineteen to those born during 1940-1945 and so on. Likewise the rates from the 1950 census are inscribed, age group ten to fourteen referring to the cohorts born during 1935-1940, and so forth. Next, 1955 activity rates are estimated by linear interpolation for each age group, across the horizontal lines of the table. ^{20/} The figures read vertically down the columns then represent segments of activity-rate life cycles of different cohorts so far as they come within the range of the 1950, 1955, and 1960 cross-sections. If and when the Panamanian census is repeated with comparable classifications in 1970, it will be possible to add two more five-year age intervals to the record of each cohort's working-life cycle, and a more comprehensive picture of the shifting patterns of age-to-age changes in activity rates of successive cohorts will be revealed. ^{21/}

Net rates of entry into or retirement from the labour force between successive age levels are derived from the data for real cohorts in table 8 by the same method used to derive such net rates for hypothetical cohorts from

^{19/} "Generation life tables", constructed in a similar way to represent the mortality and survival experience of real cohorts traced over long periods, would be used in calculating such tables of economically active life.. On the construction of generation life tables, see George Barclay, Techniques of Population Analysis *op. cit.*; Roland Pressat L'analyse démographique. Méthodes - Résultats - Applications, *op. cit.*; and Mortimer Spiegelman, Introduction to Demography, *op. cit.* On the methodology of cohort analysis, see Roland Pressat, Principes d'analyse. cours d'analyse démographique de l'I.D.U.P. (Paris, Institut national d'études démographiques, 1961), chap.III.

^{20/} This interpolation of rates for 1955 improves the coherence of the analysis by making the intervals between the cross-sections in time agree with the five-year groups of the age classification. If the interval between the two censuses were, say, seven years instead of ten, the procedure would be to reduce this to five years by interpolation. A possible alternative in such a case might be to regroup the age classification in the earlier or the later census so as to obtain a seven-year interval of ages, but this kind of regrouping is likely to present difficulties.

^{21/} For an example of such an analysis of cohort activity rates over a long period, see John D. Durand, The Labor Force in the United States, 1890-1960 (New York, Social Science Research Council, 1948), chap. 5.

Table 8

Sex-age specific activity rates of population cohorts,
Panama, 1950, 1960 and 1955 interpolations

Age (years)	Years of birth of cohorts															
	1945- 1950	1940- 1945	1935- 1940	1930- 1935	1925- 1930	1920- 1925	1915- 1920	1910- 1915	1905- 1910	1900- 1905	1895- 1900	1890- 1895	1885- 1890	1880- 1885	1875- 1880	1875 and before
Males																
1950																
1955																
1960																
10-14	14.3	15.8	17.4													
15-19		63.2	65.8	68.3												
20-24		92.3	93.6	94.8												
25-29			96.5	97.1	97.7											
30-34				97.0	97.4	97.9										
35-39					97.1	97.6	98.1									
40-44						97.1	97.8	98.4								
45-49							96.4	97.1	97.8							
50-54								95.0	95.6	96.3						
55-59									92.4	92.9	93.4					
60-64										81.8	83.5	85.2				
65-69											68.9	73.1	77.3			
70-74												57.8	64.8	71.9		
75 and over													43.8	50.8	57.7	

Table 8 (continued)

Age (years)	Years of birth of cohorts															
	1945-1950	1940-1945	1935-1940	1930-1935	1925-1930	1920-1925	1915-1920	1910-1915	1905-1910	1900-1905	1895-1900	1890-1895	1885-1890	1880-1885	1875-1880	1875 and before
Females																
1950																
1955																
1960																
10-14	3.8	4.6	5.3													
15-19		23.5	23.4	23.4												
20-24			31.2	30.4	29.6											
25-29				28.3	26.8	25.3										
30-34					27.7	26.4	25.1									
35-39						27.1	26.1	25.1								
40-44							27.0	25.5	24.0							
45-49								26.1	24.0	21.9						
50-54									21.8	20.6	19.5					
55-59										17.4	17.0	16.6				
60-64											12.9	13.0	13.0			
65-69												9.6	10.6	11.5		
70-74													6.7	7.4	8.1	
75 and over														3.5	4.2	4.9

cross-sectional data (as was done with the Malayan statistics in table 6, column 10). It is instructive to compare the results obtained for real and hypothetical cohorts, as is done with the Panamanian data in table 9. While the patterns are fairly similar on the whole, some significant differences appear, illustrating the kinds of biases to which estimates for hypothetical cohorts may be subject. For example, in the case of males, the rates for hypothetical cohorts derived from both the 1950 and 1960 census cross-sections imply net entries into the labour force continuing up to approximately age forty, whereas the estimates for real cohorts make it appear that the dividing line between the ages of net entry and net retirement of males should be placed about ten years lower, near age thirty. In regard to females, while the data for hypothetical cohorts indicate net excesses of retirements over entries in all age intervals beyond the early twenties, those for real cohorts reveal a phase of entries somewhat exceeding retirements at ages between the middle twenties and the middle forties.

Such intercensal comparisons of activity rates of real cohorts are useful for several kinds of purposes. Where the census data are satisfactory in quality and for comparative purposes, they provide more accurate measures of net rates of entry into and retirement from the labour force, and of labour force replacement rates and ratios, than can be obtained from the cross-sectional analysis of data of a single census. ^{22/} They can be used to advantage in studying influences of demographic, economic, and social factors upon labour force dimensions and trends by the methods to be considered in the next chapter; and in some circumstances, they may provide a better basis for projections of future labour force trends than cross-sectional data alone would afford. ^{23/} It is important, however, to recognize some sources of possible error in such measures. Their validity depends, again, on the familiar assumption of mortality rates at each age being the same (or at least not too different) for economically active and inactive persons. They may also be affected by immigration and emigration between the dates of the censuses if the activity rates of migrants are very different from those of non-migrants (although the effect of this factor is likely to be important only where migration occurs on a very large scale). More important, the results may be falsified by differences between the labour force definitions applied in successive censuses and by differences in the nature and magnitude of errors and biases in reporting of economic activities. Errors in the census reporting of ages, and under-enumeration or over-enumeration of the population in certain age groups, may also affect these estimates if the age-reporting and enumeration errors are not the same in the economically active and inactive segments of the population. One of the analyst's means of testing the quality and consistency of his data is to compare the cohort activity rates derived from successive censuses and look for erratic patterns.

^{22/} For examples, see A.J. Jaffe and R.O. Carleton, Occupational Mobility in the United States, 1930-1960 (New York, 1954); A.J. Jaffe and J.N. Froomkin, "Economic development and jobs - a comparison of Japan and Panama, 1950 to 1960", paper presented at Symposium No. 1 on Population Problems in the Pacific, Eleventh Pacific Science Congress, Tokyo, 1966; A.J. Jaffe, "Economic development and the growth of the male labor force of Panama, 1950-1960", American Journal of Economics and Sociology (Lancaster, Pa.), July 1966.

^{23/} For an example of labour force projections in terms of cohorts, see Durand, op. cit., appendix C.

Table 9

Net rates of entrance into (+) or retirement from (-) the labour force in successive age intervals, hypothetical and real cohorts, Panama, 1950-1960

Age intervals (years)	Males				Females			
	Hypothetical cohorts		Real cohorts		Hypothetical cohorts		Real cohorts	
	1950	1960	1950-1955	1955-1960	1950	1960	1950-1955	1955-1960
Birth to 10-14	+17.4	+14.3	...	...	+ 5.3	+ 3.8	...	...
10-14 to 15-19	+50.9	+48.9	+48.4	+47.4	+18.1	+19.7	+18.1	+18.9
15-19 to 20-24	+26.5	+29.1	+25.3	+26.5	+ 5.8	+ 7.7	+ 7.0	+ 7.8
20-24 to 25-29	+ 2.9	+ 4.2	+ 2.3	+ 2.9	- 4.3	- 2.9	- 2.8	- 2.1
25-29 to 30-34	+ 0.2	+ 0.5	- 0.3	- 0.1	- 0.2	- 0.6	+ 1.1	+ 0.9
30-34 to 35-39	+ 0.2	+ 0.1	- 0.3	- 0.3	0.0	- 0.6	+ 1.0	+ 0.7
35-39 to 40-44	+ 0.3	0.0	- 0.3	- 0.5	- 1.1	- 0.1	+ 0.4	+ 0.9
40-44 to 45-49	- 0.6	- 0.7	- 1.3	- 1.4	- 2.1	- 0.9	0.0	+ 0.6
45-49 to 50-54	- 1.5	- 1.4	- 2.2	- 2.1	- 2.4	- 4.3	- 1.3	- 2.2
50-54 to 55-59	- 2.9	- 2.6	- 3.4	- 3.2	- 2.9	- 4.4	- 2.5	- 3.2
55-59 to 60-64	- 8.2	-10.6	- 9.9	-11.1	- 3.6	- 4.5	- 3.6	- 4.1
60-64 to 65-69	- 7.9	-12.9	-12.1	-14.6	- 1.5	- 3.3	- 2.4	- 3.4
65-69 to 70-74	- 5.4	-11.1	-12.5	-15.3	- 3.4	- 2.9	- 4.1	- 3.9
70-74 to 75 and over	-14.2	-14.0	...	...	- 3.2	- 3.2	- ....	...

Chapter II

STUDIES OF FACTORS AFFECTING THE SIZE, COMPOSITION AND GROWTH OF THE LABOUR FORCE

A. Framework of demographic and other factors

The purpose of analysing census data on the labour force is not merely to measure its size, composition and growth but also to gain knowledge of the factors which enter into the determination of these characteristics. Such knowledge is useful in dealing with many questions of policy and formulation of action programmes in economic and social fields. In particular, it provides a basis for labour force projections, which occupy an important place in the statistical apparatus of planning for economic and social development.

The dimensions of the labour force can be considered as determined, on the one hand, by the size and sex-age composition of the population and, on the other by the age-specific activity rates for the two sexes. The changing size and composition of the population are determined, in turn, by the conditions of fertility, mortality and migration and modifications in these conditions in the course of time. Knowledge of the influences of these components of population change upon labour force dimensions is a matter of evident importance in connexion with questions of population policy. The age-specific male and female activity rates can be considered as representing the effects of economic, social, and cultural factors relevant to the desire of engaging in income-producing work and the opportunities for doing so. The latter also may sometimes have important bearing on the components of population change - migration especially is likely to be affected by conditions of employment opportunity - and the analyst attempting to get a comprehensive view of the determinants of labour force dimensions will not wish to omit this aspect. However, the study of factors affecting fertility, mortality and migration is outside the scope of the present manual.

B. Influences of the population age-structure

1. Age-standardized activity rates

Standardization is a useful method for estimating the effects of variations of population composition upon the dimensions of the labour force, and separating these from the effects of factors bearing on the specific activity rates. ^{1/} For these purposes, the analyst may calculate age-standardized activity rates; that is, weighted averages of age-specific activity rates with standard weights for the different dates, areas or population categories to be compared.

^{1/} On methods and applications of standardization, see Jaffe, Handbook of Statistical Methods for Demographers, op. cit., chap. III.

These show how the relative size of the labour force would vary under the influence of the variations of age-specific activity rates alone, if the population age structure were the same. Differences between age-standardized and unstandardized (crude or refined) activity rates represent the effects of variations of population age-composition, subject to reservations as regards the interdependence and interaction of factors, which will be considered farther on.

An example is given in table 10, showing the use of standardization for analysing factors of difference between urban and rural male activity rates (six years of age and over) in Peru at the census of 1961. ^{2/} The standard weights used in this example are the proportionate shares of the different age groups in the male population of the country as a whole (six years of age and over). These weights (column 7 of the table) are applied to the age-specific urban and rural male activity rates (columns 5 and 6) and the products (columns 8 and 9) are summed over all the age groups six years and up. The totals (first line of columns 8 and 9) are the urban and rural age-standardized activity rates in the male population six years of age and over. In the same way, age-standardized rates could be calculated for the female population six years of age and over, and for the population of each sex in all age groups (including those under six years). ^{3/}

In this example, the rural age-standardized male activity rate exceeds the urban rate by 5.2 per cent of the male population six years of age and over. The difference is a summary measure of the extent to which the rural age-specific rates exceed the corresponding urban rates; it is an estimate of the net effect of urban-rural differences in all factors affecting the relative size of the male labour force with the exception of the age composition of population. The difference between the rural and urban unstandardized rates (first line of columns 5 and 6) is smaller: only 2.3 per cent. This means that there is an urban-rural difference in population age composition exerting an influence on the relative sizes of the urban and rural labour force which is opposite to and partly offsets the net effect of other factors. As can be seen in columns 3 and 4, the rural population contains disproportionately many children under fifteen and men over sixty years of age, and their presence tends to depress the unstandardized rural activity rate. While in the urban population, the unstandardized rate is inflated by the presence of a disproportionately large number of men of prime working ages. Age-selective migration from rural areas to the cities is one cause of this imbalance in the age composition of the population, and a rural-urban fertility difference may be a supplementary cause. The unstandardized

^{2/} For additional examples of the use of age-standardized activity rates in analysing factors of variations of labour force dimensions, see Demographic Aspects of Manpower. Sex and Age Patterns of Participation in Economic Activities (United Nations publication, Sales No.: 61.XIII.4), pp. 13-14 and table A-4; Jaffe and Stewart, Manpower Resources and Utilization. Principles of Working Force Analysis, op. cit., pp. 287-290; Gertrude Bancroft, The American Labor Force: Its Growth and Changing Composition (New York, 1958), chap. 3.

^{3/} See the example in table 11 of calculation of age-standardized rates for the population of all ages. These may be no less useful than rates such as those calculated in table 10 for the population above the minimal age to which the labour force data refer.

Table 10

Computation of age-standardized activity-rates in the male population of Peru, urban and rural, 1961

Age (years)	Population (thousands)			Activity rates		Percent distribution of total population	Computation of standardized activity rates	
	Total	Urban	Rural	Urban	Rural		Urban	Rural
		3	4						5	6	8	9
1	2	3	4	5	6	7	8	9
Total 6 +	3 928	1 900	2 028	61.1	63.4	100.0	59.6	64.8
6-9	582	256	326	0.5	0.6	14.8	0.1	0.1
10-14	595	281	313	5.2	7.4	15.1	0.8	1.1
15-19	494	252	242	46.3	63.8	12.6	5.8	8.0
20-24	421	222	199	86.6	97.2	10.7	9.3	10.4
25-29	360	182	178	96.0	99.0	9.2	8.8	9.1
30-34	312	160	152	98.2	99.2	7.9	7.8	7.9
35-39	261	127	133	98.4	99.2	6.6	6.5	6.6
40-44	209	102	107	98.3	99.1	5.3	5.2	5.3
45-49	177	84	94	98.0	99.1	4.5	4.4	4.5
50-54	143	70	73	96.6	98.7	3.6	3.5	3.6
55-59	110	53	57	93.7	98.5	2.8	2.6	2.8
60-64	99	44	55	87.5	95.4	2.5	2.2	2.4
65-69	60	27	32	78.6	90.9	1.5	1.2	1.4
70-74	42	18	25	60.6	77.9	1.1	0.7	0.8
75 and over	63	22	41	40.4	57.7	1.6	0.6	0.9
Not reported	2	1	1	60.5	64.8	0.1	0.0	0.0

Note: Columns 7, 8 and 9 computed from unrounded data.

urban activity rate exceeds the standardized rate by 1.5 per cent; this is an estimate of the effect of the age-composition difference between the urban and the total population. For the rural activity rate, the corresponding measure is a difference of 1.4 per cent in the opposite direction.

In this example, it seems obvious that the age distribution of the male population in the whole country is an appropriate standard for computing the weights to be applied to the rural and urban age-specific male activity rates. Likewise, in standardizing the activity rates for different regions or provinces of a country, different ethnic groups in the population and so on, it would appear appropriate to use the age distribution of population in the country as a whole for the standard. In other cases, though, the choice of an appropriate standard is not so obvious - for example, in comparing activity rates of two or more countries. It is important to recognize that the selection of the standard may have a considerable effect on the results of the analysis. ^{4/}

2. Interdependence and interaction of factors

In estimating the effects of various factors upon labour force dimensions, by standardization or by other methods to be discussed later, the analyst must be on guard against errors and biases which may result from a failure to take due account of the interdependence and interactions between the factors.

In the present context, interdependence means influences of population age structure (or of its component factors - fertility, mortality and migration) upon age-specific activity rates, and of the latter upon the former. For example, a high proportion of school-age children in the population may make for a high activity rate in this age group, since the more children there are, the more difficult it is from an economic point of view for the community and the family to keep them all in school. A high proportion of younger children, due to a high birth rate, may tend to depress activity rates of women by adding to their responsibilities as mothers; conversely, high activity rates of women in child-bearing age groups may depress fertility; migration may affect specific activity rates; and so forth. It is essential that such influences be absent for the estimates of the effects of various factors obtained by methods such as are described here to be strictly valid - a condition which is probably seldom fully satisfied in reality. While a little interdependence may do no harm, the estimates obtained in a situation of great interdependence between factors may be misleading.

^{4/} Instead of age-standardized activity rates, gross years of active life (see table 5) may be used as a summary measure of the levels of age-specific activity rates. For example, see Demographic Aspects of Manpower. Sex and Age Patterns of Participation in Economic Activities (United Nations publication, Sales No.: 61.XIII.4), p. 18 and table A-7. This has the advantage of avoiding the need for arbitrary selection of a standard, but the standard represented by gross years of active life is not an ideal measure because it gives equal weight to the specific activity rates for all age groups (according to the number of years in each group). Thus the measure is affected to an undue extent by the rates for the highest age brackets, which have little influence on the size of the labour force in any population.

Interaction, in the present context, means intensification or dampening of the influence of demographic factors by variations of specific activity rates and vice versa. When the activity rate in a certain age group varies, the effect on the dimensions of the labour force depends on the proportionate share of that age group in the population; conversely, the effect of varying the proportionate share of the age group depends on the specific activity rate. Thus, when specific activity rates and population age structure vary simultaneously, their influences interact; and the interaction may be responsible for a sizeable share of the effect on labour force dimensions.

Suppose, for example, that both the age composition of a certain population and its age-specific activity rates have changed between the dates of two censuses and it is desired to estimate the effect of the change in each factor upon the change of the crude activity rate during the interval. The values of the two factors at the two dates make four combinations which can be represented by the following scheme:

<u>Population age composition</u>	<u>Age-specific activity rates</u>	
	<u>Earlier census</u>	<u>Later census</u>
Earlier census	A	C
Later census	D	B

Combinations A and B give the unstandardized crude activity rates of the earlier and the later census, respectively. Combination C gives an age-standardized activity rate as of the later census date with the population age-group weights of the earlier census. Combination D gives an age-standardized rate as of the earlier census date with the age-group weights of the later census. The effect of the change in specific activity rates can be estimated either as the difference (C - A) or (B - D); the two estimates will differ as a result of interaction between the changes of the two factors, and there is no logical basis for a preference between these two estimates. Likewise, the effect of the shift in population age composition can be estimated either as the difference (D - A) or (B - C). So the net change of the crude activity rate between the two dates (B - A) can be factored into components in either of two ways:

$$(B - A) = (C - A) + (B - C); \text{ or}$$

$$= (D - A) + (B - D).$$

A numerical illustration is provided by the calculations shown in table 11 with reference to the age composition and age-specific activity rates of the male population of Japan at the censuses of 1940 and 1960. ^{5/} In terms of the

^{5/} Actually, the 1940 and 1960 rates are not exactly comparable since the labour force enumeration in the 1940 census referred to a concept of usual activity whereas definitions referring to activity during a specified week were applied in the 1960 census. The difference in definitions is ignored in the present example.

Table 11

Calculation of age-standardized activity rates, male population
of Japan, 1940 and 1960

Age (years)	Population distribution as a percentage			Activity rates		Calculation of age-standardized activity rates		
	1940	1960	1940	1960	1960 rates	1940 rates	1940 population	1960 population
	2	3	4	5	6	7	6	7
All ages	100.0	100.0	56.0	58.5	53.9 ^{a/}	61.7 ^{a/}		
Under 15	36.4	31.2	-	-	-	-		
15-19	10.2	10.2	77.6	51.6	5.3	7.9		
20-24	8.3	9.0	91.4	87.9	7.3	8.2		
25-29	7.7	8.9	96.5	96.9	7.5	8.6		
30-34	6.8	8.2	97.8	97.8	6.7	8.0		
35-39	6.2	6.0	98.0	97.7	6.1	5.9		
40-44	5.4	5.0	98.0	97.7	5.3	4.9		
45-49	4.5	4.9	97.4	97.1	4.4	4.8		
50-54	4.0	4.4	95.5	96.0	3.8	4.2		
55-59	3.4	3.9	90.8	90.5	3.1	3.5		
60-64	2.9	3.1	83.6	82.5	2.4	2.6		
65 and over	4.1	5.0	61.9	54.4	2.2	3.1		

Source: Columns 2-5 from Bureau of Statistics, Office of the Prime Minister, 1960 Population Census of Japan, Abridged Report, Part I, All Japan, pp. 138-41, for data on age structure and pp. 226-227 for data on economic activity.

a/ Sum of unrounded products.

above scheme, the value of C is obtained as shown in column 6 of the table and D as shown in column 7. We have:

<u>Population age composition</u>	<u>Age-specific activity rates</u>	
	<u>1940 census</u>	<u>1960 census</u>
1940 census	A = 56.0	C = 53.9
1960 census	D = 61.7	B = 58.5

and according to the two alternative ways of factoring the components of change in the crude activity rate:

<u>Net change</u>	<u>Effect of changes in specific activity rates</u>	<u>Effect of changes in population age composition</u>
58.5 - 56.0 = +2.5	53.9 - 56.0 = -2.1	58.5 - 53.9 = +4.6
	or	
	58.5 - 61.7 = -3.2	61.7 - 56.0 = +5.7

One can conclude that the effect of changes in specific activity rates was to lower the crude activity rate in the Japanese male population by an amount within the range of 2.1 to 3.2 and the effect of the change in age composition was to raise the crude rate by an amount within the range of 4.6 to 5.7. Within these interaction ranges, the specific measures of the effects of the two factors are indeterminate.

For some purposes, the analyst may need to fix the estimated effect of each factor at a specific figure within the interaction range. Although it must be recognized that any method of doing this is arbitrary, one way is to put the estimates at the mid-points of their ranges. Thus, in the Japanese example, the effect of the specific activity rate changes would be estimated at -2.65 and the effect of the change in age composition at +5.15.

C. Influences of fertility, mortality and migration

1. Analytical projections

Standardization provides no means of estimating the effects of the component factors of population structure and growth, that is to say, fertility, mortality and migration, upon the dimensions of the labour force. For studying the influences of these factors, the analyst may use the method of analytical projections, so called because they are not necessarily intended to represent expected future developments but rather to study the effects of hypothetical variations in particular factors. Beginning with the population, labour force and specific activity rates for sex-age groups at the latest census and contemporary age-specific rates of mortality and fertility, the analyst makes a number of variant projections of the labour force over a future period of time.

In one projection, he holds fertility, mortality and specific activity rates constant at the initial levels, while in other projections he allows these factors to vary singly or in combinations, so as to observe the effect of changes in each factor. 6/ The effects of migration may be brought into the picture, where it is considered important, by means of supplementary calculations which will be described below.

An example of the foregoing is given in table 12, showing twenty-five year projections of the male labour force of Brazil from the date of the 1950 census and the estimated effects of decreasing mortality alone, decreasing fertility combined with decreasing mortality, and shifts of age-specific activity rates in the directions of later entrance into the labour force and earlier retirement. The effects of decreasing mortality with constant fertility (columns 10 and 11) are mainly in speeding up labour force growth; the amount of growth projected over the twenty-five year period is augmented considerably, the rate of entries into the labour force is raised and the rate of losses by death is lowered, so that the labour force replacement rate and ratio are increased. When fertility and mortality decrease simultaneously, the growth of the labour force is moderated chiefly by a reduction of the rate of entries as shown in columns 12 and 13. The changes in mortality and fertility also influence the trend of the crude activity rate, mainly through their effects on the age structure of the population. Decreasing fertility tends to raise the crude activity rate by diminishing the percentage of children in the population and increasing the percentage of adults of working age, whereas decreasing mortality with unchanged fertility has an opposite effect, slightly lowering the crude activity rate. The age distribution of the labour force is also affected. Decreasing fertility tends to reduce the proportionate share of young workers and increase the share of middle age groups in the labour force while decreasing mortality exerts a slight influence in the opposite direction. The projections also show the effects of assumed changes of male age-specific activity rates upon the growth and dimensions of the labour force (column 9).

For incorporating effects of immigration and emigration in analytical projections, a model of the sex-age distribution of immigrants and emigrants and their specific activity rates is needed. Specific activity rates of immigrants may be estimated from census data if tabulations of population and labour force by sex and age groups are given separately for the native and foreign-born. In the case of emigrants, it may not be possible to do better than to assume their activity rates to be the same as those of the non-migrant population in corresponding sex-age groups. The effects on the labour force can be calculated in terms of increments and decrements in the projected labour force measures

6/ Mahmoud Seklani, "Variations de la structure par âge et charges de la population active dans les pays sous-développés", International Population Conference (International Union for the Scientific Study of Population, New York, 1961), vol. II, has used this method to study the possible effects of varying mortality and fertility levels upon future trends of crude activity rates and dependency ratios in seven developing countries.

Table 12

Analytical projections of male labour force of Brazil, 1950-1980

Dimensions	1950 census	1980 projections						
		Constant fertility and mortality		Decreasing mortality constant fertility		Decreasing mortality and fertility		
		Constant activity rates	Changing activity rates	Constant activity rates	Changing activity rates	Constant activity rates	Changing activity rates	
1	2	3	4	5	6	7	8	
Increase of male labour force during projection period:								
Number (thousands)	-	-	13 972	11 392	16 686	13 721	14 941	12 431
Percentage of 1950 labour force			95.6	78.0	114.2	93.9	102.3	85.1
Crude activity rate (percentage of total male population)	56.4		56.5	51.4	54.9	49.7	59.9	54.8
Components of labour force change (annual rates per 1,000 male labour force): $\frac{\Delta}{L}$								
Entry rate	38.8		38.3	39.4	40.8	40.0	35.3	36.0
Retirement rate	1.0		1.3	5.1	2.2	5.2	1.9	5.4
Rate of losses by death	14.4		14.8	14.7	10.4	10.2	10.7	10.3
Replacement rate	23.4		22.2	19.6	28.2	24.6	22.7	20.3
Replacement ratio (entries per 100 retirements and deaths)	252		238	199	324	260	280	229
Age composition of male labour force (percentage):								
All ages, 10 and over	100.0		100.0	100.0	100.0	100.0	100.0	100.0
10-19	21.4		21.4	15.4	22.1	15.9	19.8	14.2
20-54	69.6		68.6	75.4	67.8	74.8	69.5	75.9
55 and over	9.0		9.9	9.2	10.1	9.4	10.7	9.8

Table 12 (continued)

Dimensions	Effects of change of activity rates alone (4-3)		Effects of decrease of mortality with constant fertility (5-3)		Effects of simultaneous decrease of mortality and fertility (6-4)		Effects of simultaneous decrease of mortality and change of activity rates (7-3)		Effects of simultaneous decrease of mortality and change of activity rates (8-3)	
	9	10	11	12	13	14	15	16	17	
Increase of male labour force during projection period:										
Number (thousands)	-2 580	+2 714	+2 329	+969	+1 039	-1 541				
Percentage of 1950 labour force	- 17.6	+ 18.6	+ 15.9	+6.7	+ 7.1	- 10.5				
Crude activity rate (percentage of total male population)	- 5.1	- 1.6	- 1.7	+3.4	+ 3.4	- 1.7				
Components of labour force change (annual rates per 1,000 male labour force): a/										
Entry rate	+ 1.1	+ 2.5	+ 0.6	-3.0	- 3.4	- 2.3				
Retirement rate	+ 3.8	+ 0.9	+ 0.1	+0.6	+ 0.3	+ 4.1				
Rate of losses by death	- 0.1	- 4.4	- 4.5	-4.1	- 4.4	- 4.5				
Replacement rate	- 2.6	+ 6.0	+ 5.0	+0.5	+ 0.7	- 1.9				
Replacement ratio (entries per 100 retirements and deaths)	- 39	+ 86	+ 61	+ 42	+ 30	- 9				
Age composition of male labour force (percentage):										
All ages, 10 and over	- 6.0	+ 0.7	+ 0.5	-1.6	- 1.2	- 7.2				
10-19	+ 6.8	- 0.8	- 0.6	-0.9	+ 0.5	+ 7.3				
20-54	- 0.7	+ 0.2	+ 0.2	+0.8	+ 0.6	- 0.1				
55 and over										

a/ Average annual rates estimated for 1950-1955 and projected for 1975-1980.

Definition of Factors

The assumptions with regard to changes in mortality and fertility correspond to those adopted for the population projections in Future Population Estimates by Sex and Age, Report II: The Population of South America, 1950-1980 (United Nations publication, Sales No.: 55.XIII.4). The decrease of mortality is such as to raise expectation of life at birth from an estimated level of 44.1 years in 1950-1955 to 56.6 years in 1975-1980. The decrease of fertility is such as to reduce the sex-age adjusted birth rate from an estimated level of 43.0 in 1950-1955 to 31.6 in 1975-1980. For the projections under changing activity rates, the age-specific male activity rates indicated by the 1950 census of Brazil are assumed to change so as to reach by 1980 the values indicated by the 1950 census of Sweden.

resulting from a given annual volume of immigration or emigration (for example, the increments and decrements per 10,000 or 100,000 annual immigrants or emigrants). ^{7/}

The method of analytical projections can also be used for estimating the effects of factors of change in labour force dimensions over a past period, if suitable data are available. The data required are sufficiently comparable measures of the population and labour force by sex and age groups at the two census dates, together with measures of fertility ^{8/} and life tables representing the conditions of mortality at the two dates. ^{9/} Estimates of population gains or losses by immigration and emigration during the interval are also required where migration has been an important factor. ^{10/} Variant projections of the population and labour force from the earlier to the later census date are made, holding each factor (or combinations of factors) in turn constant at the earlier levels while other factors are allowed to change as the data show them actually to have done during the interval. Comparisons with the labour force dimensions shown by the later census then furnish estimates of the effects of each factor. To take account of interactions, the procedure should also be followed through in reverse, by retrojecting the population and labour force from the later to the earlier census date with each factor in turn held constant at the levels of the later date, and comparing results with the measures of labour force dimensions at the earlier census.

2. Estimates of the effects of internal migration

An important application of the method of analytical projections is in estimating the effects of internal migration upon labour force dimensions in regions, urban-rural areas or other parts of a country during the interval between two censuses. First, estimates of net migratory gains and losses of population according to sex and age groups are made for the various areas to be

^{7/} For examples of such models of the effects of immigration and emigration upon population projections by age and sex (without distinction between the economically active and inactive), see The Population of South America, 1950-1980 (Future Population Estimates by Sex and Age, Report II) (United Nations publication, Sales No.: 55.XIII.4), Annex C.

^{8/} Fertility measures are not indispensable if the interval between the censuses is no longer than ten or fifteen years and the calculations are restricted to the population in working ages at the later census date. However, if estimates of the effect of each factor upon the crude activity rate are to be obtained, a measure of the change in fertility is required.

^{9/} Instead of life tables, the measures of mortality may be obtained, in appropriate circumstances, by the "census survival ratio" method commonly used in estimating net internal migration. See Barclay, op. cit., p. 253.

^{10/} For examples of analysis of the contributions of immigration to the growth of the labour force, see Hovne, op. cit.; H.V. Muhsam, "Labour force characteristics and economic absorption in Israel", Integration, International Bulletin (Vaduz), vol. 8, 1961.

considered, by methods which are described elsewhere. ^{11/} (Essentially, the population that would have been expected in each area at the later census date if no migration had occurred since the earlier census is estimated by projecting the earlier census figures with due allowances for mortality and births during the interval; the difference between this expected population and the population enumerated at the later census is taken as the estimate of net gain or loss by migration for each sex-age category.) To estimate the corresponding net increments and decrements of the labour force by migration, ideally one should have measures of activity rates of migrants according to age and sex, but such measures are ordinarily lacking. ^{12/} Instead, approximate estimates may be made by applying the sex-age specific activity rates of the population as a whole in each area to the estimated net gains and losses by migration. While the results for certain sex-age categories may be affected by large errors, the sums of estimated net migratory gains or losses of labour force in all age groups for each sex may be close enough approximations for practical purposes. In order to take account of interactions, the estimates should be made with the specific activity rates of both the earlier and the later census, and differences between the results obtained with the two sets of rates should be studied.

D. Influences of the marital and maternal status of women

1. Marital status and activity rates

The study of factors which influence age-specific activity rates for each sex begins with the data furnished by the census on other population characteristics relevant to employability and the propensity to be employed, as well as on non-economic activities and responsibilities which may inhibit income-producing employment. Among the most pertinent data are classifications of the population and labour force by marital status, of economically active and inactive women by maternal status, population in the school-going age-groups by school attendance, and adult population by level of education.

In many societies, the probability of women being engaged in economic activities varies greatly according to marital status, and consequently the age-specific activity rates of females may be influenced by the distribution of women's ages at marriage, the frequencies of non-marriage, widowhood and divorce, and the conditions of re-marriage of widows and divorcees. Men's marital status also may have some bearing on their participation in economic activities, but the variations of male activity rates according to marital status are likely to be comparatively slight.

^{11/} For example, see Spiegleman, op. cit., chap. 10; K.C. Zachariah, A Historical Study of Internal Migration in the Indian Subcontinent 1901-1931 (Bombay, Demographic Training and Research Centre, 1964).

^{12/} On the differences between specific activity rates of migrants and non-migrants in the United States of America, see Ann R. Miller, "Migration differentials in labor force participation: United States, 1960", Demography (Chicago), vol. 3, No. 1, 1966.

Cross-classifications of the male or female population and labour force by marital status in combination with age groups permit the calculation of activity rates specific for marital status and age, such as those shown in table 13 derived from the data of the census of Colombia, 1951. ^{13/} As this example shows, the cross-classification with age groups is indispensable if such data are to be really useful for studying relationships between marital status and economic activity. Cruder activity rates, calculated from totals for the marital status categories without regard to age, are greatly influenced by differences in the age composition of these categories.

In Colombia, it appears that few women who have husbands are reported in the census as economically active; the activity rates of legally married women are especially low, and those of women in common-law unions somewhat higher. Single, widowed, and divorced women all have much higher activity rates, those of single women being highest on the whole. When the rates are charted as in figure II, one can see that they describe an age-curve of one form for the three categories of women without husbands and a different form for the two categories of women with husbands. The activity rates of the former are more definitely peaked, with maximum rates in the age ranges of twenty or twenty-five to forty-four years, while the legally and consensually married categories exhibit more nearly constant, low levels of activity rates over the broad range of twenty to sixty-four years.

Data like those in table 13 provide a basis for some inferences on the likely effects of changing conditions of marriage upon trends of age-specific female activity rates. The ratio of consensually married to legally married women as reported in the 1951 Colombian census was about 1 to 4; if this ratio were reduced, while the activity rates specific for marital status and age remained unchanged, the effect would be a tendency to lower the total female activity rates in each age group. If the proportion of women with husbands were increased (by decreasing average age at marriage, decreasing frequencies of spinsterhood, widowhood and divorce, or increasing remarriage rates of widows and divorcees), the curve of age-specific total female activity rates would be depressed still more and would tend to flatten out, as the rates would be reduced more in the age groups between fifteen and thirty-five years than between thirty-five and sixty-five. On the other hand, if the proportion of married women engaging in economic activities should increase, the effect might be to transform the age-curve of female activity rates in Colombia into a shape like that of the Indonesian curve (see table 2), with two peaks separated by a trough at ages in the twenties and early thirties.

2. Maternal status and activity rates

Studies in industrialized countries have shown that the probability of women's being economically active varies to a great extent with their maternal responsibilities as well as marital status, and that the presence of a child of pre-school age is an especially powerful deterrent to paid employment of the

^{13/} A broad, international compilation and analysis of such measures for females is contained in Demographic Aspects of Manpower. Sex and Age Patterns of Participation in Economic Activities (United Nations publication, Sales No.: 61.XIII.4), chap. VI and tables A-11, A-12, A-13.

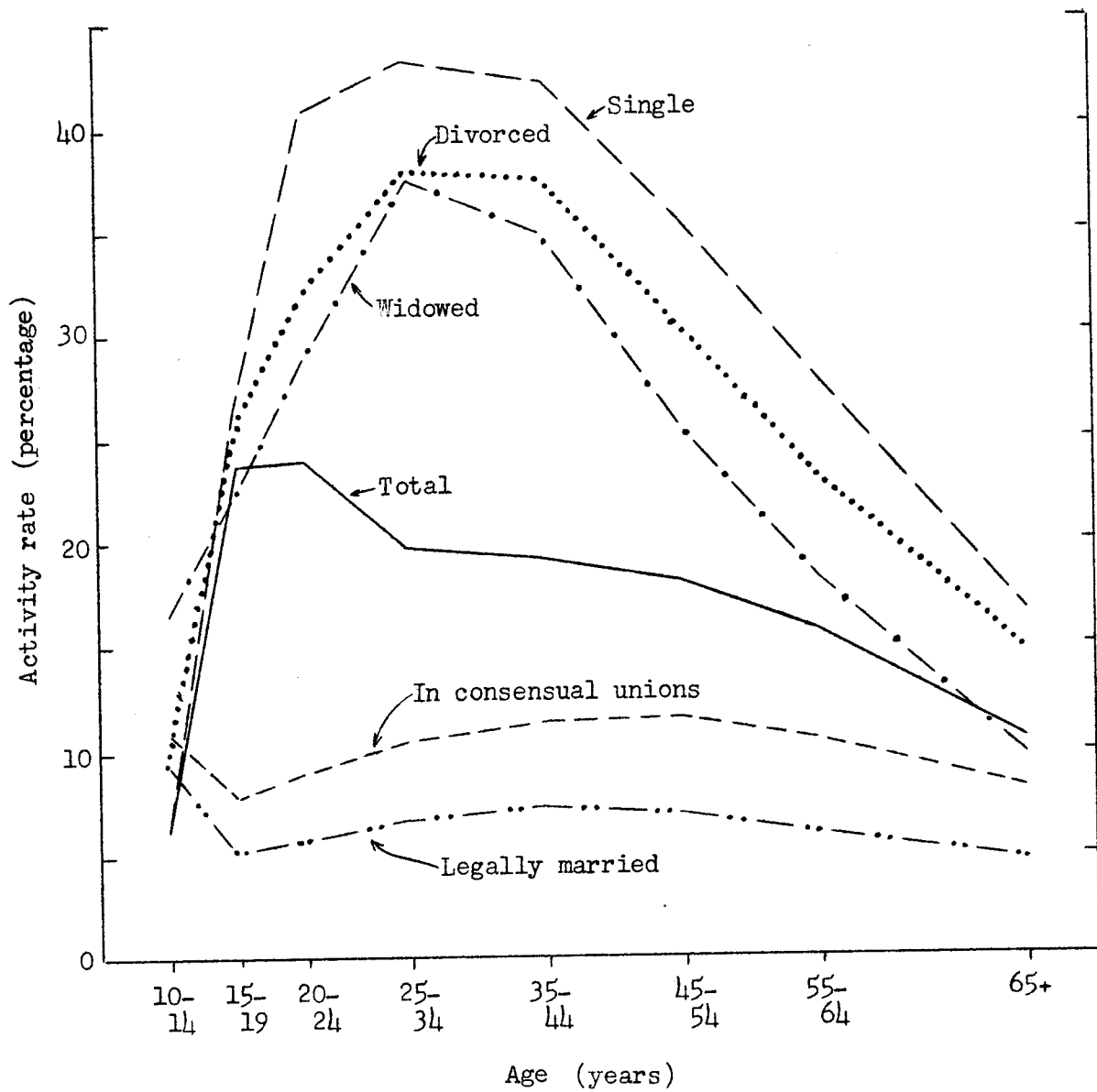
Table 13

Activity rates of males and females specific for marital status and age, Colombia, 1951

Age (years)	Total	Single	Legally married	In consensual unions	Widowed	Divorced
<u>Males</u>						
Total, 10 and over	79.7	67.3	96.4	98.1	80.3	92.0
10-14	16.9	16.9	-	-	-	-
15-19	84.8	84.6	92.9	94.1	90.9	90.0
20-24	95.4	94.5	98.9	98.3	94.6	95.2
25-34	97.6	95.8	98.8	99.1	96.9	96.8
35-44	97.9	95.0	98.7	99.1	96.6	96.7
45-54	96.8	92.9	97.7	98.6	94.5	95.6
55-64	92.7	86.4	94.2	96.5	88.0	90.7
65 and over	71.8	63.2	77.6	84.6	57.1	68.7
<u>Females</u>						
Total, 10 and over	17.7	25.1	6.6	10.2	21.0	32.4
10-14	6.2	6.2	-	-	-	-
15-19	23.6	26.9	5.2	7.9	-	-
20-24	23.9	40.8	5.7	9.0	28.8	31.9
25-34	19.7	43.2	6.8	10.4	37.3	37.8
35-44	19.1	42.1	7.3	11.4	34.8	37.5
45-54	18.0	35.4	7.0	11.6	25.4	30.1
55-64	15.7	27.7	6.0	10.3	18.2	23.1
65 and over	10.3	16.4	4.6	8.0	9.7	14.5

Figure II

Female activity rates specific for marital status and age,
Colombia, 1951



Source: Table 13.

mother. For this reason, activity rates of married women in some industrialized countries are relatively high in the early years of married life, drop in the years when they are building their families, and rise again in later years when the children have grown older and no longer require such constant attention from the mother. More or less similar relationships between maternal status and activity rates of women in the urban areas of less developed countries have also been indicated by the findings of a few studies, while it appears that the relationships may be different in little developed agricultural areas. 14/ The effects of maternal status upon women's activity rates are an important question for study, relevant to an assessment of the economic effects of changes in fertility and the possibility of promoting paid employment of women as a means of reducing fertility, as well as to the investigation of factors affecting the dimensions of the female labour force.

Classifications of women by the number of children born during their life-time are obtained in the censuses of many countries, and if these are tabulated in relation of economic activity of the women, the data can be used for studying relationships between maternal status and economic activity. 15/ It is more pertinent, though, to have a classification relating to the number of children remaining in the home, under the mother's care, at the time of the census, and including some information as to the age of the children. Such a classification can be derived from the listing of members of the household on the census forms according to age and relationships. Cross-classifications by activity status, marital status and age of the women provide a good basis for studying the effects of maternal status on women's activity rates. The work of deriving such a classification from the census records is rather expensive, though, and population sample surveys may be a more practical means of obtaining data for the study of this question. 16/

3. Analysis by multiple standardization

Given classifications of the population and labour force by age in combination with marital status, maternal status, and/or other characteristics at two census dates, or at one date in different areas of the country, different ethnic groups and so on, the analyst can use multiple standardization to estimate the effects upon the labour force dimensions of variations in population composition with regard to each of the characteristics involved in the cross-

14/ "The influence of family-building on women's rate of economic activity", Proceedings of the World Population Conference, 1965 (United Nations publication, Sales No.: 66.XIII.0), vol. IV, pp. 283-287, summarizes data from studies in various countries.

15/ For example, see A.J. Jaffe People, Jobs and Economic Development. A case History of Puerto Rico Supplemented by Recent Mexican Experiences (Glencoe, Illinois, 1959). pp. 186-194.

16/ In the United States of America, data of the kind described here have been obtained both in the population censuses and national population sample surveys. For an example of their use in analysing relationships between the maternal status and the activity status of women, see Bancroft, op. cit., pp. 57-64.

classifications. The methods are analogous to those illustrated for age-standardization by the examples in tables 10 and 11. 17/

Suppose, for example, that data are now available from the 1964 census of Colombia corresponding to the 1951 data on which the activity rates in table 13 are based, specific for sex, age, and marital status in combination. The problem is to estimate how much of the change in the crude activity rate for each sex between 1951 and 1964 is attributable to the variations in each of three factors: (a) age composition of the population, (b) marital-status composition of the population within each age group, and (c) specific activity rates for the various categories of marital status in combination with age. For his first estimate of the effect of (a), the analyst calculates the per cent distribution by age in combination with the marital status of a hypothetical population (of each sex) having the age composition of the 1951 population but the marital-status composition of the 1964 population within each age group. He applies these population weights to the specific activity rates of 1964 according to age and marital status, and sums up the products. The difference between the age-standardized activity rate so obtained and the unstandardized 1964 crude activity rate for each sex is the first estimate of the effect of the change in the age composition of the population. The second estimate of the effect of this factor is made by calculating an analogous standardized activity rate with the 1964 population age composition, 1951 marital-status composition within each age group, and 1951 specific activity rates, and taking the difference between this and the unstandardized 1951 crude activity rate. These two estimates define the range for the effect of factor (a). By analogous procedures, the analyst determines the ranges of effects of factors (b) and (c). He may then find it convenient to use an arbitrary method to fix the estimates of the effects of the three factors at specific points within their ranges, as suggested in section B.2 of the present chapter. If a further cross-classification by maternal status were included in the tabulations of the female population and labour force for both census dates, the analyst could add this fourth factor to his analysis of the components of change in the female crude activity rate, using strictly analogous procedures. The same method is applicable for estimating components of differences between crude activity rates for urban and rural areas, regions etc., at the date of either census. The techniques of matrix analysis can also be used for this purpose.

E. Influences of school attendance and educational level

Relationships between education and economic activity are of special interest for developing countries as an aspect of the many-sided question of the economic and social effects of expanding provisions for popular education. These relationships are twofold: first, prolongation of schooling has the obvious effect of decreasing activity rates of young people of school age; and second, it may affect the propensity and the opportunity to engage in economic activity in later life.

17/ For examples of such multiple-standardization analysis, see Jaffe and Stewart, op. cit., pp. 292-302; Durand, op. cit., chap. 3; Bancroft, op. cit., p. 43; S. Kono, "Demographic influence on participation rates: introduction and illustration of component analysis" (Tokyo, Institute of Population Problems, 1959) Annual Report, No. 4 (In Japanese).

1. School attendance and activity rates

Although the existence of an inverse relationship between school attendance and economic activity rates of young people hardly needs to be demonstrated, it is useful to quantify this relationship as definitely as possible with available data and to see to what extent non-participation of young people in economic activities is accounted for by their attendance at school. Ideally for this purpose, the census statistics on economic activity should be cross-classified by attendance at or enrolment in school so as to provide the following classification of males and females in each age group within the school-going age range:

	<u>Economically active</u>	<u>Not economically active</u>
In school		
Not in school		

Such classifications have seldom been provided in census tabulations; they are made more easily with population sample survey data. In some censuses, however, data on young people's attendance at or enrolment in schools have been collected and separate classifications have been made of these data and the data on economic activities. Given such classifications, it is useful to calculate sex-age specific school attendance rates as well as economic activity rates for corresponding age groups and to compare the variations of the two rates among areas of the country, ethnic groups of the population and other categories, and their changes over a period of time. Thus an understanding of the associations between the two variables can be achieved. It may be helpful in such an analysis to calculate sums of the school attendance rates and economic activity rates for corresponding sex-age categories. Any shortfall of this sum below 100 per cent is a minimal estimate of the proportion of the population in the given category that is neither in school nor economically active, and any excess over 100 per cent is a minimal estimate of the proportion of persons combining school attendance with economic activity. Of course, the validity of these interpretations depends on the correspondence of time-reference of the census questions on school attendance and economic activity; but even if the time-references do not correspond exactly, such an analysis is useful. An example using the data of the 1961 census of Indonesia is given in table 14.

In the case of females, the category of those who are neither in school nor economically active is not necessarily a problematic one; young females in this category are likely to be occupied with domestic duties, at least helping their mothers if they do not yet have their own homes and families to care for. On the other hand, the presence of any great number of males in this category may signify a waste of potential labour resources and a disquieting social problem. 18/

18/ For an example of an analysis of the relationship of school attendance rates to activity rates, on an international scale, see Population Growth and Manpower in the Philippines (United Nations publication, Sales No.: 61.XIII.2), Appendix D.

Table 14

Comparison of census data on economic activity and school attendance of persons ten to twenty-four years of age, by sex, Indonesia, 1961

Sex and age (years)	Population	Labour force	Persons attending school	Economic activity rate	School attendance rate	Sum of rates
<u>Males</u>						
10-14	4 318 543	977 351	2 793 431	22.6	64.7	87.3
15-19	3 834 117	2 556 342	890 796	66.7	23.2	89.9
20-24	3 452 362	3 008 984	210 385	87.2	6.1	93.3
<u>Females</u>						
10-14	3 860 869	602 171	2 100 005	15.6	54.4	70.0
15-19	3 874 058	1 185 071	447 149	30.6	11.5	42.1
20-24	4 338 603	1 188 852	68 810	27.4	1.6	29.0

Administrative statistics of school enrolments may be used as a substitute for census classifications relating to school attendance for the purposes of analysis along these lines. This method is limited, though, by the fact that school enrolment statistics are not commonly compiled by age groups. Without an age classification, the enrolments of each sex in categories such as elementary and secondary schools may be expressed as ratios to the population in appropriate age groups, and variations of these ratios may be studied in relation to the variations of activity rates.

As a part of the inquiry relating to economic activities in many censuses, there is a provision for reporting persons who are not economically active according to functional categories such as students and housewives. The classification of these categories may be used as another means of investigating the relationship between school attendance and economic activity of young people. For example, in the 1961 Indonesian census, the classification shown in table 15 was obtained.

It will be noticed that the numbers of "students" in table 15 differ only slightly from the numbers of persons classified in table 14 as "attending school" for the age groups ten to fourteen years and fifteen to nineteen years, but the numbers in table 15 are smaller for the age group twenty to twenty-four years. This is to be expected since some persons attending school would also be economically active especially in the older group. On the other hand, some persons not actually attending school at the time to which the census classifications refer may be reported as "students". It will also be noticed that sizeable numbers of young males were classified in the Indonesian census as

"home houseworkers". It is possible that some of these were really economically active, as unpaid family workers on farms or in other family enterprises.

Table 15

Categories of persons classified as not economically active in age groups ten to twenty-four years, by sex, Indonesia, 1961

Sex and age (years)	Total not economically active	Students	Home houseworkers	Others and not reported
<u>Males</u>				
10-14	3 341 192	2 717 829	164 682	458 681
15-19	1 277 775	894 602	219 483	163 690
20-24	443 378	175 984	165 172	102 222
<u>Females</u>				
10-14	3 258 698	2 031 144	782 852	444 702
15-19	2 688 987	441 404	2 091 900	155 683
20-24	3 149 751	53 760	3 003 867	92 124

2. Educational level and activity rates of adults

To see how the level of education affects the likelihood of individuals being in the labour force at various ages in later life, one can calculate activity rates specific for educational level, sex and age (beyond the age at which education is normally completed), as illustrated in table 16 and figure III with data for females from the census of Colombia, 1951. ^{19/} Multiple standardization can then be used to estimate the effects of variations in educational-level composition of the population upon labour force dimensions. The cross-classifications of population of each sex by educational level, activity status, and age, necessary for such analysis, are provided also in the census tabulations of some other developing countries. Here, as in the analysis of activity rates in relation to marital and maternal status, an age classification is necessary because there are likely to be important differences of age composition in different educational categories of the population.

^{19/} For other examples, see Bancroft, *op. cit.*, pp. 65-70; Jaffe, *People, Jobs and Economic Development. A Case History of Puerto Rico Supplemented by Recent Mexican Experiences*, *op. cit.*, pp. 202-203, 210-211.

Table 16

Activity rates of females specific for level of educational attainment and age, Colombia, 1951

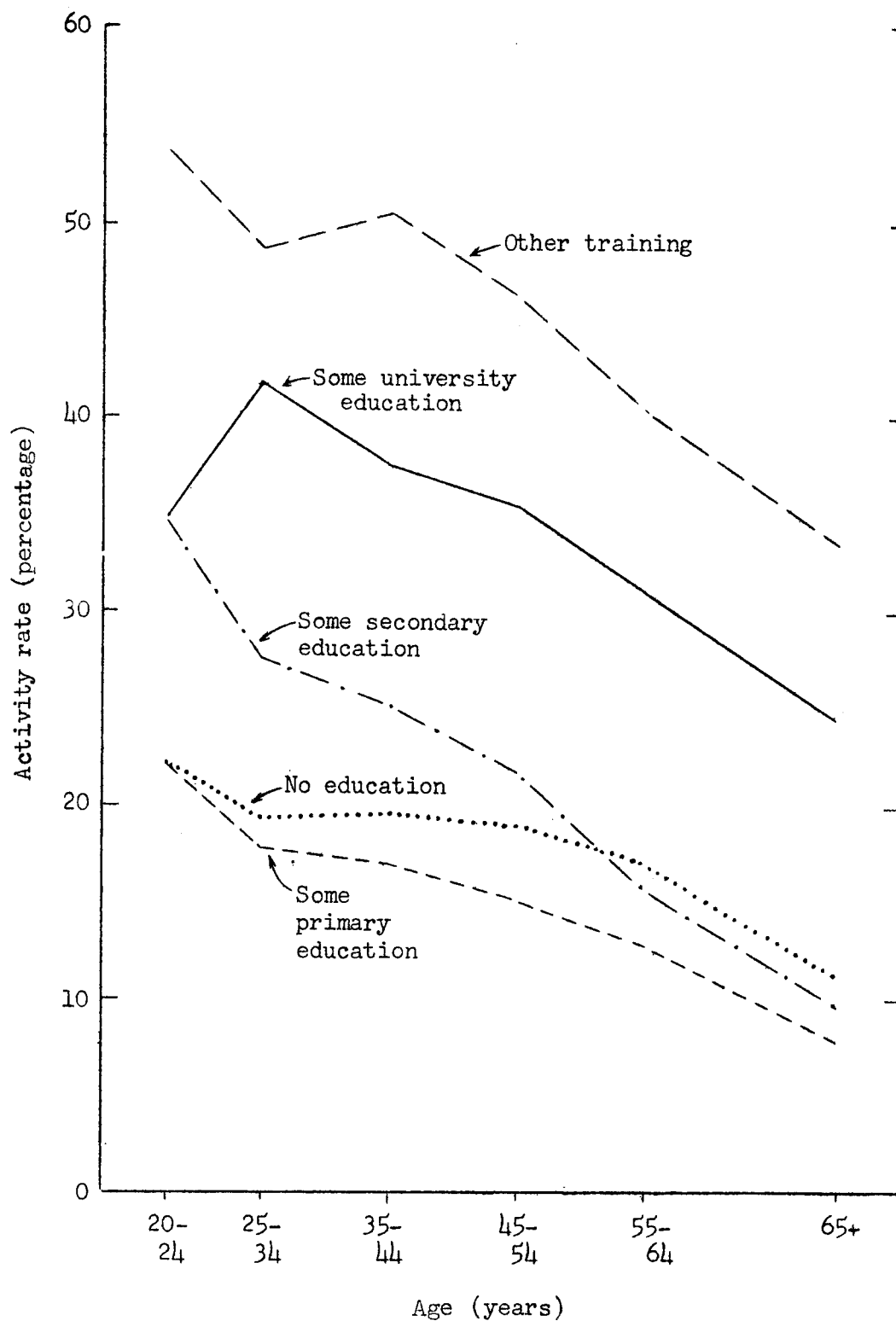
Educational attainment	Total 20 and over	Age					
		20-24	25-34	35-44	45-54	55-64	65 and over
Total	19.2	23.9	19.7	19.1	18.0	15.7	10.3
No education	18.7	22.1	19.4	19.5	19.0	17.0	11.2
Some primary education	17.6	22.1	17.8	17.1	15.2	12.8	7.8
Some secondary education	26.7	34.6	27.6	25.2	21.7	15.8	9.7
Some university education	37.2	34.8	41.7	37.5	35.4	31.0	24.5
Other training	49.7	53.7	48.6	50.5	46.3	40.4	33.5

In the Colombian statistics, the highest activity rates are displayed by women with "other training", probably primarily in stenographic and other commercial skills. Next highest are women with some university education, though in the age group twenty to twenty-four years, the activity rate of women with some university education is depressed by the presence in this age group of some women still attending the university. Women with some secondary schooling rank third over-all, but at the oldest ages their rates are exceeded by those for women with no schooling. Women with some primary education have generally the lowest activity rates.

In any such analysis, one must consider the possibility that the variations of the activity rates according to the given characteristics may be affected significantly by other related variables. For example, educational attainment of women may be related to their marital and maternal status; in particular, women with university education may marry later, begin bearing children later and bear fewer children, on the average, than women with less education do; and more of the university women may remain unmarried throughout their lives. Thus it is possible that the relatively high activity rates of university women, especially in the younger age groups, may be partly or mainly due to marital and maternal status rather than to education. Another possibility is that the better educated women have relatively high activity rates because they live mostly in the cities, where (in the case of Colombia) the recorded activity rates of females are higher than

Figure III

Female activity rates specific for level of education and age,
Colombia, 1951



Source: Table 16.

in rural areas. The latter possibility can be investigated by computing the rates separately for urban and rural areas if the census tabulations provide this cross-classification. It is not practical, though, to make cross-classifications of all potentially related variables. The analyst attempting to unravel these relationships may use other methods such as those mentioned in the next section, to supplement the information provided by available cross-classifications.

F. Influences of economic factors

Knowledge of the effects of changing economic conditions upon the dimensions of the labour supply is, of course, highly pertinent to economic planning and especially to the definition of employment targets in economic development plans. The study of economic factors affecting activity rates deserves an important place in analyses of census data on the labour force. (As already noted, study of the effects of economic factors upon the components of population change, especially migration, is also important, but the methods of study in that field are outside the scope of the present manual). The principal economic factors to be considered include levels of earnings (from self-employment as well as wage-employment), family incomes, and the volume and composition of employment opportunities (including opportunities for self-employment and for productive work of unpaid helpers in family enterprises, as well as for paid employment).

Population censuses do not ordinarily provide suitable data for studying the effects of economic factors upon activity rates by the methods described in earlier sections of this chapter: classifying economically active and inactive individuals according to relevant characteristics, calculating specific activity rates for the categories so defined, and applying techniques of standardization, analytical projections and similar methods. ^{20/} In this field, the principal applications of census data are in studies of associations between variations of activity rates and economic measures in different areas and population categories and in historical time-series. The census itself may provide measures of some of the pertinent economic variables - measures of unemployment and part-time employment considered as indicators of relative volume of employment opportunities; the classifications of the labour force by occupation, industry, and status, considered as reflections of the composition of employment opportunities; and often some data which may serve as substitutes for income and wealth measures, such as characteristics of housing. Other economic measures may be obtained from various sources. The techniques of analysis - as, for example, comparisons of average activity rates for areas defined or grouped with reference to certain economic characteristics, simple and multiple correlation, analysis

^{20/} In some censuses and population sample surveys, income and employment data have been collected and tabulated in forms which do permit the application of such techniques. For example, in recent censuses and surveys in the United States of America, some classifications of economically active and inactive married women according to income and employment status of their husbands have been provided, and these data have been used together with other materials in research on the effects of income and employment conditions upon the dimensions of the labour force. For example see Long, op. cit., chap. 5; Glen C. Cain, Married Women in the Labor Force: An Economic Analysis (Chicago, 1966).

of variance and derivation of regression equations - are not specifically demographic techniques and do not require explanation and illustration here. In addition to referring to some examples of such analyses, 21/ it is sufficient to mention a few principles of relevant research designs.

So far as possible, it is useful to refine the measures of activity rates used in such analyses, so as to minimize extraneous influences. Clearer insight into the influences of the economic factors can be reached if the analyses are carried out with age-specific activity rates, or at least age-standardized rates, than with crude rates alone; and it is still better, if possible, to use activity rates specific for marital status, level of education (or rates standardized in these respects) as well as sex and age. In time-series analyses, the use of cohort measures of changing activity rates (as illustrated in table 8) may be helpful to clarify the picture of economic influences. In cross-sectional analyses of data for geographical units, it is advantageous where possible to separate urban and rural segments (or metropolitan and non-metropolitan segments etc.) because of the differences typically found between activity-rate patterns of urban and rural populations. In the circumstances existing in some countries, a distinction between ethnic components of the population is also important.

21/ For examples of relatively simple analyses, involving comparisons of certain measures of labour force dimensions for areas having different economic and other characteristics, derivation of simple correlation and regression co-efficients etc., see Human Resources of Central America, Panama and Mexico, 1950-1980 (United Nations publication, Sales No.: 60.XIII.1), pp. 46-50; J.N. Sinha, "Dynamics of female participation in economic activity in a developing economy", Proceedings of the World Population Conference (United Nations publication, Sales No.: 66.XIII.0), Vol. IV, p. 336 (Summary); The Mysore Population Study (United Nations publication, Sales No.: 61.XIII.3), chap. 15; Simon Kuznets, Ann R. Miller and Richard A. Easterlin, Population Redistribution and Economic Growth, United States, 1870-1950. II. Analyses of Economic Change (Philadelphia, American Philosophical Society, 1960), Vol. II, p. 22. Some examples of more complex analyses are to be found in the works of Cain, op. cit. and Long, op. cit., and William G. Bowen and T.A. Finegan, "Labor force participation and unemployment", Employment Policy and the Labor Market, ed. Arthur M. Ross (Berkeley, California, 1965); National Bureau of Economic Research, "Labor force participation of married women", Aspects of Labor Economics. A Conference of the Universities - National Bureau of Economic Research (Princeton, 1962); Richard N. Rosett, "Working wives: an econometric study", Thomas F. Dernberg, Richard N. Rosett and Harold W. Watts, Studies in Household Economic Behavior (New Haven, 1958); Kenneth Strand and Thomas Dernberg, "Cynical variations in civilian labor force participation", Review of Economics and Statistics (Cambridge, Mass.), November 1964.

Chapter III

STUDIES OF TYPES OF ECONOMIC ACTIVITIES

A. Introduction

Studies of the types of economic activities in which the labour force is engaged deserve an important place in the analysis of population census data, along with studies of the size and growth of the labour force and its composition in terms of sex, age and other characteristics. As already mentioned (Introduction, B, p. 3), the types of economic activity are described by three primary classifications of workers, by industry (in other words the activity of the establishment or enterprise in which the individual works), occupation (that is, the kind of work done by the individual), and status (as employer, employee and so on). ^{1/} It is worth while studying all three aspects of the distribution of manpower among types of economic activities with attention to differences in various parts of the country and changes in the course of time; to demographic, economic and other factors in the spatial and temporal variations; and to their relations to production, earnings, employment, unemployment and underemployment. Interrelations between the industry and occupation distributions and between each of these and the status distribution are also worth examining in order to see how the uses of manpower in production are organized and to gain knowledge of factors and processes of change in the structure of labour supply and demand.

Studies of these questions contribute in many ways to form the basis for economic policy and development plans, especially as they relate to the problems of improving the qualities of manpower, raising productivity, and minimizing unemployment and underemployment. One purpose of such studies is to provide a foundation for projections of labour force and employment in various categories of economic activities, which form an integral part of the statistical framework for economic plans. Such projections classified by industry are related to production targets, estimates of capital requirements, plans for the strategy of investments and provisions for facilitating necessary transfers of manpower from one industry to another. The corresponding figures classified by occupations present an inventory of the skills exercised by the workers of a particular nation and a picture of anticipated future changes in this inventory which is to be compared with anticipated trends of demand for the various skills. Study of these data is helpful to the planner in assessing development needs in the educational system, vocational training and rehabilitation programmes, and other means of equilibrating labour supply and demand in the different occupational categories. The current and projected numbers of status groups such as those of

^{1/} Sometimes these classifications are limited to persons reported as employed during the period of reference of the census questions on economic activities; but unemployed persons with previous work experience may also be included and classified by industry, occupation, and status of their latest or usual employment.

employees, employers and self-employed represent another aspect of the skills exercised by the workers and the responsibilities which they bear and also an aspect of the organization of production and employment which the economic policy-maker and the planner can ill afford to ignore.

Census data on industry, occupation, and status of labour force members are useful also for many other purposes, including sociological and demographic as well as economic studies. The numbers of workers attached to various groups of industries, together with data on the value of products and the use of other factors of production, provide materials for the study of variations of productivity and determinants of demand for labour in different sectors of the economy. The shares of broad industry sectors in the labour force serve as an indicator of the level of economic development which may be used in conjunction with other indicators to compare a country's position in this respect with the positions of other countries, to identify more or less developed regions within the country, and to measure progress in economic development in the course of time. The occupation and status distributions of the labour force are also valuable indicators of the level of development, although they are less commonly used for this purpose. Occupation and status classifications are used alone or in combination with other data for defining socio-economic groups of the population and studying social mobility, fertility and mortality differentials, patterns of consumers' expenditures and other sociological, demographic and economic questions too numerous to list.

It is not possible within the scope of this chapter to consider all analytical methods which may be involved in the diverse uses of industry, occupation, and status distributions of the labour force. Attention will be focussed, first, on elementary problems in the classification, manipulation and interpretation of these data which are encountered in all kinds of applications; and second, on the use of certain demographic techniques for analysing these data, with special reference to questions which pertain to economic development, manpower and employment policies and plans in developing countries.

It is worth repeating that there is no intention in this manual to present a model for a study of the census data of any country. In the circumstances of a given country, some lines of analysis described here may not be very useful or the census statistics may not be in suitable form for such analysis. On the other hand, the analyst studying the data of any country will almost certainly find questions demanding investigation for which no appropriate methodology is presented here. The methodological explanations and examples are necessarily simplified; they are intended only as general guidelines and not as detailed specifications for application to any country's statistics. Erroneous or misleading results could be obtained by indiscriminately applying the methods as described and illustrated here, without regard for special conditions of the country and peculiarities of its statistics. While this warning applies also to the use of the methods described in preceding chapters, it deserves special emphasis here because the pitfalls in the way of the unwary analyst are most numerous and most dangerous when he comes to the study of industry, occupation and status distributions of the labour force.

Before going further, it should also be noted that applications of the methods considered here represent only first steps in studies of the kinds of questions relevant to policy and planning which have been mentioned above. These are methods for measuring variations of industry, occupation, and status distributions

in space and in time and for breaking such variations down into their demographic and other components. The results gain meaning when they are studied in relation to other economic, social and demographic variables, but it is beyond the scope of this chapter to treat methods for studying such relationships.

B. Classifications and summary groupings of industry, occupation and status

Complete descriptions of the economic activities of all individuals would produce unmanageably long listings and therefore grouped classifications of industry, occupation and status are used in tabulating census returns. Standards for these classifications have been drawn up by international bodies to facilitate comparisons of the statistics for different countries. The International Standard Industrial Classification of All Economic Activities (ISIC) 2/ provides nine industry divisions subdivided into forty-five major groups and further into a detailed classification of 124 groups. The International Standard Classification of Occupations (ISCO) 3/ provides ten major groups subdivided into seventy-three minor groups and 201 unit groups, and further into 1,345 "occupations". For the classification of status, the United Nations Statistical Commission has recommended six principal categories as follows: (a) Employers; (b) Own-account workers (hiring no employees); (c) Employees; (d) Family workers (assisting in an economic enterprise operated by another member of the same household); (e) Members of producers' co-operatives; (f) Persons not classifiable by status (including, among others, unemployed persons seeking their first jobs). 4/

While it is highly desirable to use detailed industry and occupation classifications at least in the simpler tabulations of census data on the activities of the labour force in a country as a whole and its principal parts, it is often found necessary to resort to abridged classifications in more complex cross-tabulations and in simple tabulations for small areas. The divisions and major groups of ISIC and the major and minor groups of ISCO serve the latter purpose. The analyst, even when he has a detailed classification at his disposal, often finds it necessary to reduce it so as to bring out the principal features of the industry or occupation distribution, its variations and relations with other characteristics. He may do this by using the ISIC divisions or ISCO major groups or combinations of these in broader groupings if he finds them suitable for his purpose, or he may prefer to make other kinds of summary groupings which suit the purpose better.

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- 2/ International Standard Industrial Classification of all Economic Activities (United Nations publication, Sales No.: 58.XVII.7). In addition, some further subdivisions of the categories of wholesale and retail trade are provided for possible national use.
- 3/ International Labour Office, The International Standard Classification of Occupations (Geneva, 1958). An improved classification is at present being developed to replace this.
- 4/ More exact definitions of these categories are stated in Principles and Recommendations for National Population Censuses (United Nations publication, Sales No.: 58.XVII.5), para. 417.

Table 17 illustrates the classification of the labour force by the nine industry divisions of ISIC and certain broad sectoral groups formed by combinations of these divisions. Data from recent censuses of four developing countries and one industrialized country (Japan) are shown. The simplest sectoral grouping shows the place occupied in the labour force by agriculture (together with forestry, fishing and hunting) and by non-agricultural industries. This is of fundamental importance in studies of manpower problems of developing countries. One of the objectives of the economic policy in such countries is generally to promote the transfer of manpower from agriculture to non-agricultural employments as a means of accelerating growth of output per head and an aid in coping with underemployment in agriculture. So the study of trends and factors in the growth of the agricultural and non-agricultural labour force sectors deserves emphasis in analyses of census data of developing countries. Also, the proportionate share of non-agricultural industries in the labour force is one of the most widely used indicators of the level of economic development and the degree of industrialization, 5/ although it should be recognized that this indicator alone is not a very reliable measure.

A three-sector grouping is obtained by dividing non-agricultural industries into two categories: the "M" sector (manufacturing, mining, and construction) and the "S" sector ("service" industries broadly defined, embracing ISIC divisions 5-8). An international, cross-sectional and historical study of variations in labour force distribution according to this sectoral classification has shown that progress in economic development is generally marked by a relative contraction in the share of agriculture and expansion in the share of the M sector, while the tendency is for the S sector's share to vary, expanding in some cases and remaining relatively constant or contracting in others. 6/ In the same study, a subdivision of the S sector revealed a definite trend towards expansion, going with economic development, in the shares of commerce, transport and communication, while the trend of other service industries showed little consistency. A slightly different sectoral classification which has been used by Clark 7/ and others in studying such relationships is the classification of "primary" or extractive industries (ISIC divisions 0 and 1), "secondary" or processing industries (divisions 2-4) and "tertiary" or service industries (divisions 5-8).

The analyst may also find it helpful to devise other industry groupings and sub-groupings relevant to the purposes of his analysis. For example, it may be useful to group industries within the manufacturing and service sectors according to such criteria as recent trends in their shares of national manpower, value of

5/ For example, in the Demographic Aspects of Manpower. Sex and Age Patterns of Participation in Economic Activities (United Nations publication, Sales No.: 61.XIII.4), countries were classified on this basis as industrialized, semi-industrialized, or agricultural.

6/ Simon Kuznets, "Quantitative aspects of the economic growth of nations. II. Industrial distribution of national product and labor force", Economic Development and Cultural Change (Chicago), Supplement, July 1957; in his Modern Economic Growth: Rate, Structure and Spread (New Haven, 1966), Kuznets used a slightly different classification.

7/ Colin Clark, The Conditions of Economic Progress (New York and London, 1957), third edition, chaps. 9 and 10.

Table 17

Industry distribution of the labour force in selected countries

Industry divisions and sectors	Ghana, 1960 a/	Iran, 1956	Thailand, 1960	Turkey, 1960	Japan 1960
	(percentage of total labour force)				
<u>ISIC divisions</u>					
0. Agriculture, forestry, hunting and fishing	57.9	56.3	82.3	74.9	32.3
1. Mining and quarrying	1.8	0.4	0.2	0.6	1.2
2-3. Manufacturing	8.6	13.8	3.4	6.8	21.7
4. Construction	3.3	5.7	0.5	2.2	6.1
5. Electricity, gas, water and sanitary services	0.5	0.2	0.1	0.1	0.5
6. Commerce	13.6	6.0	5.7	3.1	17.5
7. Transport, storage and communication	2.5	3.5	1.2	1.9	5.1
8. Services	5.7	11.1	4.8	8.5 e/	14.8
9. Activities not adequately described	6.0 b/	3.0 c/	1.8 d/	1.8 f/	0.8 g/
<u>Industry sectors</u>					
Agriculture ... (division 0)	57.9	56.3	82.3	74.9	32.3
Non-agricultural industries (divisions 1-8)	36.0	40.7	15.9	23.3	66.9
M sector (divisions 1-4)	13.7	19.9	4.1	9.6	29.0
S sector (divisions 5-8)	22.3	20.8	11.8	13.6	37.9

a/ Data based on a 10 per cent sample of census returns.

b/ Unemployed persons.

c/ Including unemployed persons (2.7 per cent of labour force).

d/ Including unemployed persons seeking their first jobs (0.5 per cent of labour force).

e/ Armed forces (3.3 per cent of labour force), apparently included in division 9 in the national statistics, transferred here.

f/ Including unemployed persons seeking their first jobs.

g/ Consisting almost entirely of unemployed persons.

product per worker, capital-labour ratio, unemployment rate, proportionate shares of status groups in the labour force of the industry and so on. In developing countries, it is particularly useful if possible to make distinctions between such categories as handicrafts and mechanized manufacturing, traditional and more modern agriculture, retail trade and other commerce, and the like. Unfortunately groupings of this kind cannot be derived directly from the industry classifications used in most population censuses, but it may be possible to make estimates or approximations with the help of cross-classifications of industry and status and other data. The analyst may contribute to the improvement of census classifications by demonstrating the utility of kinds of information which have not been provided but could be made available in future censuses.

The occupation distribution of the labour force in selected countries is shown in table 18 in terms of the ISCO major groups. This classification indicates in general terms what kinds of functions workers perform in the economy. By and large, the administrative, executive, and managerial workers are decision makers, the clerical workers are record keepers, the sales workers and those in transport occupations are conveyors of goods and services from the producer to the consumer (transport workers also convey people), while the producers of goods are mainly in the groups of farmers, miners, craftsmen, and the like (ISCO major groups 4-5 and 7-9). The group of professional, technical and related workers perform varied functions, differing from those of other groups mainly as regards the training or special talents required.

In the process of economic development, the distribution of manpower among such functional categories shifts, just as it does among industry sectors. In part, the shift in occupations is a reflection of the changing industry distribution; this is the case of farmers especially, whose share in the occupation distribution shrinks, of course, as the proportion of agriculture in the industry distribution is diminished. ^{8/} (This does not mean that the change in the occupation distribution is necessarily a result of the change in industry distributions; causal influences may also work in the opposite direction.) Among the workers in non-agricultural occupations, the relative numbers of professional, technical, administrative, executive, managerial and clerical workers especially tend to expand as economic development progresses, and there is a growing diversity of occupational specialization within the major groups, which reflects the increasing complexity of technology and economic organization. So the occupational distribution, like the distribution of industries, may be used as a mirror to give a different angle on the economic development of a country. However, the typical patterns of change in occupation distribution which go with economic development have not been studied so extensively. Comparative international studies in this field are severely handicapped by differences in the forms of occupational classification used in national censuses and in the kinds of jobs subsumed under the major group headings.

^{8/} It should be noted that where farmers and farm labourers or equivalent categories are specified in the occupation classification, the sum of these categories may be used, in the absence of an industry classification, to measure approximately the share of agriculture in the industry distribution of the labour force (and by subtracting this from the total, the approximate share of non-agricultural industries), since relatively few workers in agriculture are likely to be classified under other occupational headings.

Table 18

Occupation distribution of the labour force
in selected countries

Occupation (ISCO major groups)	Ghana,	Iran,	Thailand,	Turkey,	Japan,
	1960 <u>a/</u>	1956	1960	1960	1960 <u>i/</u>
Percentage of total labour force					
0. Professional, technical and related workers	2.2	1.6	1.3	1.6	4.9
1. Administrative, executive and managerial workers	0.5	0.5	0.2	(2.6	2.2
2. Clerical workers	1.6	2.5 <u>d/</u>	1.1		10.2
3. Sales workers	12.7	5.7	5.3	2.4	10.7
4. Farmers, fishermen, hunters, loggers and related workers	57.3	54.1	82.3	74.7	32.2
5. Miners, quarrymen and related workers	1.2	0.9	0.2	0.5	0.8
6. Workers in transport and communication occupations	1.9	2.3 <u>d/</u>	1.1	1.8	3.4
7/8. Craftsmen, production-process workers and labourers not elsewhere classified	14.5	19.9 <u>e/</u>	5.8	9.6	28.4
9. Service, sport and recreation workers	2.0	7.5	2.0	2.9	6.0
X. Workers not classifiable by occupation	6.0 <u>b/</u>	4.3 <u>f/</u>	0.7 <u>g/</u>	0.5 <u>h/</u>	0.8
Armed forces	- <u>c/</u>	0.8	- <u>c/</u>	3.3	0.5

a/ Data based on a 10 per cent sample of census returns.

b/ Consisting of unemployed persons.

c/ No information on disposition of members of the armed forces (0.2 per cent of labour force).

d/ Workers in communication occupations, apparently included in group 2 rather than group 6.

e/ "Labourers not elsewhere classified" (1.1 per cent of labour force), included in group X in the national classification, transferred here.

f/ Including unemployed persons (2.7 per cent of labour force).

g/ Including unemployed persons seeking their first jobs (0.5 per cent of labour force).

h/ Including unemployed persons seeking their first jobs.

i/ Diplomatic personnel outside the country and foreign military and civilian personnel and their dependants stationed within the country excluded.

j/ Consisting almost entirely of unemployed persons.

Various ways of grouping occupations, as well as industries, into broad categories are useful in the analysis of national census data, for studying their relationships to economic and other factors, assessing the significance of variations and trends, and judging likely directions of future trends. One such broad grouping distinguishes four major categories of occupations: white collar workers (professional, administrative, clerical and sales workers); blue collar workers (production or manual workers); farm workers; and service workers. Such a grouping is often particularly useful in constructing historical series since it avoids many of the most difficult problems of comparing data over a period of time, while indicating also the direction of trends among significantly differentiated groups. ^{9/} Groupings may be made with reference to other criteria than the functions performed by workers; criteria such as earnings or income, levels of education, degrees of skill, specialized training and experience required for the jobs and the degree of social prestige attached to them. Various kinds of social and economic status groupings of occupations have been made using such criteria, for purposes of economic, demographic, and sociological analyses. In most cases, groupings of this kind have represented expert judgements of the relative status attached to occupations in the different groups, but empirical groupings can be made where data are available on the pertinent characteristics of persons in each occupational category. ^{10/} Another kind of summary grouping of occupations which is especially pertinent to manpower problems of developing countries refers to the relevance of the various kinds of skills and work experience to the manpower needs of an industrializing economy. ^{11/} Still another kind of grouping refers to long-term trends of demand for the different skills; thus occupations may be classified as expanding, contracting or relatively constant in absolute numbers or in proportion to the total labour force.

The status classification of the labour force is illustrated in table 19 with recent census data for selected countries. As can be seen from the contrast between the figures for Japan and those for the less developed countries (except Iran), ^{12/} economic development involves an expansion of the employee group and

^{9/} See, for example, United States, Bureau of the Census, D.L. Kaplan and M.C. Casey, Occupational Trends in the United States 1900 to 1950 (Washington, 1958), Working Paper No. 5.

^{10/} Jerome B. Gordon, "Occupational classification: current issues and an interim solution", paper presented at the annual meeting of the American Statistical Association, December 1967. An example of a somewhat similar kind of grouping used in an analysis of census data of a developing country is the classification of "occupational levels" of the labour force of the Sudan, shown in Population Growth and Manpower in the Sudan (United Nations publication, Sales No.: 64.XIII.5), chap. IV.

^{11/} For example, see A.J. Jaffe, "Suggestions for a supplemental grouping of the occupational classification system", Estadística (Washington, D.C.), March 1957, pp. 13-23, where an illustration is given (with Puerto Rican census data) of a grouping of "modern" versus "classical" occupations, that is, occupations which involve the use of modern technology and those which do not.

^{12/} In regard to the data for Iran, which are out of line with those for the other developing countries considered here, see the discussion in the following section C on the effects of definitions and reporting practices on the status distribution.

Table 19

Distribution of the labour force by status in selected countries

Status	Ghana, 1960 a/	Iran, 1956	Thailand, 1960	Turkey, 1960	Japan, 1960 b/
(percentage of total labour force)					
1. Employees	19.9	44.4	11.8	22.1 c/	53.4
2. Employers	61.5	1.1	0.3	1.2	2.7
3. Own-account workers		40.1	29.5	28.3	19.3
4. Family workers a/	12.6	9.8 d/	57.7 d/	47.9 d/	23.9
5. Not reported, or not classifiable by status	6.0 e/	4.5 f/	0.7 g/	0.5 h/	0.7 i/
(percentage of labour force in non-agricultural industries)					
1. Employees	39.7	69.3	48.4	61.4 c/	77.3
2. Employers	57.9	1.5	1.1	3.9	3.5
3. Own-account workers		26.3	29.6	29.5	11.6
4. Family workers	2.5	2.4 d/	20.8 d/	4.3 d/	7.5
5. Not reported, or not classifiable by status	-	0.5 f/	0.1 g/	0.9 h/	-

a/ Data based on a 10 per cent sample of census returns.

b/ Data based on a 1 per cent sample of census returns.

c/ Armed forces (3.3 per cent of labour force), apparently included in status group 5 in the national classification, transferred here.

d/ Limited to unpaid family workers; those who received pay included in status group 1.

e/ Consisting of unemployed persons.

f/ Including unemployed persons (2.7 per cent of labour force).

g/ Including unemployed persons seeking their first jobs (0.5 per cent of labour force).

h/ Including unemployed persons seeking their first jobs.

i/ Consisting almost entirely of unemployed persons.

contraction of the groups of own-account workers and family workers, if not also of employers, in proportion to the labour force as a whole. These changes reflect the shift from the "atomized" organization of production in the less developed economy, where much of the economic activity is carried on in small, family-operated enterprises, to the more integrated organization of the industrialized economy with its large-scale, mass-production units. The decrease of the share of agriculture in the labour force has much to do with this, of course, but the shift of the status distribution occurs also within the non-agricultural sector, as illustrated by the figures in the lower panel of table 19. A simple measure which sums up variations of the status distribution from this point of view is the ratio of the employee group to the sum of employers, own-account workers, and family workers. From the data in table 19, the following ratios are obtained:

	Employees per 100 employers, own-account workers, and family workers	
	In total labour force	In non-agricultural industries
Ghana, 1960	27	66
Iran, 1956	87	229
Thailand, 1960	13	94
Turkey, 1960	29	163
Japan, 1960.	116	342

These figures illustrate a point of wider significance: that cross-classifications of status with industry and with occupation provide a more illuminating description of types of economic activities than is given by any of the three classifications alone. For example, in analysing the distribution of the labour force of a developing country among industry sectors along the lines suggested above, it is pertinent to consider separately the numbers of employees and other status categories within the labour force of each sector, since own-account workers and family workers are likely to be found, to a much greater extent than employees, in enterprises where little capital is employed, technology is backward, and productivity is low. Indeed, the category of family workers in particular and to a less extent that of own-account workers in occupations which require relatively little education, training, or equipment can be regarded as reservoirs of underemployment in the circumstances existing in many developing countries.

C. Effects of varying definitions, errors and biases

The analyst should be wary of errors in the reporting of industry, occupation and status in the census, which may create serious biases in the distributions. The type of activity may be inaccurately described, particularly when the informant is not the worker himself but another member of the household (as is very often the case). In the reporting of occupations, there may be much of euphemistic bias, the hod-carrier being reported as a mason, the janitor as a superintendent of buildings, the office clerk as an executive and so forth. In the reporting of status, the distinction between employers and own-account workers is especially likely to be unreliable; that a self-employed worker hires one or

two employees may easily be overlooked by the census informant, with the result that the number of employers is understated and the number of own-account workers overstated. Industry reports may be inaccurate especially in the case of employees of large establishments with a complex organization or those who are engaged in more than one type of activity.

Comparisons with data from other sources are important for the analyst as a means of testing the quality of industry and occupation data from the census and identifying categories which may be over-reported or under-reported. In many countries, there are statistics of employment in certain industries derived from establishment reports. In checking the consistency of the census statistics with such data, it has to be taken into account that establishment reports are affected by double counting of persons who have been employed in more than one establishment (within the same industry or in different industries) during the reporting period. There may be other differences in coverage and definitions between the two sets of data, which also have to be borne in mind. Independent data on employment in occupation groups are less commonly available.

Labour force distributions by industry, occupation and status are affected not only by errors in the reporting of these items in the census but also by variations of the labour force definitions and by errors and biases in the reporting of individuals as economically active or inactive. These may affect the figures for certain industry, occupation and status groups relatively far more than they affect the measure of the total labour force. The time reference of the census questions takes on crucial importance in the measurement of the labour force in agriculture and other activities which vary greatly with the seasons. The analyst should be especially wary of the effects of variations in the extent to which the economic activities of women and family workers of both sexes have been reported. These considerations are of the greatest importance in the interpretation of data for the agricultural labour force in developing countries. It is commonly true in such countries that nearly all able-bodied members of farm households take some part in agricultural work, if only during the seasons of peak labour requirements, but the extent to which the women and young people are reported as economically active varies over a wide range, strongly affecting the census measures of the agricultural labour force and the industry, occupation and status distributions of the labour force totals.

In order to minimize effects of such variations in definitions and reporting, analyses of these data are often restricted to the statistics for males, and sometimes the figures for family workers are deducted for the same purpose. Such restrictions have the effect of introducing other biases, since the industry, occupation and status distributions of the male labour force or of the residual after deduction of family workers are not the same as the distributions of the total manpower. The analyst is faced here with a dilemma which cannot be fully resolved without information which is very difficult to obtain, about the specific effects of the variations in definitions and reporting upon the statistics for different industry, occupation and status groups. However, by carrying out the analysis in different ways, both including and excluding the figures for females and/or family workers, the analyst can get some idea of possible distortions in the data.

The importance of this problem is illustrated by the example in table 20 of measures of the agricultural labour force in several countries, in absolute

Table 20

Shares of agricultural industries (ISIC division 0) in
the labour force of selected countries

	Ghana 1960	Iran 1956	Thailand 1960	Turkey 1960	Japan 1960
<u>A. All status groups, including family workers</u>					
Number of agricultural workers (thousands):					
Both sexes	1 579	3 326	11 334	9 737	14 237
Males	1 003	3 183	5 576	4 706	6 863
Females	576	143	5 758	5 031	7 374
Agricultural workers as percentage of total of specified sex in all industries:					
Both sexes	57.9	54.8	81.9	74.9	32.3
Males	59.6	58.0	78.0	61.1	25.6
Females	55.2	24.9	86.0	95.0	42.9
<u>B. Status groups other than family workers</u>					
Number of agricultural workers (thousands):					
Both sexes	1 260	2 790	3 808	3 640	5 980
Males	855	2 730	3 189	3 228	4 752
Females	406	60	620	411	1 228
Agricultural workers as percentage of total of specified sex in all industries:					
Both sexes	52.9	51.0	65.0	53.7	17.9
Males	55.9	54.6	68.8	52.6	19.8
Females	47.6	12.7	50.7	64.7	12.8

See notes to tables 17 and 19.

numbers and in proportionate shares of the total. The census figures for both sexes together, including family workers, make it appear, for example, that agriculture has a considerably smaller share of the labour force in Iran than in Turkey; but this difference is due wholly to the fact that many more women have been reported in the Turkish census as family workers in agriculture. The figures for males or for the labour force excluding family workers probably give a more nearly accurate picture of the relative shares of agriculture in the labour force of these countries, but this picture also is distorted so far as any real difference exists between countries as regards the extent of women's participation in agriculture as family workers. The problem of international comparisons aside, the true proportion of the national labour supply engaged in agriculture is misrepresented when the data for each country are considered separately. In Iran, the failure to count many women who take part in agricultural work means that the relative share of agriculture is understated by all the measures shown in the table. In Turkey, on the other hand, while the share of agriculture is understated when the figures for women or family workers are excluded, it may be overstated when they are included. It would be so if a great many of the women classified as family workers in agriculture were engaged only to a relatively small extent in agricultural work. The analyst can correct the latter kind of distortion, however, if the census provides information on the amount of time spent working by individuals.

The status distribution is even more susceptible to the effects of variations in reporting of family workers, as illustrated by the comparison in table 19 between the status distribution for Iran and the corresponding figures for other countries. Very few women were reported as family workers in the Iranian census: only 102,000, or less than 2 per cent of the female population fifteen years of age and over, although 492,000 male family workers were reported. Thus the percentage of family workers in the Iranian labour force as measured by the census is lower than that in any of the other countries included in the table. Partly for this reason, the percentage of employees is pushed up far higher than the corresponding figures for other developing countries in the table, so that it comes not far below the Japanese percentage in spite of Japan's much higher level of economic development.

D. Dual economic activities

Persons working at more than one job present a problem in the measurement of the proportions of manpower engaged in various industry, occupation and status groups; a problem which becomes important when such duality of economic activity occurs frequently, as it does in many developing countries. The normal practice in censuses is to classify each individual according to the industry, occupation and status of the job reported as his main activity. The result, of course, is a tendency to understate the share of manpower in those types of activities that are frequently subsidiary, and to overstate the share in those which frequently occupy the major part, though less than the whole, of the worker's time.

In some censuses, data on the subsidiary as well as the main economic activities of individuals are provided. Such data permit the analyst to derive the total numbers of workers engaged primarily or secondarily in various categories of industry, occupation and status, after the manner illustrated in table 21 with occupation data from the 1956 census of the Sudan. In this

Table 21

Main and subsidiary occupations reported by adults in the census of the Sudan, 1955-1956

Sex and occupation groups	Main occupation		Subsidiary occupation		Total, main or subsidiary occupation			
	Number	Percentage	Number	Percentage	Number	Percentage		
<u>Adult males</u>								
All gainful occupations	2 751	506	100.0	680	445	3 451	949	100.0
Farmers, shepherds ... (codes A,B,J,3)	2 297	751	83.4	525	212	2 820	963	82.2
Farm labourers (code H)	37	680	1.4	29	985	67	665	2.0
Professional and semi-professional workers (codes O,1,4,5)	48	642	1.7	27	278	75	920	2.2
Shop owners, managerial workers ... (codes 2,6)	67	251	2.5	15	686	82	937	2.4
Clerical workers ... (codes C,7)	23	695	0.8	5	338	29	633	0.9
Craftsmen, skilled service workers ... (codes 8,9)	122	569	4.5	60	738	183	357	5.3
Machinery operatives, non-skilled service and protective service workers (codes D,E,K)	79	545	2.9	7	633	86	576	2.5
Labourers other than farm labourers (code F)	74	375	2.7	11	123	85	498	2.5
<u>Adult females</u>								
All gainful occupations	285	637	100.0	948	454	1 231	471	100.0
Farmers, shepherds ...	232	696	82.0	745	823	977	919	79.4
Farm labourers	5	913	1.4	20	781	24	694	2.0
Professional and semi-professional workers	3	996	1.4	3	506	7	502	0.6
Shop owners, managerial workers ...	879	641	0.3	1	180	2	659	0.2
Clerical workers ...	641	641	0.2	315	956	956	956	0.1
Craftsmen, skilled service workers ...	56	437	12.8	172	275	208	712	16.9
Machinery operatives, non-skilled service, and protective service workers	3	226	1.1	2	607	5	233	0.5
Labourers other than farm labourers	1	849	0.7	2	547	4	396	0.4

Source: Population Growth and Manpower in the Sudan (United Nations publication, Sales No.: 64.XIII.5), table 6, p. 69.

instance, the data show that, in particular, the proportions of workers in professional and semi-professional occupations and of craftsmen, skilled service workers etc. are understated in the classification of main occupations only. Combinations of various kinds of main and subsidiary activities can also be studied if appropriate cross tabulations of the census data are given. ^{13/} It is difficult, however, to weight the figures for main and subsidiary activities satisfactorily in order to get unbiased measures of the place in the total labour supply occupied by given industry, occupation and status groups.

E. Regional and urban-rural patterns

In tables 22, 23 and 24 data from the 1954 demographic and economic survey of Thailand illustrate some simple measures of distributions and rates which are useful in studying the variations in types of economic activities in the different parts of a country. The data in this example are classified by major occupational groups, but these analytical measures are equally useful in studying industry and status distributions.

In the 1954 survey of Thailand, the country was divided into four regions: northeast, north, central, and south, and data were also provided separately for the provinces of Bangkok and Thonburi, which contain the country's two principal cities. For the purpose of this illustration, attention is confined to the figures for the northeast region (which is the least industrialized), the central region (which is most industrialized) and the Bangkok province, which is located in the central region. The calculations are made in such a way as to permit comparisons between measures derived from the statistics for both sexes and those for males only, so as to take into account the kinds of bias mentioned in section C, above.

Where, as in Thailand, a large majority of the labour force is employed in agricultural occupations, so that there is little scope for variation in the proportionate shares in different kinds of non-agricultural activities, it is helpful to calculate the distributions by types of activities within the non-agricultural sector, as illustrated in table 22. It can be seen in this example that, although the occupation distributions of the total labour force in rural parts of the northeast and central regions are rather similar, both being marked by an overwhelming proportion of farm workers, there are pronounced differences between the two regions as regards the kinds of functions performed by workers within the non-agricultural sector.

The urban-rural classification is fundamental in an analysis of geographical variations in the patterns of economic activity, since the economic functions of rural and urban communities are to a large extent complementary, the former being related mainly to primary production while processing, distribution, and service functions are concentrated mainly in the cities and towns. The degree of such polarization of functions in the urban and rural communities tends to vary with the level of economic development. In under-developed countries, a sizeable

^{13/} The United Nations report on the analysis of the Sudan census data Population Growth and Manpower in the Sudan (United Nations publication, Sales No.: 64.XIII.5), note 10, gives attention to some such combinations.

Table 22

Percentage distribution of the labour force by occupation groups in regions and urban and rural areas of Thailand, 1954

Sex and major occupation group	Whole Kingdom		Northeast region	
	Total	Urban	Total	Urban
		Rural		Rural
<u>Both sexes</u>				
Total labour force	100.0	100.0	100.0	100.0
Farmers, fishermen ...	88.0	11.7	28.3	97.1
Non-agricultural occupations	11.2	81.6	68.5	2.7
Others and not reported	0.8	6.7	3.2	0.2
Non-agricultural occupations	100.0	100.0	100.0	100.0
Professional, technical and related workers	9.2	6.3	7.7	25.8
Managers, administrators and officials	4.4	5.0	3.5	2.6
Clerical, office and related workers	6.0	9.0	2.4	4.4
Salesmen and related workers	32.8	28.6	37.3	33.8
Workers in mines, quarries and related occupations	0.9	-	-	0.2
Workers in operating transport occupations	5.7	7.5	6.5	3.2
Craftsmen, production process workers ...	21.4	22.6	18.9	19.3
Manual workers and labourers (not elsewhere classified)	9.6	8.5	8.9	5.4
Service and related workers	10.0	12.6	12.4	5.2
<u>Males</u>				
Total labour force	100.0	100.0	100.0	100.0
Farmers, fishermen ...	84.0	9.4	24.2	95.8
Non-agricultural occupations	14.5	81.0	70.8	3.9
Others and not reported	1.5	9.6	5.0	0.3
Non-agricultural occupations	100.0	100.0	100.0	100.0
Professional, technical and related workers	9.9	4.7	7.0	31.6
Managers, administrators and officials	6.2	6.8	7.0	3.8
Clerical, office and related workers	7.6	10.6	3.5	6.4
Salesmen and related workers	25.6	24.0	28.1	22.5
Workers in mines, quarries and related occupations	1.0	-	-	0.3
Workers in operating transport occupations	8.4	10.9	9.6	4.7
Craftsmen, production process workers ...	21.8	23.5	18.4	18.4
Manual workers and labourers	11.2	9.6	11.4	7.3
Service and related workers	8.4	10.0	14.9	5.0

Table 22 (continued)

Sex and major occupation group	Central region		Bangkok province		
	Total	Urban	Rural	Total	Urban
<u>Both sexes</u>					
Total labour force	100.0	100.0	100.0	100.0	100.0
Farmers, fishermen ...	72.5	6.6	84.2	17.0	1.5
Non-agricultural occupations	25.7	85.5	15.0	74.7	89.1
Others and not reported	1.8	7.9	0.8	8.3	9.4
Non-agricultural occupations	100.0	100.0	100.0	100.0	100.0
Professional, technical and related workers	6.7	6.4	7.0	5.8	6.0
Managers, administrators and officials	4.7	4.7	4.7	4.4	4.5
Clerical, office and related workers	7.2	10.8	3.5	11.0	11.5
Salesmen and related workers	30.0	26.1	33.9	23.1	24.2
Workers in mines, quarries and related occupations	0.6	-	1.3	-	-
Workers in operating transport occupations	6.0	7.0	5.1	7.2	7.2
Craftsmen, production process workers ...	23.6	23.8	23.6	23.9	23.7
Manual workers and labourers (not elsewhere classified)	10.7	8.8	12.5	10.7	8.8
Service and related workers	10.4	12.4	8.4	13.8	14.1
<u>Males</u>					
Total labour force	100.0	100.0	100.0	100.0	100.0
Farmers, fishermen ...	65.2	5.9	80.2	13.1	1.8
Non-agricultural occupations	31.4	83.4	18.3	75.6	86.0
Others and not reported	3.4	10.7	1.5	11.3	12.2
Non-agricultural occupations	100.0	100.0	100.0	100.0	100.0
Professional, technical and related workers	6.5	4.6	8.7	4.6	4.6
Managers, administrators and officials	6.6	6.3	6.9	5.8	5.9
Clerical, office and related workers	8.8	12.3	4.8	11.8	12.3
Salesmen and related workers	24.8	23.5	26.4	22.0	23.3
Workers in mines, quarries and related occupations	0.5	-	1.0	-	-
Workers in operating transport occupations	8.8	9.9	7.7	9.9	9.9
Craftsmen, production process workers ...	23.8	24.6	22.9	24.7	24.5
Manual workers and labourers	12.0	9.6	14.8	11.7	9.5
Service and related workers	8.1	9.3	6.7	9.5	10.0

Source: Thailand, Central Statistical Office, Final Report of the Demographic and Economic Survey, 1954 (Bangkok, no date) vol. 1, table 14, pp. 345-361.

Table 23

Percentage shares of regions and urban and rural areas in occupation groups of the labour force, Thailand, 1954

Sex and major occupation group	Whole kingdom		Central region	Bangkok ^a province
	Total	Urban			Rural
Both sexes				
Total labour force	100.0	5.9	94.1	3.7
Farmers, fishermen ...	100.0	0.8	99.2	0.7
Non-agricultural occupations, total	100.0	41.2	58.8	23.6
Professional, technical and related workers	100.0	27.9	72.1	14.8
Managers, administrators and officials	100.0	47.3	52.7	23.8
Clerical, office and related workers	100.0	62.1	37.9	43.6
Salesmen and related workers	100.0	35.9	64.1	16.6
Workers in mines, quarries and related occupations	100.0	-	100.0	-
Workers in operating transport occupations	100.0	54.2	45.8	30.1
Craftsmen, production process workers ...	100.0	43.4	56.6	26.5
Manual workers and labourers (not elsewhere classified)	100.0	36.7	63.3	26.4
Service and related workers	100.0	51.7	48.3	32.7
Others and not reported	100.0	50.4	49.6	38.9
Males				
Total labour force	100.0	7.9	92.1	5.2
Farmers, fishermen ...	100.0	0.9	99.1	0.8
Non-agricultural occupations, total	100.0	42.9	57.1	26.0
Professional, technical and related workers	100.0	20.4	79.6	12.1
Managers, administrators and officials	100.0	46.8	53.2	24.1
Clerical, office and related workers	100.0	60.0	40.0	40.6
Salesmen and related workers	100.0	40.2	59.8	17.7
Workers in mines, quarries and related occupations	100.0	-	100.0	-
Workers in operating transport occupations	100.0	55.2	44.8	30.6
Craftsmen, production process workers	100.0	46.4	53.6	29.5
Manual workers and labourers (not elsewhere classified)	100.0	36.7	63.3	27.2
Service and related workers	100.0	51.2	48.8	29.5
Others and not reported	100.0	50.0	50.0	38.4

Source: Computed from, Thailand, Central Statistical Office, Final Report of Demographic and Economic Survey, 1954 (Bangkok, no date), vol. 1, table 14, pp. 345-363.

a/ Central region includes Bangkok province.

Table 24

Activity rates in the population of fifteen years and over, specific for occupation sectors and sex, in regions and urban and rural areas of Thailand, 1954
(Persons reported as economically active in specified groups of occupations per 100 inhabitants of specified sex, fifteen years and over)

Sex and occupation sector	Whole kingdom		Northeast region		Central region		Bangkok province		
	Total	Rural	Total	Rural	Total	Rural	Total	Urban	
<u>Males</u>									
All occupations	89.1	73.3	90.7	92.2	83.0	73.1	86.0	75.8	74.6
Farmers, fishermen ...	74.8	6.9	81.8	88.3	54.1	4.3	68.9	9.9	1.3
Non-agricultural occupations	13.0	59.4	8.2	3.6	26.1	60.9	15.8	57.3	64.2
Others and not reported	1.3	7.0	0.7	0.3	2.8	7.9	1.3	8.6	9.1
<u>Females</u>									
All occupations	81.9	34.9	86.3	91.1	68.7	30.3	78.8	32.0	26.9
Farmers, fishermen ...	75.5	5.9	81.9	89.6	55.8	2.6	69.7	8.7	0.2
Non-agricultural occupations	6.4	29.0	4.4	1.5	12.9	27.5	9.1	23.1	26.4
Others and not reported	-	-	-	-	-	0.2	-	0.2	0.3

Source: See table 23.

fraction of the urban labour force is often found to be employed in agricultural work as illustrated by the relatively high percentage of farmers etc. in the urban labour force of the northeast region of Thailand. This percentage is appreciably lower in the urban part of the central region as a whole, and still lower in Bangkok. The study of the relationship between urbanization and the pattern of economic activities has special importance for developing countries, where the social and economic problems involved in the rapid growth of city populations are commonly matters of grave concern and policy-makers would like to avoid, if possible, situations where urbanization outpaces the growth of urban employment opportunities. The labour force distributions by industry and status as well as occupation in urban and rural areas, and their changes in the course of time, deserve an important place in the analysis of the census data for such countries. Measures of unemployment and underemployment in industry and occupation categories of the urban and rural labour force are also evidently relevant to the study of these questions, but the methods of analysing unemployment and underemployment data are outside the scope of the present discussion.

It is also important to keep the urban-rural classification in view when regional variations in occupation, industry and status distributions are being studied, since these distributions are greatly influenced by the degree of urbanization. For example, it can be seen in table 22 that the difference in occupation distribution of the labour force between the northeast and central regions of Thailand is mainly a reflection of the higher degree of urbanization of the central region. Within either the rural or the urban parts, the occupation distributions are less disparate in the two regions, although those in the central region show marks of a higher level of economic development both for the urban and rural areas.

In addition to the occupation, industry and status distributions of the labour force within different parts of the country, it is useful to consider the distribution per area of workers engaged in each type of activity, as illustrated in table 23 with the occupation data for Thailand. For example, one sees that in Thailand, the clerical, transport and service functions are concentrated to the greatest extent in the cities and towns while rural areas have larger shares in the professional and technical, sales and manual groups. In the regional distributions, one finds a high degree of concentration in the central region and especially in the Bangkok province of clerical, office and related workers. The central region also has a disproportionately large share of manual workers and labourers, craftsmen, production process workers etc., workers in operating transport occupations, and managers, administrators and officials. There is a less unbalanced regional distribution of professional, technical, and related workers (including school-teachers) and of salesmen and related workers. In part, these variations can be viewed as reflections of the differentiated functional roles of regions and urban and rural communities. The concentration of clerical, office, and related workers in the Bangkok province, for example, is doubtless related to the presence there of the country's capital and the main body of the Civil Service. On the other hand, the geographical distribution of certain service occupations, as related to the distribution of the population, can provide an indicator of the extent to which the need for such services is being met in different parts of the country. Moreover, the geographical distribution

of certain types of activities may be associated with regional differences in activity rates, particularly of females. ^{14/}

Occupation-specific activity rates as illustrated for Thailand in table 24 and corresponding rates specific for industry and status may also be helpful in analysing variations in the patterns of economic activities. Such rates measure the extent of participation in a specified type of economic activity in proportion to the population (or a specified age-sex category of the population) instead of in proportion to the total number of economically active persons. Unlike the percentage of a given occupation group in the total labour force, the occupation-specific activity rate is not directly affected by the numbers of workers in other occupations.

F. Trends over a period of time

The value of the picture of a nation's economic activities that is provided by a census is enormously enhanced if it can be viewed in perspective against the background of data from earlier censuses. The analyst can then see in what directions the industry, occupation and status distributions of the nation's manpower have been changing, study factors associated with these changes and obtain some basis for predicting likely directions of change in the future. If data are available from one census only, the analyst may still be able to make some inferences about these matters as illustrated below with reference to the statistics of Ghana; but it is far more satisfactory to work with data collected at several points in time. Although considerable difficulties are often encountered as a result of changes in the concepts and classifications used in the successive censuses, it is well worth the effort to overcome these difficulties if at all possible.

In early censuses, the distinctions between the concepts of industry, occupation and status were often not recognized, or it was not considered necessary to make separate classifications of economic activities according to these three concepts. The common practice was to call for a single entry on the census form, typically referring to "usual occupation", and to make a single classification of the returns. This was usually a combination of industry and occupation rubrics, and the status concept was often missing or found only in categories of agricultural workers. Comparisons between statistics classified in this way and the data of more recent censuses classified by industry, occupation, and status pose major difficulties and exact measures of changes over a period of time cannot be obtained in these circumstances. However, it may be possible to derive approximate estimates for some industry and occupation groups, especially if the earlier data refer to a time when the economy was relatively little

^{14/} See chapter II, E, above. An example is provided by the data for Colombia in 1951. In the departamento of Nariña (which was primarily agricultural at that date, with some 58 per cent of its economically active population in this sector), female activity rates at every age were very substantially higher than those for other primarily agricultural areas in the country. The industrial distribution showed a disproportionately high concentration in manufacturing in Nariña and further analysis of the data indicated a close association between these two atypical situations.

developed and the organization of economic activities relatively simple. In such an economy the relationship between industry and occupation is often quite close. For example, the labour force of enterprises engaged in manufacturing footwear may consist very largely of shoemakers who perform the whole process of production; retail trade may be almost entirely in the hands of hawkers, pedlars and small shop-keepers with or without family members or employees helping to sell the merchandise, but without any great number of specialized personnel such as managers, book-keepers and secretaries. So the analyst may be able to make rough estimates of certain major categories from data which do not appear on the surface to be at all comparable. 15/ Some of the problems of making and interpreting such estimates will be discussed below.

In the analysis of more recent data with separate classifications of industry, occupation and status, problems also arise from changes in the forms of these classifications in successive censuses. The phenomena which the statistics are designed to measure are never static and if the classifications were not changed, they would eventually cease to provide a meaningful picture. When changes are made, it is very helpful for trend analysis to include in the census tabulation programme a conversion table showing the numbers of workers in industries or occupations switched from one group to another (with classifications, so far as possible, according to the most important characteristics), if not a full tabulation of the labour force according to the former classification as well as the new one. This has been done, for example, in the 1960 census publications of the United Arab Republic and of the United States of America. But such tabulations have not ordinarily been provided and, more often than not, the analyst is faced with a problem of estimating adjustments when he undertakes to compare the statistics of two censuses.

In addition, changes in the census concepts and definitions of the labour force and in the ways of applying them also make it more difficult to compare time-series of industry, occupation and status statistics. A question which arises very often in long-range trend analysis relates to the effect on industry, occupation and status distributions when the basis of the inquiry is shifted from "usual" gainful activity to activity during a specified brief time-period, as has been done recently in the censuses of many countries. The figures for seasonal activities are likely to be most affected by such a shift as well as by changes in the time of the year at which censuses are taken. 16/

15/ Likewise in analysing recent census data for countries where the organization of the economy is still relatively simple, approximate estimates for certain industrial categories may be obtainable from an occupation classification or vice versa. See for example the estimates for primary, secondary and tertiary industrial sectors derived from the occupation classification of the Sudan census in Population Growth and Manpower in the Sudan (United Nations publication, Sales No.: 58.XIII.4), chap. 4.

16/ For examples of problems encountered in studies of long-range occupation and industry trends, and ways of dealing with these problems, see, for India, B.R. Kalra, op. cit.: A.M. Edwards, "Comparative occupation statistics for the United States, 1870 to 1940", Sixteenth Census of the United States, 1940, Population (Washington, Bureau of the Census, 1943). See also Kaplan and Casey, op. cit.

The data for Peru shown in table 25 illustrate some of the problems encountered when changes have been made both in the labour force definitions and in the forms of classifications. The questions in the Peruvian census of 1940 referred to usual activities, whereas those in the 1961 census referred to activities during a specified week. The industry classification used in 1961 followed the ISIC standard, whereas a different classification was used in 1940, as shown in the table. It is probably the best procedure in such circumstances as a general rule to begin by examining the detailed classifications used in the two censuses and making whatever combinations and rearrangements of categories appear to be called for; and then to try to assess the effects of the change in labour force definitions and enumeration procedures, taking account of available cross-classifications of the industry, occupation and status data with other characteristics. In the present example, the combination of the first two categories in the 1940 industry classification is apparently equivalent in industry coverage to "agriculture, forestry, hunting and fishing" (ISIC division 0) in the 1961 census. The table shows a very substantial decrease between 1940 and 1961 in the percentage of females among workers in this group, which suggests that the change in definitions eliminated a large number of women from the count of the agricultural labour force. One way of obtaining an idea of the possible extent of this effect is to assume that the percentage of females in the agricultural labour force would have been the same at both census dates if the 1961 definitions had been applied in 1940. On this basis, assuming further that the figures for males require no adjustment and dividing the 1940 sum of 1,060 thousand males in the first two industry categories by the 1961 percentage of females (13.8 per cent) one obtains estimates of 1,233 thousand workers of both sexes and thus only 173 thousand female workers in agriculture and related occupations, instead of 486 thousand as reported in 1940. Substituting these estimates in table 25, and assuming for the purpose of the illustration that no adjustment is to be made in the figures for other industry groups, one obtains the following results:

	<u>1940 as reported</u>	<u>1940 as adjusted</u>	<u>1961</u>
<u>Number (thousands)</u>			
Total labour force: both sexes	2 475	2 162	3 125
males.	1 598	1 598	2 445
females.	877	563	679
Agriculture ... (division 0):			
both sexes	1 546	1 233	1 556
males.	1 060	1 060	1 340
females.	486	173	215
<u>Percentage share of agriculture ...</u>			
<u>in total labour force, both sexes</u>	62.4	57.0	49.8
<u>Percentage of females:</u>			
in total labour force	35.4	26.0	21.7
in agriculture	31.4	13.8	13.8

Table 25

Labour force by industry groups and sex, Peru,
1940 and 1961

Industry groups	Number (thousands)	Percentage distribution	Percentage of females
<u>1940</u>			
Total	2 475	100.0	35.4
Agriculture	1 293	52.2	28.0
Animal raising, forestry, fishing and hunting	253	10.2	49.0
Extractive industries	45	1.8	2.8
Manufacturing industries	380	15.4	56.5
Building, construction and repair	46	1.8	1.9
Transport and communication	51	2.1	4.7
Commerce, finance, and insurance	112	4.5	32.2
Public administration and other services in the public interest	89	3.6	18.5
Independent professions, domestic service and other personal service	165	6.7	67.4
Other and unclassified activities	41	1.7	19.9
<u>1961</u>			
Total	3 125	100.0	21.7
Agriculture, forestry, hunting and fishing	1 556	49.8	13.8
Mining and quarrying	66	2.1	2.7
Manufacturing industries	411	13.2	28.2
Construction	105	3.4	0.9
Electricity, gas, water and sanitary service	9	0.3	4.6
Commerce	282	9.0	28.0
Transport, storage and communications	94	3.0	4.9
Services	477	15.3	49.2
Activities not adequately specified (including persons seeking first jobs)	126	4.0	21.6

Such an estimate is, of course, very rough. It should be possible to improve the adjustment of the 1940 count of females in agriculture by taking into consideration other information such as classifications by status, age and regions of the country, so far as such data are provided in the census tabulations. It would also be necessary to consider the required adjustments in the figures for males in agriculture (especially in the youngest age groups) and for workers in other industry groups. In regard to the latter, it will be noticed that in table 25 the reported share of the labour force in manufacturing industries decreased slightly from 1940 to 1961 and that here, too, there was a great reduction in the percentage of females. A cross-tabulation of the 1940 data by industry and status showed that 62 per cent of the female workers reported in manufacturing industries were own-account workers, most of them undoubtedly being in handicrafts. (The corresponding cross tabulation of the 1961 census data is not yet available.) Many women employed part time or seasonally in handicrafts, like those in agriculture, may have been excluded from the 1961 census count as a result of the change in definitions, although there may also have been a decrease in the volume of this kind of employment. An estimated adjustment should take into account the 1940 and 1961 census returns for different categories of industries within the manufacturing group, in different parts of the country, and any available independent data on the trend of employment in handicraft industries.

The difficulty with the Peruvian statistics is due partly to the long interval between the censuses. Where data are available for more census dates and the intervals are shorter, it is less difficult to sort out the effects of changes in definitions and classifications on the one hand and the real trends of industry and occupation distributions on the other. Furthermore, in recent censuses of many countries, there has been more continuity in definitions and classifications than is found in the statistics of Peru. In such circumstances, there can be more certainty in the study of trends and the analysis can be carried out in greater detail. There follow here some examples of the types of analysis to which such data can be subjected.

Table 26 shows an analysis of changes in the industry distribution of Turkey's labour force between the censuses of 1955 and 1960, which were taken under the same system of concepts and classifications. (It is not assured, however, that the 1955 and 1960 data are precisely comparable, since differences in completeness of coverage and accuracy of reporting may affect comparisons even when definitions and classifications are unchanged.) In view of the preponderance of the agricultural sector, it is useful here, as in the regional analysis of occupation data for Thailand, to calculate the proportionate shares of non-agricultural industry groups within the total for the non-agricultural

Table 26

Trends in industry groups of the labour force, Turkey, 1955-1960

Industry (ISIC divisions)	Labour force (thousands)		Percentage of all industries		Percentage of non-agricultural industries		Percentage change, 1955-1960
	1955	1960	1955	1960	1955	1960	
Total, all industries	12 205	12 993	100.0	100.0	-	-	+ 6.5
Agriculture, forestry, hunting and fishing	9 446	9 737	77.4	74.9	-	-	+ 3.1
Non-agricultural industries	2 032	2 595	16.6	20.0	-	-	+27.7
Industry not reported ^{a/}	727	661	6.0	5.1	-	-	- 9.1
Total, non-agricultural industries	2 032	2 595	16.6	20.0	100.0	100.0	+27.7
Mining and quarrying	63	77	0.5	0.6	3.1	3.0	+23.4
Manufacturing	727	885	6.0	6.8	35.8	34.1	+21.8
Construction	200	290	1.6	2.2	9.8	11.2	+44.9
Electricity, gas, water and sanitary services	16	15	0.1	0.1	0.8	0.6	- 3.7
Commerce, insurance and banking	341	404	2.8	3.1	16.8	15.6	+18.4
Transport, storage and communication	190	247	1.6	1.9	9.4	9.5	+30.1
Services	496	677	4.1	5.2	24.4	26.1	+36.4

^{a/} Including members of armed forces and unemployed persons seeking their first jobs.

sector as well as their shares in the whole labour force. ^{17/} It can be seen, for example, that although manufacturing, mining and quarrying, commerce, insurance and banking made substantial gains in numbers of workers during the five-year period, they did not keep pace with the expansion of other industries in the non-agricultural sector. The same point is made by comparing the percentages of increase or decrease of the labour force in the various industry groups which appear in the last column of the table. The latter measures also bring out features of the picture which the measures of changing proportionate shares of industry groups do not reveal. For example, one sees that while the share of the agricultural sector in the labour force was diminishing in Turkey during this period, the number of agricultural workers was increasing at a rate which was not negligible, although it was distinctly below the rate of population increase (15.3 per cent increase in the total population between 1955 and 1960). The relationship is shown in another way by the trend of the activity rate specific for agricultural industries, which dropped from 64.7 per cent of the population fifteen years of age and over in 1955 to 59.6 per cent in 1960. ^{18/}

Table 27 presents 1955 and 1960 data for major occupation groups of the Turkish labour force and it is clear that the changes in them are closely related to those in the industry groups. This is partly due to the fact that some of the occupation groups, that of workers in mines and quarries, for example, are essentially industrial rather than occupational. But even where this is less clearly the case, the association between occupation and industry changes is apparent. The increase in the numbers of craftsmen and production process workers reflects the growth in manufacturing and construction industries, for example. Nevertheless, the fastest growing occupation group, that of managerial, administrative, and clerical workers, is one that crosses industry lines. As

^{17/} It should be noted that the category of "industry not reported" amounted to a sizeable percentage of the labour force enumerated in both censuses. Of course, the presence of such an undistributed category tends to lower the percentages for all other categories. In this case, the "not reported" group is inflated by inclusion of the armed forces (3.3 per cent of the labour force in 1960). For the comparison in table 17, the armed forces were reclassified under "services" in the 1960 data, but this cannot be done here because the number of the armed forces in 1955 is not given.

A procedure often followed is to pro-rate the "not reported" group among the categories of reported industries (and likewise in occupation and status distributions); or, which comes to the same result, to exclude this group from the total in calculating percentage distributions. However, since the relative frequency of non-reporting is likely to differ significantly among persons attached to different industries, it is safer to keep the "not reported" in view as a separate item, and to take into account in the analysis how much any of the measures under consideration might be distorted by non-reporting.

^{18/} For some analytical purposes, it is more pertinent to calculate measures like those presented in table 26 (as well as those in many other tables in this chapter) derived from statistics of employed persons instead of the total labour force. In the Turkish censuses, however, the numbers reported as unemployed were so small that their exclusion would not be likely to affect the measures significantly.

Table 27

Trends in occupation groups of the labour force, Turkey, 1955-1960

Major occupation groups	Labour force (thousands)		Percentage of all occupations		Percentage of non- agricultural occupations		Percentage change, 1955-1960
	1955	1960	1955	1960	1955	1960	
Total, all occupations	12 205	12 993	100.0	100.0	-	-	+ 6.5
Farmers, fishermen ...	9 431	9 713	77.3	74.8	-	-	+ 3.0
Non-agricultural occupations	2 221	2 792	18.2	21.5	-	-	+25.7
Not reported a/	554	488	4.5	3.8	-	-	-11.9
Total, non-agricultural occupations	2 221	2 792	18.2	21.5	100.0	100.0	+25.8
Professional, technical ...	159	214	1.3	1.6	7.1	7.7	+34.6
Administrative, executive ...	226	339	1.9	2.6	10.2	12.1	+49.9
Sales workers	269	318	2.2	2.4	12.1	11.4	+18.2
Miners, quarrymen ...	49	58	0.4	0.4	2.2	2.1	+20.3
Workers in transport and communication occupations	168	231	1.4	1.8	7.6	8.3	+37.5
Craftsmen and production process workers	760	956	6.2	7.4	34.2	34.2	+25.7
Labourers not elsewhere classified	313	294	2.6	2.3	14.1	10.5	- 5.8
Service, sport and recreation workers	277	382	2.3	2.9	12.5	13.7	+37.9

a/ Including members of armed forces and unemployed persons seeking their first job.

Table 28

Trends in status groups of the labour force,
Turkey, 1955-1960

Status	Labour force (thousands)		Percentage distribution		Number	Change, 1955-1960
	1955	1960	1955	1960		Per cent of 1955 number
Total, all industries	12 205	12 993	100.0	100.0	+788	+ 6.5
Employees (except armed forces)	1 624	2 437	13.3	18.8	+813	+ 50.0
Employers	40	156	0.3	1.2	+116	+ 290.0
Own-account workers	3 289	3 683	27.0	28.3	+394	+ 12.0
Family workers	6 669	6 221	54.6	47.9	-448	- 6.7
Armed forces	584	423	4.8	3.3	- 88	- 15.0
Not reported <u>a/</u>		73		0.6		
Agriculture ... (ISIC division 0)	9 419	9 737	100.0	100.0	+318	+ 3.4
Employees	229	677	2.4	7.0	+448	+ 195.6
Employers	3	49	-	0.5	+ 46	+1533.3
Own-account workers	2 631	2 903	27.9	29.8	+272	+ 10.3
Family workers	6 549	6 098	69.6	62.6	-451	- 6.9
Not reported	7	10	0.1	0.1	+ 3	+ 42.8
Non-agricultural industries <u>b/</u>	2 032	2 595	100.0	100.0	+563	+ 27.7
Employees	1 212	1 594	59.6	61.4	+382	+ 31.5
Employers	34	101	1.7	3.9	+ 67	+ 196.6
Own-account workers	633	764	31.2	29.4	+131	+ 20.6
Family workers	114	112	5.6	4.3	- 2	- 1.6
Not reported	39	24	1.9	0.9	- 15	- 37.4

a/ Including unemployed persons seeking their first jobs.

b/ Excluding armed forces and others not classified by industry.

already mentioned, expansion of the group of workers specialized in these functions is a mark of a rising level of economic development and a growing complexity of economic organization.

In the aspect of economic organization reflected by the status distribution of the labour force, the Turkish census data once again indicate considerable changes between 1955 and 1960, as shown in table 28. According to these data, the number of employees increased by 50 per cent and the number of employers increased nearly four-fold during this five-year period while the group of own-account workers made a much more modest gain in proportionate terms and there was a large decrease in the number of family workers. In interpreting these changes, it is necessary to bear in mind the point which was mentioned in section C, p. 73, that the status classification is highly sensitive to the variations of reporting practices as well as of definitions; and it is also important to look at changes in status distribution within industry and occupation groups of the labour force. In the case of Turkey, as the table shows, the most pronounced shifts in the status categories occurred in the agricultural sector, where the number of workers classified as employees tripled and the number classified as employers multiplied almost twenty-fold between the 1955 and 1960 census. If the figures are strictly comparable, they imply a pronounced increase in the employment of hired hands on Turkish farms and a corresponding decrease in the use of family members as unpaid helpers, but it is also possible that the data were affected significantly by a change in the accuracy of reporting of status or in the interpretation of the definitions of status categories. In the non-agricultural sector as a whole, the increases of employees and employers were proportionately smaller and there was no decrease in the number of family workers reported.

G. Cohort analysis of changes in the industry, occupation and status groups

The method of cohort analysis described in chapter I can be used in studying the processes and factors of change in industry, occupation and status groups of the labour force where data for such groups classified by age are available from two or more censuses taken at appropriate time intervals. This method will be illustrated with 1955 and 1960 Turkish census data for the male labour force in community and business services (a part of the industry division, "Services"), which increased by 36.7 per cent during the five-year interval. As table 29 shows, the number of males in this industry increased in every age group except that of forty to forty to forty-four years but the changes were extremely uneven in the different age groups and more than half of the increase occurred between the ages of thirty and thirty-nine. A very different and more understandable picture appears when the data are put in a cohort arrangement, as in table 30, comparing the number in each age group as of 1955 with the number in the corresponding group five years older in 1960. This arrangement shows high rates of growth for the cohorts in the youngest ages and progressively lower rates for those at higher age levels; it appears that most of the increase in the industry's male labour force came from the inflow of workers under the age of thirty-five, and indeed over 50 per cent in the age range fifteen to twenty-four.

Table 29

Male labour force in community and business services,
by age, Turkey, 1955 and 1960

Age (years)	1955	1960	Change, 1955-1960	
			Number	Percentage
Males, 15 and over	121 954	166 689	+44 735	+36.7
15-19	5 827	6 955	+ 1 128	+19.4
20-24	15 734	17 058	+ 1 324	+ 8.4
25-29	21 860	29 412	+ 7 552	+34.5
30-34	17 358	31 380	+14 022	+80.8
35-39	10 743	21 164	+10 421	+97.0
40-44	13 217	11 846	- 1 371	-10.4
45-49	9 902	14 575	+ 4 673	+47.2
50-54	9 110	11 096	+ 1 986	+21.8
55-59	6 230	8 752	+ 2 522	+40.5
60-64	4 833	6 491	+ 1 658	+34.3
65 and over	6 843	7 639	+ 796	+11.6
Not reported	297	321	+ 24	+ 8.1

Table 30

Changes in cohorts of the male labour force in the community
and business services industry, Turkey, 1955-1960

Age (years)		Number		Net change, 1955-1960	
1955	1960	1955	1960	Number	Percentage of 1955 number
10-14	15-19	-	6 955	+ 6 955	-
15-19	20-24	5 827	17 058	+11 231	+192.7
20-24	25-29	15 734	29 412	+13 678	+ 86.9
25-29	30-34	21 860	31 380	+ 9 520	+ 43.5
30-34	35-39	17 358	21 164	+ 3 806	+ 21.9
35-39	40-44	10 743	11 846	+ 1 103	+ 10.3
40-44	45-49	13 217	14 575	+ 1 358	+ 10.3
45-49	50-54	9 902	11 096	+ 1 194	+ 12.1
50-54	55-59	9 110	8 752	- 358	- 3.9
55-59	60-64	6 230	6 491	+ 261	+ 4.2
60 and over	65 and over	11 676	7 639	- 4 037	- 34.6
Not reported		297	321	+ 24	+ 8.1
Total, 15 and over		121 954	166 689	+44 735	+ 36.7

The components of change in the number of a given cohort in a given industry, occupation or status group as the cohort advances from one age level to the next can be outlined as follows:

1. Changes due to demographic factors:
 - (a) Attrition by mortality
 - (b) Net balance of immigration and emigration
2. Changes due to activity factors:
 - (a) Accessions to the labour force, that is, persons moving from the inactive population into the given industry, occupation or status group of the labour force
 - (b) Retirements, that is, persons withdrawing voluntarily or involuntarily into inactive status from the given industry, occupation or status group
 - (c) Activity shifts, that is, net gain or loss in the given industry, occupation or status group by shifts of workers to and from other groups of the labour force.

So far as possible, it is useful to analyze cohort changes in terms of these components as an aid in studying the factors which influence the dynamics of industry, occupation and status distributions and providing a basis for predictions.

A simple method for dividing cohort changes into those due to demographic factors and those due to activity factors is illustrated in table 31 with data for Turkish males in the community and business services industry. This is done by assuming that the net effect of the demographic factors was proportionately the same at each age level in the labour force of the given industry as it was in the total male population of Turkey. For the total male population, the net effects of demographic factors are measured (subject to the errors discussed below) by the cohort survival ratios shown in column 2 of table 31; these are derived from the 1955 and 1960 census data as illustrated in the following example for one cohort:

1. Male population aged 15-19 as reported in 1955 census: 1 246 288
2. Male population aged 20-24 as reported in 1960 census: 1 175 912
3. Cohort survival ratio (item 2 divided by item 1): 0.944

Multiplying the 1955 figures for males of various age groups in community and business services by these survival ratios, one obtains the expected numbers for 1960 which would have resulted from the operation of the demographic factors alone, as shown in column 3 of the table. Differences between the expected 1960 numbers and the reported 1955 numbers then represent estimated net effects of the demographic factors (column 5), while the differences between the expected and reported 1960 numbers are an estimate of the net effects of activity factors (column 7). (The percentages in column 6 only re-state in different form (comparable to column 8) the same relationship shown by the survival ratios in column 2.)

Table 31

Estimates of components of change in cohorts of male labour force in the community and business services industry, Turkey, 1955-1960

Age (years)	Reported number in 1955 (1)	Survival ratio (2)	Expected number in 1960 (column 1 x column 2) (3)	Reported number in 1960 (4)
1955				
15-19	-	-	-	6 955
20-24	5 827	0.944	5 501	17 058
25-29	15 734	0.956	15 042	29 412
30-34	21 860	1.071	23 412	31 380
35-39	17 358	1.000	17 358	21 164
40-44	10 743	0.974	10 464	11 846
45-49	13 217	0.915	12 094	14 575
50-54	9 902	1.044	10 338	11 096
55-59	9 110	0.840	7 652	8 752
60-64	6 230	1.127	7 021	6 491
65 and over	11 676	0.689	8 045	7 639
Not reported	297		297	321
Total, 15 and over	121 954		117 224	166 689

Table 31 (continued)

Age (years) 1955	Net change due to demographic factors		Net change due to activity factors		Percentage of 1955 number
	Number (column 1)	Percentage of 1955 number (6)	Number (column 4 - column 3)	Percentage of 1955 number (8)	
10-14	-	-	+ 6 955	-	-
15-19	- 326	- 5.6	+11 557	+198.3	+198.3
20-24	- 692	- 4.4	+14 370	+ 91.3	+ 91.3
25-29	+1 552	+ 7.1	+ 7 968	+ 36.4	+ 36.4
30-34	-	-	+ 3 806	+ 21.9	+ 21.9
35-39	- 279	- 2.6	+ 1 382	+ 12.9	+ 12.9
40-44	-1 123	- 8.5	+ 2 481	+ 18.7	+ 18.7
45-49	+ 436	+ 4.4	+ 7 58	+ 7.6	+ 7.6
50-54	-1 458	-16.0	+ 1 100	+ 12.1	+ 12.1
55-59	+ 791	+12.7	- 530	- 8.5	- 8.5
60 and over	-3 631	-31.1	- 406	- 3.5	- 3.5
Not reported	-	-	+ 24	+ 8.1	+ 8.1
Total, 15 and over	-4 730	- 3.9	+49 465	+ 40.6	+ 40.6

Such estimates are affected by several kinds of errors. First, it is inaccurate to assume that the estimated effects of the demographic factors in the given industry, occupation or status group are proportionate to their effects in the total male population. So far as mortality is concerned, the error on this account is unlikely to be very great in most circumstances. However, in a country where there is much immigration or emigration, there may be substantial errors in estimates of net migration for particular groups of the labour force obtained by this method, since the net migration may differ in direction as well as in amount for various industry, occupation and status categories. Turkey was a country of net emigration during the period under consideration, but the net emigration rate of workers attached to rapidly growing industries like the community and business services may have been lower than the rate in the male population as a whole, or there might even have been net immigration of workers attached to this industry.

Second, the estimates of the net effects of demographic factors are subject to other errors due to the inaccurate reporting of ages in the censuses and to under-enumeration or over-enumeration (if the proportionate amounts of under-enumeration or over-enumeration vary with age or differ considerably between the two censuses). The Turkish census statistics are affected to a great extent by such errors, as shown by the erratic variations in the cohort survival ratios at different age levels (column 2 of table 31). For a closed population, if the statistics were accurate, the survival ratios at all age levels would naturally be less than unity, as a reflection of the losses by mortality. In a population which experienced net emigration, the ratios would be further depressed to an extent which would vary from one age level to another, while with net immigration, ratios above unity might appear for certain age levels. In the Turkish statistics, the ratios at or above unity for certain age levels are patently erratic, and the main source of error is undoubtedly misreporting of ages. If this error affected the count of the male labour force of each age in the given industry in the same way and to the same extent as it affected the enumeration of the whole male population, the resulting distortion would be confined to the estimates of net changes in the industry cohorts due to demographic factors, while the estimates of net changes due to activity factors would be unaffected. Unfortunately, however, it cannot be expected that this should be the case, since the extent of age misreporting varies, with illiteracy for instance, the extent of which differs in industry, occupation and status groups of the labour force.

Third, the estimates of the net effects of activity factors are affected by errors and omissions in reporting the industry of labour force members in the two censuses, as well as in reporting individuals as economically active or not. Errors of this type are likely to vary considerably between groups of industry, occupation or status, but they may be largely cancelled out if the patterns of misreporting of economic activities are closely similar in the two censuses.

In view of these possibilities of error, estimates obtained by methods like the one illustrated here have to be interpreted with cautious reserve, especially where, as in Turkey, the age reports in the censuses are unreliable. It is reassuring to observe, though, in the present example that the estimated net changes due to activity factors, in the cohorts of the male labour force in business and community services, exhibit a fairly regular pattern. The net rates of gain diminish as age increases up to the two highest age levels, where the losses by retirement predominate, as one would expect.

Table 32

Estimated components of change in industry divisions of the male labour force, Panama, 1950-1960

Industry divisions	1950 number	1960 number	Net change	Components of change			Net industry shifts
				Labour force entries	Retirements	Deaths	
<u>A. Numbers in thousands</u>							
Total, all industries	201.8	250.0	+48.2	+79.9	- 9.0	-22.7	-
Agriculture, forestry ...	117.4	141.9	+24.5	+52.1	- 4.1	-12.9	-10.6
Non-agricultural industries and not reported ^{a/}	84.4	108.1	+23.7	+27.8	- 4.9	- 9.8	+10.6
Manufacturing	14.7	19.3	+ 4.6	+ 6.7	- 0.7	- 1.6	+ 0.2
Construction	10.0	14.7	+ 4.7	+ 3.5	- 0.4	- 1.1	+ 2.8
Electricity, gas ...	1.3	1.5	+ 0.2	+ 0.3	- 0.1	- 0.1	+ 0.1
Commerce	15.9	21.1	+ 5.2	+ 6.6	- 0.8	- 1.9	+ 1.3
Transport, storage ...	8.3	10.4	+ 2.1	+ 2.2	- 0.3	- 0.8	+ 1.0
Services	16.7	26.8	+10.1	+ 6.5	- 0.5	- 1.9	+ 6.0
Canal zone	18.3	15.3	- 3.0	+ 2.0	- 2.1	- 2.3	- 0.6
<u>B. 1950-1960 changes per 100 males in 1950 labour force</u>							
Total, all industries	-	-	+23.9	+39.6	- 4.5	-11.2	-
Agriculture, forestry ...	-	-	+20.9	+44.4	- 3.5	-11.0	- 9.0
Non-agricultural industries ^{a/} and not reported	-	-	+28.1	+32.9	- 5.8	-11.6	+12.6
Manufacturing	-	-	+31.3	+45.8	- 4.8	-10.8	+ 2.0
Construction	-	-	+47.0	+35.1	- 4.1	-11.3	+28.0
Electricity, gas ...	-	-	+15.0	+27.6	- 4.1	-11.0	+10.0
Commerce	-	-	+32.7	+41.4	- 5.0	-12.0	+ 8.0
Transport, storage ...	-	-	+25.3	+26.5	- 3.6	- 9.6	+12.0
Services	-	-	+60.0	+39.1	- 3.2	-13.3	+36.0
Canal Zone	-	-	-16.4	+11.2	-11.7	-12.8	- 3.3

Source: Adapted from Jaffe and Froomkin, op. cit., table 4.

^{a/} Including mining.

The analysis can be continued where the reliability of the data warrants it, by splitting the estimated net changes due to activity factors into their components: accessions to the labour force, retirements, and industry, occupation or status shifts. The methodology tends to be complicated and has to be adapted to the circumstances of the country and to the forms of the census tabulations. A complete illustration of the methods would involve too many details to be presented here. 19/ Table 32 shows, however, an example of the results obtained from such an analysis of the components of the 1950-1960 changes in industry divisions of the male labour force in Panama, carried out by A.J. Jaffe and J.N. Froomkin. 20/ The estimates imply, for example, that if there had been no movement of workers between industries, the agricultural sector of Panama's male labour force would have increased during the decade by about 35 thousand or 24 per cent of the initial number, through the net balance of entries into the labour force, retirements and deaths. The actual increase was reduced to about 25 thousand, or 21 per cent, as a result of the net shift of workers from agriculture into non-agricultural industries. Following the example of the authors of the Panamanian study, the results of such analysis can be applied to the study of such questions as the amount of net transfer of manpower from agriculture to the non-agricultural sector required to stabilize the number in agriculture or to hold its growth within given bounds under existing conditions of natural increase; the rate of expansion of non-agricultural employment required to absorb such a shift, and the rate of capital investment in the non-agricultural sector required to achieve such an expansion. The effects of potential changes in demographic factors (fertility, mortality, international migration) upon such measures of the problems encountered in achieving certain manpower policy objectives can also be analysed.

H. Age distribution of the labour force in the industry, occupation and status groups

In a number of countries analysts have at present only the results of a single census to work with. Of course, it is not possible in these circumstances to measure changes in the patterns of economic activities over a period of time, but some inferences about trends and dynamic factors can be drawn from the age distributions of industry, occupation and status groups shown by even a single census. Methods of such an analysis will be illustrated with industry data from the 1960 census of Ghana, shown in table 33.

19/ A detailed exposition of methods of such analysis applied to the census data of the United States of America will be found in Jaffe and Carleton, op. cit.

20/ Jaffe and Froomkin, op. cit.; A.J. Jaffe "Economic development and the growth of the male labor force of Panama, 1950-1960", American Journal of Economics and Sociology (Lancaster, Pa.), July 1966. See also Yoichi Okazaki, Manpower Mobility and Dynamics of Industrial Structure (Tokyo, Institute of Population Problems, 1965), Population Problem Studies No. 96 (In Japanese); Izaslaw Frenkel, "Wychodztwo zawodowe z rolnictwa polskiego w latach 1950-1960 i jego struktura demograficzna" (Occupational mobility of Polish agricultural workers between 1950 and 1960 and its demographic characteristics) Studia Demograficzne (Warsaw), No. 9, 1966.

Table 33

Age distribution of employed persons in industry divisions by sex,
Ghana, 1960

Sex and age (years)	All industries	Agriculture, forestry, hunting, fishing	Non-agricultural industries, total	Mining	Manufac- turing	Construction	Electricity, gas ...
Males, 15 and over	1 573 170 100.0	1 003 320 100.0	569 850 100.0	45 910 100.0	136 360 100.0	86 630 100.0	13 920 100.0
15-19	8.5	8.6	8.2	4.7	13.7	7.4	4.4
20-24	13.7	11.1	18.2	16.9	18.3	18.8	19.2
25-29	16.2	13.5	20.9	24.8	18.2	21.9	20.1
30-34	14.4	13.4	16.3	19.5	14.9	16.8	18.1
35-39	11.8	11.7	11.9	12.6	11.3	12.2	14.1
40-44	10.1	10.8	8.7	9.4	8.2	8.7	9.3
45-49	7.5	8.2	6.1	5.6	5.5	6.2	7.2
50-54	5.8	6.8	4.0	3.1	3.9	3.5	3.7
55-59	3.5	4.3	2.2	1.6	2.1	1.8	1.7
60-64	3.5	4.7	1.6	.9	1.6	1.6	1.0
65 and over	5.1	6.8	1.9	.9	2.4	1.1	1.1
Median age	34.0	36.4	30.8	30.9	30.0	30.6	31.8

Table 33 (continued)

Sex and age (years)	Commerce total	Petty trading ...	Other commerce	Transportation ...	Services
Males, 15 and over	95 520	50 780	44 740	67 500	124 010
	100.0	100.0	100.0	100.0	100.0
15-19	5.5	5.8	5.2	8.0	6.4
20-24	14.9	11.3	19.0	20.4	19.3
25-29	19.0	15.7	22.7	23.7	21.7
30-34	16.7	16.6	16.8	16.2	15.9
35-39	12.4	13.7	10.8	11.7	11.7
40-44	10.1	11.5	8.4	8.6	7.9
45-49	7.2	8.3	6.0	5.3	6.3
50-54	5.4	5.9	4.9	3.4	4.1
55-59	3.1	3.5	2.5	1.5	2.5
60-64	2.5	2.9	2.1	.7	1.7
65 and over	3.2	4.7	1.6	.5	2.4
Median age	33.2	35.2	31.0	29.6	30.8

Table 33 (continued)

Sex and age (years)	All industries	Agriculture, forestry, hunting, fishing	Non-agricultural industries, total	Mining	Manufacturing	Construction	Electricity, gas ...
Females, 15 and over	987 870	575 560	412 310	2 520	98 880	2 740	190
	100.0	100.0	100.0	100.0	100.0	100.0	-
15-19	11.4	10.4	12.9	27.4	17.9	22.3	-
20-24	15.9	14.1	18.3	22.6	23.4	22.3	-
25-29	15.6	14.8	16.7	18.6	18.1	15.7	-
30-34	14.0	13.6	14.5	9.5	12.8	9.1	-
35-39	10.4	10.6	10.3	6.0	8.8	8.4	-
40-44	9.5	10.1	8.6	4.0	6.1	6.2	-
45-49	6.4	6.8	5.7	4.0	3.6	5.8	-
50-54	5.7	6.4	4.8	2.8	3.0	4.7	-
55-59	3.4	3.9	2.8	1.2	1.9	.7	-
60-64	3.5	4.3	2.3	2.0	1.7	1.1	-
65 and over	4.2	5.0	3.2	2.0	2.6	3.6	-
Median age	32.6	33.9	30.7	25.0	27.4	26.8	-

Table 33 (continued)

Sex and age (years)	Commerce total	Petty trading ...	Other commerce	Transportation ...	Services
Females, 15 and over	275 980	273 120	2 860	920	31 080
	100.0	100.0	100.0	-	100.0
15-19	9.9	9.8	15.4	-	21.5
20-24	15.8	15.6	33.9	-	23.1
25-29	16.3	16.3	16.4	-	16.3
30-34	15.3	15.4	12.9	-	12.7
35-39	11.2	11.2	7.0	-	7.8
40-44	9.8	9.9	5.6	-	6.0
45-49	6.7	6.7	3.8	-	4.1
50-54	5.5	5.6	2.5	-	3.6
55-59	3.2	3.3	1.0	-	1.9
60-64	2.7	2.7	.4	-	1.3
65 and over	3.6	3.6	1.0	-	1.8
Median age	32.6	32.7	25.2	-	26.6

It is not the data for particular industry, occupation or status categories that are of primary interest in this kind of analysis, but rather the pattern of differences between age distributions of workers in different categories of activities, or between the distribution of one category and that of the whole labour force. In the Ghanaian data, the median age of workers of each sex in each industry division of the non-agricultural sector is lower than the median for agricultural workers. This observation implies that the non-agricultural industries have been gaining from an influx of young workers from agriculture. To be sure, such movements are not the only factor which may produce differences in age distribution between industry, occupation or status groups; another important factor is the variations in average ages of entry into and retirement from the different categories of economic activities. In agriculture, the average age of entry for males is ordinarily lower and the average age of retirement for males is higher than in the non-agricultural sector as a whole (an observation which corresponds to the typical pattern of urban-rural differences in male age-specific activity rates mentioned in the preceding chapter). On this account, one would expect a lower rather than a higher median age of male agricultural workers as compared with males in other industries, if there were no net movement out of agriculture.

The median age is a rather gross measure, and since a very detailed age classification has been provided in the Ghanaian census, it is useful to take a closer look at the differences. Comparing the per cent distributions of males in the agricultural and non-agricultural sectors, one finds that the percentages of the three five-year age groups between twenty and thirty-four years are higher in the non-agricultural sector, the percentages for the age group thirty-five to thirty-nine are the same, and those for all other age groups are lower in the non-agricultural than in the agricultural sector. Focussing attention on the male age groups between twenty and thirty-four and considering the figures for the separate industry divisions within the non-agricultural sector, one sees that in every case they are higher than the percentages for the agricultural labour force. Clearly it is in the age span of twenty to thirty-four years that the shift of male workers from agricultural to non-agricultural employments has its greatest effect and the analyst can get some indications of the size of this movement from the comparison of the age distributions. Also noteworthy is the comparatively small proportion of males of fifty years of age and over in non-agricultural industries. This might be due partly to a reverse movement of older men back to agriculture, as well as to the swollen proportion of young men in the non-agricultural labour force which has resulted from the inflow of workers from agriculture. If corresponding data from earlier censuses were available, it might be possible to estimate (by analysis of cohort changes along the lines indicated in the preceding sections) the net gain or loss in the non-agricultural male labour force by inter-industry transfers at each age level, and to see how much the age distributions have been affected by this and by other factors. Alternatively, the question might be clarified by sample survey inquiries into the work histories of individuals. The results of studies of migration between rural and urban areas according to sex and age are also pertinent to the interpretation of the data.

The value of such information is obvious. When assuming the task of expanding the labour force in a particular industry, those concerned must ascertain whether they may reasonably expect most of the workers presently engaged in the industry to remain there as they grow older (allowing for deaths

and a certain number of transfers) or whether they must count on bringing in new, young workers in sufficient numbers to replace the current supply as well as to expand it. Conversely, for industries in which there is much underemployment or unemployment and in which it is considered desirable to reduce the labour supply, or at least restrict it to a minimum growth rate, it must be determined whether the return flow of older workers constitutes a continuing problem or whether those who have left remain away.

To return to the Ghanaian example, the differences in age concentration for males among the major industry groups may be conveniently summarized in a table such as the following:

Percentages of males aged twenty to thirty-four and
fifty years and over among all males employed in
specified industries, Ghana, 1960

	<u>Percentage aged 20-34</u>	<u>Percentage aged 50 and over</u>
All industries	44.3	17.9
Agriculture ...	38.0	22.6
Non-agricultural industries	55.4	9.7
Mining	61.2	6.5
Manufacturing	51.4	10.0
Construction	57.6	8.0
Electricity, gas ...	57.4	7.5
Commerce, total ...	50.6	14.2
Petty trading ...	43.6	16.9
Other commerce	58.5	11.1
Transportation	60.3	6.1
Services	56.9	10.7

The contrast between agricultural and non-agricultural industries is sharply emphasized here. The Ghanaian census gives the data by age for about ninety industry categories, permitting the analyst to get a close view of industry segments that are of special interest. Two sub-groups of commerce have been distinguished in the above table to help to confirm the hypothesis that a difference exists between the traditional and the newer industries. The category of petty trading, hawking, and peddling represents a long established activity in Ghana, and, as the table indicates, the age concentration for males employed here is closer to that in agriculture than in any other non-agricultural divisions. When the influence of this traditional activity on the percentages for all males in commerce is removed, the group of those dealing in other commerce is seen to have age concentrations much more in line with those prevailing in other non-agricultural industries.

Because of the relatively great detail available in the tabulations of the Ghanaian census, the analyst can push his examination of the data quite far, and many valuable results can be obtained by doing so. Thus, within the service division, which relies as a whole on a relatively young group of male workers, there are sharp differences between the various sub-categories. For example, some 75 per cent of the males employed in education services are below the age of thirty-five, whereas only 44 per cent of those in medical and other health services are in this age range. The analyst's own knowledge of existing conditions in the country and of biases and errors in the census data can be very helpful to him in evaluating such differences. In this instance, the inclusion of native healing enterprises in the medical services category undoubtedly raises the age level; it is also possible that some persons who were in fact students may have been erroneously included among the employed in education services. Nevertheless, it is highly probable that even after such factors are taken into consideration, a residual difference remains, reflecting the fact that under present conditions of organization, workers are drawn into education services at an earlier age than into the medical and health sectors. The implication with respect to plans for the development of these sectors is clear.

I. Types of activity of workers in various age groups

In the preceding sections, we were concerned with the age distributions of persons in various types of economic activities. The same data may be examined from another point of view, to compare the industry, occupation or status distributions of persons in different age groups.

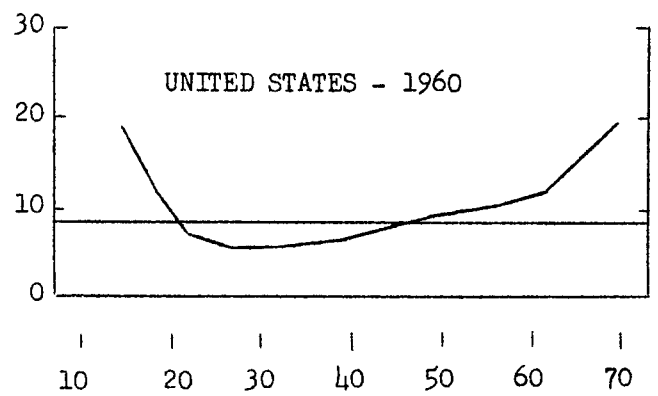
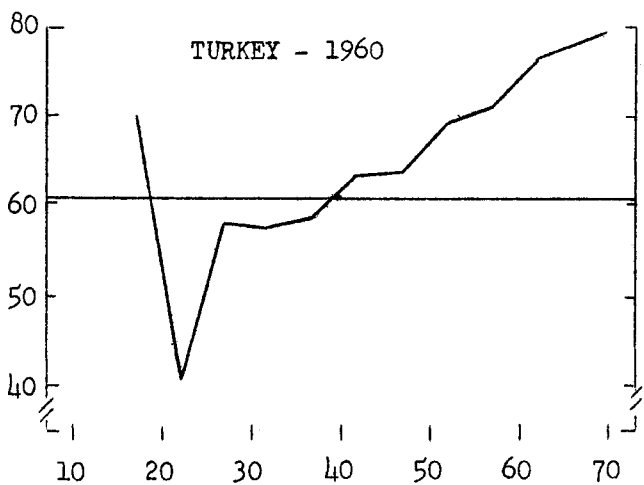
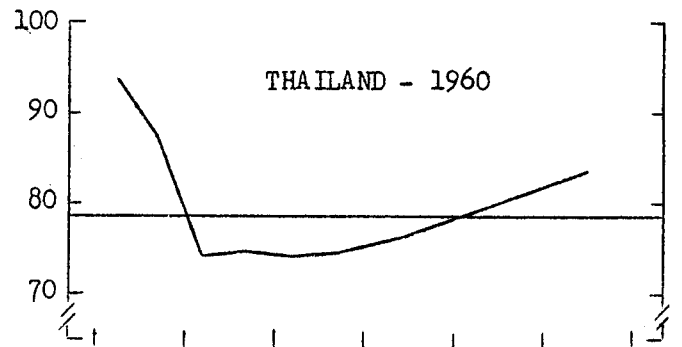
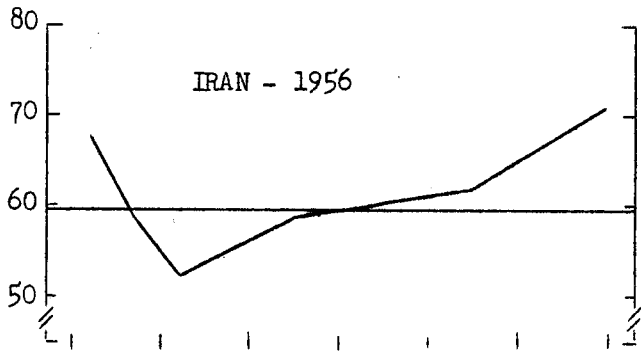
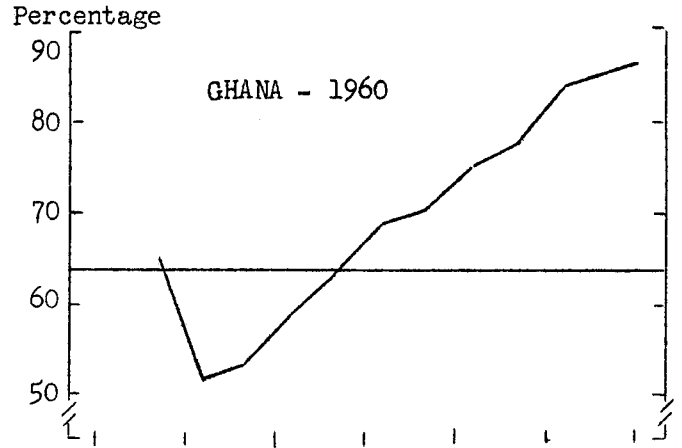
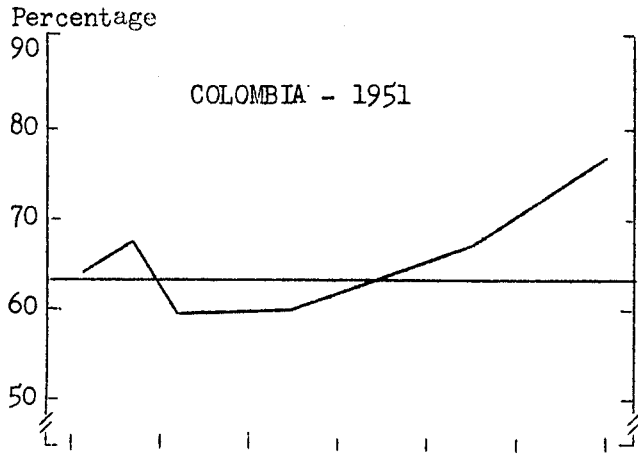
Figure IV presents a series of "age profiles" for the male labour force in agriculture in five countries where agriculture is the dominant sector and in one country, the United States of America, where agriculture now engages less than 10 per cent of the male labour force. These profiles show the proportion of all economically active (or employed) males in each age group who are engaged in agriculture. The horizontal line through each graph indicates the comparable proportion for males of all ages.

The similarity of the curves for all the countries is quite striking. The only major deviation from the general U-shape occurs in the youngest age group (ten to fourteen years) of males in Colombia, where it is apparently customary for a substantial number of boys to enter domestic service.

The converse of the fact indicated by this chart is, of course, that in general, the young and middle-aged groups of adult males are most likely to take up non-agricultural pursuits, as indicated for Ghana and Turkey by the analysis described above. Looking at the curves upside down, one sees the age profiles for those in non-agricultural industries and the "over representation" of the youngest and oldest workers in agriculture becomes their "under representation" in non-agricultural industries. The presentation of data in this format, either in a table or a chart, will often draw attention to the way in which the available labour supply responds to demand, and, particularly when time-series of these data are available, may give considerable insight into the dynamics of change.

Figure IV

Percentage of economically active males in each age group
in agricultural industries, selected countries



Age (years)

Age (years)

J. Interrelations of industry and occupation

As noted previously, where the forms of economic organization are relatively simple the relation between occupation and industry is often so close that the two classifications largely reflect each other. This is particularly the case where agriculture dominates the economy, since even in the most highly developed economies the differentiation of occupations within agriculture has not progressed far. Much useful information can, however, be derived from the analysis of a cross tabulation of industry by occupation in the more developed sectors of the economy or in the more developed regions of a nation.

Table 34 presents the cross-classification of major occupation group by major industry group for Atlantico, the most urban of the departamentos of Colombia in 1951. Such a table is valuable as a sort of input-output matrix, showing how demands for various occupational skills may be influenced by changes in demand for labour in given groups of industries, or, conversely, how changes of labour supply in certain occupations may affect the growth of manpower in certain industries. In order to bring out these interrelations, it is useful to calculate the per cent distributions both by the occupation of workers in each industry group and by the industry of those in each occupation group, as illustrated in the table. In Atlantico, for example, the proportion of professional and technical workers (5.0 per cent) in the industry division of electricity, gas, water and sanitary services is higher than that for any other division except that of services; yet the electric, gas and related industries use only one-half of one per cent of all professional and technical workers in Atlantico, so that even if employment in this industry division doubled, the impact on the demands for professional and technical personnel in the area would be slight. On the other hand, although only 1.6 per cent of manufacturing workers are in the professional and technical category, manufacturing industries employ 10 per cent of all professional and technical workers; a sizeable expansion of manufacturing under these conditions would have a very important effect on the demand for professional and technical workers.

Another example of the uses of these data is provided by the percentages for clerical workers. A wide industrial distribution of such workers is characteristic of highly developed economies; in the United States of America in 1960, 12 per cent of all workers in manufacturing industries were in clerical occupations and 22 per cent of all clerical workers were employed in manufacturing establishments. The data for Atlantico indicate that such a development is well under way there. Clerical workers form a significant proportion of workers in several industry divisions, as the percentages in part B of the table indicate, and they also are distributed fairly widely among most of the largest industrial divisions, as shown in part C. The analyst's knowledge of local conditions must, of course, be brought to bear in interpreting the data. For example, the high proportion of workers in the mining industry who are in clerical occupations might reflect the location in Atlantico of home offices of mining companies which operate also in other areas. But even the crude data warrant some confidence in the conclusion that in whatever direction Atlantico's non-agricultural sector may expand - whether it becomes increasingly a manufacturing or a commercial area, a transportation and communication centre, or an area providing services to the rest of the country - the demand for clerical workers will increase.

Table 34

Cross-classification of the labour force by occupation and industry in the departamento of Atlántico, Colombia, 1951

Occupation groups	A. Absolute numbers						
	All industries	Agriculture, forestry, hunting and fishing	Mining	Manufacturing	Construction	Electricity, gas, water and sanitary services	
Total labour force	134 938	27 419	1 052	30 601	7 813	519	
Professional, technical and related workers	4 814	10	26	476	102	26	
Executives, administrators and managerial workers	13 896	161	75	1 160	69	38	
Clerical and related workers	7 866	39	165	1 318	75	85	
Sales and related workers	6 084	20	23	588	---	---	
Farmers, fishermen, hunters, loggers and related workers	27 552	26 866	---	483	---	1	
Miners, quarrymen, and related workers	324	---	294	9	10	1	
Transport workers	6 388	21	107	525	78	17	
Craftsmen, production process and related workers	38 267	98	231	24 380	6 626	288	
Manual and day labour (not elsewhere classified)	5 256	30	65	418	486	25	
Service workers	16 311	59	10	169	14	19	
Other and not reported	8 180	115	56	1 075	353	19	

Table 34 (continued)

A. Absolute numbers

Occupation groups	Commerce	Transport and communications	Services	Other and not reported
Total labour force	18 360	13 398	28 625	7 151
Professional, technical and related workers	301	281	3 506	86
Executives, administrators and managerial workers	8 659	487	1 996	1 251
Clerical and related workers	1 629	1 718	1 605	1 232
Sales and related workers	4 510	62	319	562
Farmers, fishermen, hunters, loggers and related workers	131	38	---	33
Miners, quarrymen and related workers	4	4	---	2
Transport workers	167	4 730	624	119
Craftsmen, production process and related workers	1 861	1 990	1 634	1 159
Manual and day labour (not elsewhere classified)	166	3 250	695	121
Service workers	217	210	15 481	132
Other and not reported	715	628	2 765	2 454

Table 34 (continued)

B. Percentage distributions by occupations

Occupation groups	Agriculture, forestry, hunting and fishing							Manufacturing	Construction	Electricity, gas, water and sanitary services
	All industries	100.0	100.0	Mining	100.0	100.0	100.0			
Total labour force	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
Professional, technical and related workers	3.6	0.0	0.0	2.5	1.6	1.3	5.0			
Executives, administrators and managerial workers	10.3	0.6	0.6	7.1	3.8	0.9	7.3			
Clerical and related workers	5.8	0.1	0.1	15.7	4.3	1.0	16.4			
Sales and related workers	4.5	0.1	0.1	2.2	1.9	---	---			
Farmers, fishermen, hunters, loggers and related workers	20.4	98.0	98.0	---	1.6	---	0.2			
Miners, quarrymen and related workers	0.2	---	---	27.9	0.0	0.1	0.2			
Transport workers	4.7	0.1	0.1	10.2	1.7	1.0	3.3			
Craftsmen, production process and related workers	28.4	0.4	0.4	22.0	79.7	84.8	55.5			
Manual and day labour (not elsewhere classified)	3.9	0.1	0.1	6.2	1.4	6.2	4.8			
Service workers	12.1	0.2	0.2	1.0	0.6	0.2	3.7			
Other and not reported	6.1	0.4	0.4	5.3	3.5	4.5	3.7			

Table 34 (continued)

B. Percentage distributions by occupation

Occupation groups	Commerce	Transport and communications	Services	Other and not reported
Total labour force	100.0	100.0	100.0	100.0
Professional, technical and related workers	1.6	2.1	12.2	1.2
Executives, administrators and managerial workers	47.2	3.6	7.0	17.5
Clerical and related workers	8.9	12.8	5.6	17.2
Sales and related workers	24.6	0.5	1.1	7.9
Farmers, fishermen, hunters, loggers and related workers	0.7	0.3	---	0.5
Miners, quarrymen and related workers	0.0	0.0	---	0.0
Transport workers	0.9	35.3	2.2	1.7
Craftsmen, production process and related workers	10.1	14.9	5.7	16.2
Manual and day labour (not elsewhere classified)	0.9	24.3	2.4	1.7
Service workers	1.2	1.6	54.1	1.8
Other and not reported	3.9	4.7	9.7	34.3

Table 34 (continued)

C. Percentage distributions by industry

Occupation groups	All industries	Agriculture, forestry, hunting and fishing	Mining	Manufacturing	Construction	Electricity, gas, water and sanitary services
Total labour force	100.0	20.3	0.8	22.7	5.8	0.4
Professional, technical and related workers	100.0	0.2	0.5	9.9	2.1	0.5
Executives, administrators and managerial workers	100.0	1.2	0.5	8.3	0.5	0.3
Clerical and related workers	100.0	0.5	2.1	16.8	1.0	1.1
Sales and related workers	100.0	0.3	0.4	9.7	---	---
Farmers, fishermen, hunters, loggers and related workers	100.0	97.5	---	1.8	---	---
Miners, quarrymen and related workers	100.0	---	90.7	2.8	3.1	0.3
Transport workers	100.0	0.3	1.7	8.2	1.2	0.3
Craftsmen, production process and related workers	100.0	0.3	0.6	63.7	17.3	0.8
Manual and day labour (not elsewhere classified)	100.0	0.6	1.2	8.0	9.2	0.5
Service workers	100.0	0.4	0.1	1.0	0.1	0.1

Table 34 (continued)

C. Percentage distributions by industry

Occupation groups	Commerce	Transport and communications	Services	Other and not reported
Total labour force	13.6	9.9	21.2	5.3
Professional, technical and related workers	6.3	5.8	72.8	1.8
Executives, administrators and managerial workers	62.3	3.5	14.4	9.0
Clerical and related workers	20.7	21.8	20.4	15.7
Sales and related workers	74.1	1.0	5.2	9.2
Farmers, fishermen, hunters, loggers and related workers	0.5	0.1	---	0.1
Miners, quarrymen and related workers	1.2	1.2	---	0.6
Transport workers	2.6	74.0	9.8	1.9
Craftsmen, production process and related workers	4.9	5.2	4.3	3.0
Manual and day labour (not elsewhere classified)	3.2	61.8	13.2	2.3
Service workers	1.3	1.3	94.9	0.8

When the data are given only in terms of broad industry and occupation groups, as in table 34, the inferences which can be drawn from them are necessarily rather general and must be hedged with cautions. The more detailed the occupation and industry classifications, the more useful the data can be in assessing the implications of economic changes and measures of policy. The cross tabulation of a detailed industry classification with a detailed occupation classification is costly and can hardly be provided for many geographic subdivisions of a country; but much valuable information can be provided by less expensive tabulations such as one showing major occupation groups in combination with a detailed or intermediate industry classification and/or another showing major industry groups in combination with a detailed or intermediate occupation classification.

It is obvious that the occupational structures of different manufacturing industries will vary widely according to the nature of their products. Similarly, the ratio of white-collar to blue-collar workers in the petroleum extraction industry differs substantially from the ratio of these two categories in most other mining operations, and the several sectors of the transport and communications group will make quite disparate demands on the labour supply. Where the census tabulations do not provide data in sufficient detail for studying specific questions (such as the effect of establishing new plants to make certain kinds of products in a certain area), the analyst may be able to find supplementary information in reports of studies on particular industries where the occupational distribution of employees in selected establishments has been examined in detail. But the population census data, even if they are tabulated only in broad industry and occupation groups, are invaluable for a general survey of the interrelations of occupation and industry in the economy as a whole and as an aid to the studying of the ramifications of changes in particular sectors.

The utility of such data is greatly enhanced when a time-series of occupation-industry cross tabulations at successive census dates has been built up. Long-range trends of changing occupational distributions within various industry groups can then be studied and occupational projections can be made, taking these trends into account. From time-series of such tabulations, it is also possible to derive estimates of the components of change in various occupation groups between census dates, distinguishing between changes which can be attributed to the changing industry distribution of manpower and those which are due to changing distribution of occupations within industry categories. Such component estimates are derived by standardization in the manner illustrated by table 35, which presents the results of a study of the census statistics of the United States of America for employed workers in 1950 and 1960. 21/

21/ Details of the method used in this study are explained in: K.S. Gnanasekaran, Interrelations between Industrial and Occupational Changes in Manpower - United States, 1950-1960 (Philadelphia, University of Pennsylvania, Population Studies Center, 1966), Analytical and Technical Report No. 6. As illustrated in this study, the standardization procedure also provides estimates of changes in given occupation groups attributable to changes in each division of the industry classification, as well as the net effects of the changes in the industry distribution as a whole. However, a problem of dealing with interaction effects is encountered here, as in other applications of standardization to analyses of components of change. This problem is not dealt with in the study cited. See also Canada, Department of Labor, Economics and Research Branch, Noah H. Meltz, Changes in the Occupational Composition of the Canadian Labor Force, 1931-1961 (Ottawa, 1965), Occasional Paper No. 2.

Table 35

Components of occupational changes in employment, United States of America, 1950-1960

Major occupational group	Number employed		1960 Total		1960 Industry total weighted by 1950 occupation pattern
	1950	1960	weighted by 1950 industry and occupation patterns	(Number in thousands)	
	1	2	3	4	
<u>A. Gaining occupations</u>	29 702	39 091	34 019	37 149	
Professional, technical and related workers	4 987	7 609	5 712	7 228	
Clerical and related workers	7 047	9 824	8 071	8 759	
Service workers including private household workers	5 784	7 623	6 625	7 170	
Sales workers	3 959	4 875	4 534	4 751	
Craftsmen, foremen and related workers	7 925	9 160	9 077	9 241	
<u>B. Losing occupations</u>	26 732	25 547	30 618	27 483	
Farmers and farm managers	4 368	2 570	5 003	2 765	
Labourers including farm labourers and foremen	5 931	4 782	6 793	5 529	
Operatives and related workers	11 329	12 523	12 976	13 157	
Managers, officials and proprietors other than of farms	5 104	5 672	5 846	6 032	
All occupations	56 435	64 639	64 639	64 639	

Table 35 (continued)

Major occupational group	All factors	Changes due to			Occupation mix effect
		Employment growth	Industry effect	Occupation mix effect	
	5=2-1	6=3-1	7=4-3	8=2-4	
<u>A. Gaining occupations</u>	9 389	4 317	3 130	1 942	
Professional, technical and related workers	2 622	725	1 516	381	
Clerical and related workers	2 777	1 024	688	1 065	
Service workers including private household workers	1 839	841	545	453	
Sales workers	916	575	217	124	
Craftsmen, foremen and related workers	1 235	1 152	164	-81	
<u>B. Losing occupations</u>	-1 185	3 886	-3 135	-1 936	
Farmers and farm managers	-1 798	635	-2 238	-195	
Labourers including farm labourers and foremen	-1 149	862	-1 264	-747	
Operatives and related workers	1 194	1 647	181	-634	
Managers, officials and proprietors other than of farms	568	742	186	-360	
All occupations	8 204	8 204	..	..

Source: Gnanasekaran, op. cit., table 4, p. 13.

K. Interrelations of status with industry and occupation

Cross-tabulations of status with industry and with occupation describe the organizational framework within which the various types of economic activities take place. Analytical methods analogous to those illustrated in the preceding section are equally applicable to the study of status-industry and status-occupation interrelations, where the census provides data in those forms. Detailed illustration of such analyses is superfluous, but it may be useful to give some examples of the kinds of information which status-industry and status-occupation cross tabulations provide and their relevance to studies of the manpower problems of developing countries.

Table 36 presents the cross-classification by status and major occupation groups of employed persons in Iran in 1956. The importance of family enterprises in the economy of Iran is immediately evident - over half the employed persons are in the two categories, own-account workers and unpaid family workers. Not only persons in agricultural occupations but also those in sales occupations are likely to have this sort of attachment to the labour force, although in the latter occupations, unpaid family workers play a less important role.

Some significant differences between the distribution of males and that of females are apparent. The relatively high proportion of female craftsmen and production process workers who are own-account workers reflects the importance of the manufacture of hand-made rugs and other cottage industries in the Iranian economy. More of the male workers in this occupation group work as employees in government or privately operated industries. The predominance of own-account and family workers and the close relationship between occupation and industry which was mentioned previously are both typical of relatively simple forms of economic organization. For example, in the present instance one would expect the numbers in the agricultural and commercial industries to bear quite a close relationship to those in the respective occupation groups of farming, forestry, hunting and fishing, and sales and related occupations.

The second bank of data in table 36 shows the occupational distribution of workers in the several status groups. As one would expect, the vast majority of unpaid family workers are in farm occupations, and these are also the occupations of the majority of employees working for private employers, but the groups, craftsmen and production process workers and service occupations also engage sizeable proportions of employees in private enterprise.

Table 37 presents the status classification of workers in industry divisions, and selected subgroups within them, for Thailand in 1960. ^{22/} The subgroups have been selected to indicate the diversity in the organization of activity that can occur within industry divisions and to emphasize the usefulness of a more detailed analysis than can be presented in a manual such as the present one. The importance of family work in the agricultural sector as a field of economic activity for women in Thailand is immediately apparent. Among non-agricultural industries the category in which the greatest number of women is found is that of retail trade,

^{22/} It is useful to consider the distributions of workers in the several status groups by industry as well, after the fashion shown in table 36, with regard to the occupation status cross-classification.

Table 36

Cross-classification of the labour force by status and occupation in Iran, by sex, 1956

A. Status distribution of occupation groups

Sex and major occupation groups	Number (thousands)	Private employees	Government employees	Employers (percentage)	Own-account workers	Unpaid family workers	Not reported
All occupations	5 908	38.0	7.6	1.2	41.2	10.1	1.9
Both sexes	5 334	36.4	7.9	1.2	43.2	9.2	2.1
Males	573	53.3	5.4	0.6	22.8	17.8	0.1
Professional, technical and related occupations	94	16.6	58.1	0.6	24.1	0.1	0.4
Both sexes	76	16.7	54.8	0.7	27.3	0.1	0.3
Males	18	16.2	72.2	0.2	10.8	0.1	0.5
Managerial and administrative, clerical and related occupations	183	6.8	80.2	1.8	9.3	1.8	0.1
Both sexes	175	6.5	80.0	1.8	9.6	1.9	0.1
Males	8	13.2	84.0	0.2	2.2	0.1	0.3
Sales and related occupations	345	17.6	0.6	2.8	76.5	2.2	0.3
Both sexes	340	17.3	0.6	2.8	76.8	2.2	0.3
Males	5	36.4	1.1	2.2	56.5	3.6	0.2
Farming, forestry, hunting and fishing occupations	3 281	27.4	0.3	1.0	54.4	16.5	0.2
Both sexes	3 124	27.6	0.3	1.0	56.2	14.6	0.3
Males	157	24.4	0.8	1.1	20.2	53.4	-

Table 36 (continued)

A. Status distribution of occupation groups (continued)

Sex and major occupation groups	Number (thousands)	Private employees	Government employees	Employers (percentage)	Own-account workers	Unpaid family workers	Not reported
Mining, quarrying and well drilling occupations							
Both sexes	54	82.9	9.3	1.0	6.3	0.4	0.1
Males	53	82.8	9.3	1.0	6.3	0.4	0.1
Females	1	85.6	8.0	0.8	4.9	0.8	-
Transport occupations							
Both sexes	139	53.2	16.6	0.7	26.4	1.5	1.6
Males	137	53.1	16.6	0.7	26.6	1.5	1.6
Females	2	65.7	16.8	0.2	16.5	0.8	0.1
Craftsmen, production process and related occupations							
Both sexes	1 142	64.8	7.8	1.4	22.8	2.6	0.5
Males	872	67.5	9.5	1.7	19.2	1.4	0.6
Females	270	56.1	2.4	0.6	34.3	6.5	-
Service occupations							
Both sexes	455	73.6	14.7	0.7	9.5	1.4	0.2
Males	346	66.5	18.5	0.8	12.1	1.7	0.3
Females	109	96.1	2.5	0.1	1.0	0.4	-
Armed services (regular and occupations unidentifiable or not reported)							
Both sexes	214	29.2	24.1	0.2	0.8	1.8	43.8
Males	210	28.2	24.4	0.2	0.8	1.8	44.5
Females	4	81.8	9.4	0.2	1.5	0.2	7.0

Table 36 (continued)

B. Occupation distribution of status groups

Sex and status	Number (thousands)	Professional, technical and related occupations	Managerial, administrative, clerical and related occupations (percentage)	Sales and related occupations	Farming, forestry, hunting and fishing occupations
All status groups					
Both sexes	5 908	1.6	3.1	5.8	55.5
Males	5 334	1.4	3.3	6.4	58.6
Females	573	3.2	1.3	0.9	27.4
Private employees					
Both sexes	69	0.9	4.7	14.1	49.5
Males	65	0.9	5.0	14.7	49.6
Females	4	1.0	0.4	3.1	46.4
Government employees					
Both sexes	2 435	0.9	0.7	10.8	73.3
Males	2 304	0.9	0.7	11.3	76.1
Females	131	1.5	0.1	2.2	24.3
Employers					
Both sexes	451	12.2	32.5	0.5	2.5
Males	420	9.9	33.4	0.5	2.4
Females	31	42.6	20.6	0.2	4.0
Own-account workers					
Both sexes	2 246	0.7	0.6	2.7	40.1
Males	1 940	0.7	0.6	3.0	44.4
Females	305	1.0	0.3	0.6	12.6
Unpaid family workers					
Both sexes	594	-	0.6	1.3	91.0
Males	492	-	0.7	1.5	92.9
Females	102	-	-	0.2	82.1

Table 36 (continued)

B. Occupation distribution of status groups (continued)

Sex and status	Mining, quarrying and well drilling occupations	Transport occupations	Craftsmen, production process and related occupations (percentage)	Service occupations	Armed forces and not reported
All status groups					
Both sexes	0.9	2.4	19.3	7.7	3.6
Males	1.0	2.6	16.4	6.5	3.9
Females	0.2	0.3	47.0	19.0	0.7
Private employees					
Both sexes	0.8	1.3	23.7	4.4	0.7
Males	0.8	1.4	22.4	4.5	0.8
Females	0.3	0.1	46.6	1.8	0.2
Government employees					
Both sexes	0.1	1.5	10.7	1.8	0.1
Males	0.1	1.6	7.3	1.8	0.1
Females	-	0.2	70.7	0.8	-
Employers					
Both sexes	1.1	5.1	19.8	14.8	11.5
Males	1.2	5.4	19.7	15.3	12.2
Females	0.3	1.1	21.2	8.7	1.2
Own-account workers					
Both sexes	2.0	3.3	33.0	14.9	2.8
Males	2.3	3.7	30.4	11.9	3.1
Females	0.4	0.4	49.5	34.2	1.1
Unpaid family workers					
Both sexes	-	0.3	5.1	1.1	0.6
Males	-	0.4	2.5	1.2	0.8
Females	-	-	17.2	0.4	-

Table 37

Status distribution of employed persons in industry groups, by sex,
Thailand, 1960

A. Males

Industry	Number (thousands)	Private employees	Government employees	Employers (percentage)	Own-account workers	Unpaid family workers	Not reported
All industries	7 107	10.9	6.0	0.5	47.0	35.4	0.2
Agriculture, forestry, hunting and fishing	5 576	4.1	-	0.3	52.8	42.8	-
Mining and quarrying	22	72.1	2.4	1.4	15.5	8.6	-
Metal mining	13	92.4	0.9	1.0	4.3	1.4	-
Manufacturing	294	55.8	2.9	2.5	29.8	8.9	-
Rice mills	27	78.0	0.1	4.8	13.0	4.1	-
Manufacture of wearing apparel, excluding foot-wear	24	31.1	1.0	3.2	51.6	13.1	-
Manufacture of wood and cork, excluding manufacture of furniture	49	44.7	0.5	1.1	46.2	7.5	-
Manufacture of metal products excluding machinery and transport equipment	13	47.6	1.1	3.2	38.7	9.3	-
Manufacture of machinery excluding electrical and transport equipment	5	77.2	1.2	5.6	12.1	4.0	0.1
Manufacture and repair of motor vehicles and bicycles	21	63.3	2.9	2.5	25.9	5.4	-
Construction	62	44.9	36.6	1.5	15.5	1.5	-
Electricity, water and sanitary service	15	18.9	77.0	0.4	3.2	0.5	-
Commerce	363	20.8	0.5	2.0	54.9	21.8	-
Retail trade	321	12.6	0.1	1.9	61.0	24.5	-
Other	42	83.0	4.1	3.1	8.1	1.9	-
Transportation, communication Railway and road passenger transport	157	41.0	23.6	1.0	31.5	2.8	-
Road transport (not elsewhere classified)	42	39.5	52.9	0.9	5.9	0.8	-
Services	71	41.6	0.8	1.1	53.8	2.7	-
Government services	458	12.6	73.7	0.6	10.4	2.6	-
Educational services	245	-	100.0	-	-	-	-
Restaurants and other drinking and eating places	95	12.1	86.8	0.3	0.6	0.1	-
Barber and beauty shops	42	20.8	-	2.6	54.8	21.8	-
Activity not adequately described or unknown	16	32.2	0.5	3.0	60.0	4.3	0.1
	159	87.6	0.5	-	0.9	0.2	10.7

Table 37 (continued)

B. Females

Industry	Number (thousands)	Private employees	Government employees	Employers (Percentage)	Own-account workers	Unpaid family workers	Not reported
All industries	6 665	5.5	1.0	0.1	11.1	82.1	0.2
Agriculture, forestry, hunting and fishing	5 758	2.1	-	0.1	8.6	89.2	-
Mining and quarrying	7	31.5	0.4	0.4	17.5	50.1	-
Metal mining	2	30.2	0.7	0.5	45.3	23.4	-
Manufacturing	177	34.7	1.6	0.6	32.0	30.0	-
Rice mills	6	56.2	0.1	2.8	9.0	31.9	-
Manufacture of wearing apparel excluding footwear	56	21.9	0.3	0.6	56.6	20.6	-
Manufacture of wood and cork, excluding manufacture of furniture	10	11.9	-	0.1	39.2	48.7	-
Manufacture of metal products excluding machinery and transport equipment	2	39.8	0.5	1.1	10.8	47.8	-
Manufacture of machinery excluding electrical and transport equipment	...	57.5	-	10.7	7.7	23.8	-
Manufacture and repair of motor vehicles and bicycles	1	30.0	3.3	4.2	11.6	50.9	-
Construction	6	51.2	32.0	0.3	5.8	10.6	0.1
Electricity, water and sanitary service	1	19.6	72.7	0.3	3.0	4.4	-
Commerce	417	4.4	0.1	0.3	38.7	56.4	-
Retail trade	407	2.9	-	0.3	39.5	57.4	-
Other	10	71.0	5.1	1.6	7.5	14.8	-
Transportation, communication Railway and road passenger transport	9	31.3	21.7	0.8	13.4	32.9	-
Road transport (not elsewhere classified)	2	45.1	49.4	1.1	2.2	2.2	-
Services	1	60.4	1.2	2.4	18.7	17.2	-
Government services	197	38.7	29.2	0.6	13.5	18.0	-
Educational services	13	-	100.0	-	-	-	-
Restaurants and other drinking and eating places	46	25.5	72.5	0.6	0.8	0.4	0.4
Barber and beauty shops	44	8.2	-	0.6	23.8	67.4	-
Activity not adequately described or unknown	11	36.3	0.1	4.1	47.2	12.2	0.1
	93	86.9	0.1	-	0.5	0.8	11.7

and here again most of the women are family workers. These two industry groups also have high proportions of male family workers, but the dominant status category for both of them in the case of males is that of own-account workers, the category that includes heads of enterprises staffed by family workers. In other sectors within the commerce division, the vast majority of workers are employees, indicating a very different type of organization of these activities.

A similar diversity characterizes the several divisions of manufacturing shown. The manufacture of wearing apparel is carried on largely on a family or individual basis, whereas the production of machinery and the processing of rice are in general organized on what may be called a more modern basis.

L. Other variables related to the industry,
occupation and status distributions

Although relationships with other demographic, economic and social variables are of primary interest in studies of industry, occupation and status characteristics of the labour force, the kinds of relationships that are worth investigating are too numerous and the methods of analysis too diverse to be treated here. Of course, it is particularly appropriate in census-based studies to examine relationships with other data provided by the population census itself. Relationships between sex and types of economic activities are one of the fields of study for which population census data are best suited. Industry, occupation and status distributions of male and female workers and sex-ratios of workers in the various categories of activities can be analysed with a view to trends over a period of time, its differences between parts of a country and between the ethnic or other groups of its population, and to factors associated with these variations, and as an aspect of the status of women in the society as well as of the problems of labour supply and demand. ^{23/} Differences between distributions of ethnic groups by types of economic activities are of great importance for study in some countries, as they relate to problems of inequality in economic opportunities and social status. ^{24/} Another field of study in which population census data are especially valuable is that of relationships between educational levels and

^{23/} The following studies, among many others, may be cited for illustrations of methods of applying population census data in this field of analysis: Kaplan and Casey, op. cit.; P. Paillat, "Féminisation de la population active en France", International Union for the Scientific Study of Population, International Population Conference (New York, 1961), vol. II.

^{24/} For illustration of pertinent analytical methods, see the following works on occupation distribution of non-white as compared with white workers in the United States of America: Ralph H. Turner, "Occupational patterns of inequality", American Journal of Sociology (Chicago), vol. LIX, No. 5, March 1954; Norval D. Glenn, "Changes in American occupational structure and occupational gains of Negroes during the 1940's", Social Forces (University of North Carolina Press, Chapel Hill), December 1962; Matthew A. Kessler, "Economic status of non-white workers, 1955-1962", Monthly Labor Review (Washington D.C., United States Bureau of Labor Statistics), July 1963.

occupation or industry distributions of the labour force. 25/ Still another is the relationship between urbanization and the changing conditions of labour supply and demand in various industries and occupations. 26/ The two last-mentioned questions are especially important at present in connexion with problems of economic and social policy for developing countries.

25/ See, for example: P.R.G. Layard and J.C. Saigal, "Educational and occupational characteristics of manpower: an international comparison", British Journal of Industrial Relations (London School of Economics and Political Science), July 1966; J.K. Folger and Charles B. Nam, "Trends in education in relation to the occupational structure", Sociology of Education (Albany, N.Y., 1964), Vol. 38, No. 1, p.19.

26/ See, for example: Economic Survey of Asia and the Far East, 1964 (United Nations publication, Sales No.: 65.II.F.1), pp. 80-87: An Analytical Study of the Urban and Rural Population of Costa Rica (United Nations Population Division, Working Paper No. 22, November 1967) (mimeographed document).

ANNEX

A COMPLETE TABLE OF ECONOMICALLY ACTIVE LIFE,
UNITED ARAB REPUBLIC, MALES, 1960

An example of a complete table of economically active life by single years of age is given in table A, referring to the male population of the United Arab Republic in 1960. The table has been derived from the statistics of population and labour force as enumerated in the 1960 census a/ and an official life table for the population of the country as of the same date. b/

Definition and derivation of functions

Column (1) Years of age. The functions in columns (3), (4), (5), (12), (13) and (14) refer to exact ages at each birthday (x) while those in the rest of the columns refer to age intervals (x to x + 1).

Column (2) w_x : Activity rate, or percentage of population in the labour force. The 1960 census gives the data in age groups as follows:

<u>Age group</u>	<u>Activity rate</u>	<u>Age group</u>	<u>Activity rate</u>
10-14	28.4	45-49	97.7
15-19	68.4	50-54	96.3
20-24	86.6	55-59	94.5
25-29	96.0	60-64	85.2
30-34	97.7	65-69	74.3
35-39	98.1	70-74	63.5
40-44	97.9	75 and over	52.9

Although data were collected in the census for children of less than twelve years old, the age twelve has been chosen to start the table because employment of children below that age is legally prohibited.

Activity rates calculated for the above-mentioned age groups were taken as central values for these age groups, interpolated by single years of age and extrapolated beyond the age of seventy-five, minor changes being introduced in the central values for the sake of smoothness. Several mathematical formulae for interpolation and extrapolation were attempted, but they did not give satisfactory results. A free-hand curve fitting was therefore adopted.

a/ United Arab Republic, 1960 Population Census (Cairo, 1963), table 35, p. 225. The following categories are excluded from the calculations: aliens (143,312 persons), nomads (101,225 persons) and "not stated" cases (12,890 persons).

b/ United Arab Republic, Statistical Committee, Population Trends in the United Arab Republic (Cairo, 1960), pp. 42-44. On the reliability of mortality measures used in the 1960 life table, see M. El Badry, "Population growth in the Arab countries of the Middle East", Demography (Chicago), vol. 2, 1965.

Column (3) l_x : The number of males who would survive to the exact age indicated from a cohort of 100,000 males born alive, subject throughout life to the mortality rates given by the 1960 life table.

Column (4) lw_x : The number of survivors of 100,000 males born alive expected to be in the labour force at each exact year of age (or birthday) subject to the activity rates given in column (2). lw_x values may be computed directly by multiplying activity rates by the corresponding values of survivors, that is,

$$lw_x = l_x \cdot w_x$$

provided that w_x values are computed at exact age x . Since the w_x values used in the present example are central values, lw_x values were computed as follows:

$$lw_x = 1/2 (Lw_{x-1} + Lw_x)$$

that is, by direct interpolation from the Lw_x function, on the assumption of an even distribution of labour force accessions and separations in successive years.

Column (5) lw_x^* : The number of male survivors at each exact age who would hypothetically be in the labour force if the activity rate at each age under thirty-seven years were the same as at age thirty-seven. Therefore,

$$lw_x^* = 1/2 (Lw_{x-1}^* + Lw_x^*)$$

where Lw_x^* values are based on the maximal activity rate (see note on column (8)). This function is required in calculating average number of remaining active years per active survivor at ages under thirty-seven years (column 14), in order to eliminate the effects of accessions to the active population. (See chapter II, section D.)

Column (6) L_x : The male stationary population or the number who would be living in the successive age intervals in a population replenished annually by a constant number of 100,000 male births and subject to the prevailing mortality rates. L_x values were computed by linear interpolation between the corresponding values of l_x functions, on the assumption of an even distribution of deaths within each year of age, as follows:

$$L_x = 1/2 (l_x + l_{x+1})$$

Column (7) Lw_x : The number of males in the stationary population expected to be in the labour force at each age in the life span, in other words, the stationary labour force, under the prevailing conditions of activity rates, that is:

$$Lw_x = L_x \cdot w_x$$

Column (8) Lw_x^* : The number of males in the stationary population who would hypothetically be active if the activity rate at each age under thirty-seven years were the same as at age thirty-seven, that is:

$$Lw_x^* = L_x \cdot w_{37}$$

Column (9) T_x : The total number of man-years of life remaining at the given year of age and in all following years, for males alive at the exact year of age. It may be expressed as follows:

$$T_{x_i} = \sum_{x=i}^{\infty} (L_x)$$

Column (10) Tw_x : The total number of man-years in the labour force remaining in the given year and all later years for males in the labour force at the exact year of age, computed from the values of the Lw_x function as follows:

$$Tw_{x_i} = \sum_{x=i}^{\infty} (Lw_x)$$

Column (11) Tw_x^* : These are the hypothetical values of the total man-years in the labour force which correspond to the hypothetical Lw_x^* values for ages under thirty-seven which may be expressed as follows:

$$Tw_{x_i}^* = \sum_{x=i}^{\infty} (Lw_x^*)$$

Column (12) e_x^o : The average number of years of life remaining at the beginning of the given year of age. It is computed as follows:

$$e_x^o = T_x \div l_x$$

Column (13) ew_x^o : The expectation of active life, that is to say, average number of economically active years for all males surviving at the given age. It is computed, like the e_x^o function, by dividing the cumulated man-years in the labour force in the given year and all succeeding years by the number of survivors at the beginning of the year of age:

$$ew_x^o = Tw_x \div l_x$$

Column (14) ew_x^* : The average remaining number of years of active life for males in the labour force at the given age. This is calculated with reference to the values of Tw_x^* and the hypothetical numbers of active survivors at ages under thirty-seven (lw_x^*) as follows:

$$ew_x^* = Tw_x^* \div lw_x^*$$

For ages thirty-seven and over ew_x^* values are computed as follows:

$$ew_x^* = Tw_x \div lw_x$$

The differences between the corresponding values in columns (13) and (14) are due to the differences between l_x 's and lw_x 's as well as the effects of the assumption of the hypothetical activity rate at younger ages (under thirty-seven). c/

The expectation of inactive life can be computed easily by subtracting ew_x^o from the corresponding e_x^o . Similarly, by subtracting ew_x^* from the corresponding

c/ For discussion of differences between the two measures, see chapter II, section D, and Seymour L. Wolfbein and A.J. Jaffe, "Demographic factors in labor force growth", American Sociological Review (Menasha, Wis.), August 1946.

e_x , we get the average remaining number of inactive years of life for males in the labour force at any given age.

Column (15) Q_x : Mortality rate for males living in year of age. It is computed as follows:

$$Q_x = \frac{L_x - L_{x+1}}{L_x}$$

that is, in terms of the stationary population rather than the survivors at birthdays as in the computation of probability of dying in the conventional life table. d/

Column (16) A_x : Accession rates to the labour force for males living in each year of age. If it is assumed that activity rates remain constant, the differences between the rates for successive ages at a given time serve as reasonable estimates of the net annual rates of labour force accession or separation between successive ages, after allowing for mortality. Accession rates were computed from the net increments in the stationary labour force per 1,000 persons in the stationary population after allowing for deaths among workers, as follows:

$$A_x = \frac{Lw_{x+1} - Lw_x + Lw_x (Q_x)}{L_x} \quad \underline{e/}$$

No accessions are shown beyond the age of the peak activity rate because the rates of accessions are derived from the net changes in activity rates.

Column (17) Q_x^S : The separation rates from the labour force due to all causes in a given year of age was computed as a ratio of the difference between stationary labour force in successive years to the labour force of age x:

$$Q_x^S = \frac{Lw_x - Lw_{x+1}}{Lw_x}$$

For ages twelve to thirty-seven, it was assumed that the labour force separations were due solely to death, and therefore:

$$Q_{12-37}^S = Q_{12-37}$$

Column (18) Q_x^d : Separations from the labour force due to death for males in the labour force in the given year of age, assuming that the age-specific death rate for males in the labour force was the same as that for all males of the same age. The Q_x^d function was computed as follows:

$$Q_x^d = \frac{Q_x (2 - Q_x^S)}{(2 - Q_x)}$$

d/ See United States Bureau of Labor Statistics, Tables of Working Life - Length of Working Life for Men (Washington, 1950), Bulletin No. 1001.

e/ A_x may be expressed, equivalently, as: $A_x = (w_{x+1} - w_x) (1 - Q_x^d)$ where Q_x^d is separation rate from the labour force due to death.

Column (19) Q_x^r : Probabilities of separation from the labour force due to retirement (or all causes other than death). Given Q_x^s and Q_x^d , the values of the Q_x^r function were calculated as the difference between the two:

$$Q_x^r = Q_x^s - Q_x^d$$

Patterns of working life

The functions of the table just described illustrate the patterns of working life in the United Arab Republic in 1960. It is useful to compare some of the indices with those of other countries:

(a) The average remaining number of economically active years, ${}^oew_x^*$ for males at age seventeen, for example, is 45.4 years in the United States of America (1967), f/ 46.5 years in the United Kingdom of Great Britain (1955), g/ 44.8 years in New Zealand (1951), h/ 49.0 years in Japan (1955), i/ 46.0 years in Malaya (1957), j/ and 46.8 years in the United Arab Republic (1960).

(b) Since these countries differ, among other things, in their evaluation of the expectation of life a single index may be used for this comparison, namely the percentage of the expectation of life spent in the labour force. The evaluation of this index for males at age seventeen is 86.8 in the United States of America, 87.7 in the United Kingdom of Great Britain, 83.7 in New Zealand, 92.1 in Japan, 93.1 in Malaya, and 92.9 in the United Arab Republic in the years listed above. The same pattern of the differences in this index among these countries holds not only at age seventeen but also throughout the age span. These results suggest the following proposition: the higher the socio-economic level, the lower will be the percentage of expectation of life spent in economically active status for males in the labour force at given ages, or, conversely, the higher the socio-economic level, the higher will be the percentage of expectation of life spent in retirement. Roughly speaking, this proposition holds for all countries mentioned above but one. New Zealand apparently deviates.

(c) The differences in the index in the preceding paragraph are due primarily to differences in activity rates. Male activity rates by age have generally a universal pattern, where they rise sharply in the teens and early twenties, approach 100 per cent in the middle adult ages, decline after age fifty, at first gradually and then more rapidly at an advanced age. Differences exist mainly in the youngest and oldest age groups, where developing countries generally have higher activity rates than developed countries. This is true for the countries under consideration. Only New Zealand has the highest activity rates in the young age groups and the lowest at ages above sixty.

f/ Stuart Garfinkle "The lengthening of working life and its implications", Proceedings of the World Population Conference, 1965 (United Nations publication, Sales No.: 66.XIII.0), volume IV, pp. 277-282.

g/ United Kingdom of Great Britain, Ministry of Labour, The Length of Working Life of Males in Great Britain (London, 1959).

h/ New Zealand Census and Statistics Department, Table of Working Life, 1951: Male Population (including Maoris) (Wellington, 1955).

i/ Koya Azumi, op. cit.

j/ Swee-Hock Saw, op. cit. p. 432.

(d) Not only do differences in activity rates affect the pattern of the average remaining years of economically active life in different countries, but also they affect all other functions of labour force dynamics included in the table. For example, in developing countries such as Malaya and in the United Arab Republic, the main reason for separation from the labour force is death, throughout the life span, while in developed countries such as the United States of America and the United Kingdom of Great Britain, retirement becomes the major factor at advanced ages.

Table A

Complete table of economically active life, United Arab Republic, males, 1960

Year of age	Activity rate	Number living of 100,000		In the labour force		In the population		Number living of 100,000 born alive in year of age	
		$\frac{1}{x}$	$\frac{1}{x}$	$\frac{1}{x}$	$\frac{1}{x}$	$\frac{1}{x}$	$\frac{1}{x}$	$\frac{1}{x}$	$\frac{1}{x}$
x (1)	w _x (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
12	28.4	76 572	19 399	75 120	76 496	21 725	75 043	75 043	75 043
13	37.0	76 419	24 986	74 968	76 343	28 247	74 892	74 892	74 892
14	47.2	76 266	32 104	74 815	76 186	35 960	74 738	74 738	74 738
15	55.3	76 106	39 001	74 660	76 026	42 042	74 582	74 582	74 582
16	62.3	75 946	44 654	74 504	75 866	47 265	74 425	74 425	74 425
17	68.4	75 786	49 523	74 345	75 703	51 781	74 265	74 265	74 265
18	73.3	75 619	53 573	74 181	75 532	55 365	74 097	74 097	74 097
19	77.4	75 445	56 845	74 010	75 355	58 325	73 923	73 923	73 923
20	80.7	75 264	59 494	73 833	75 170	60 662	73 742	73 742	73 742
21	83.8	75 076	61 747	73 648	74 979	62 832	73 554	73 554	73 554
22	86.6	74 881	63 796	73 457	74 780	64 759	73 359	73 359	73 359
23	89.1	74 679	65 603	73 259	74 575	66 446	73 158	73 158	73 158
24	91.3	74 470	67 170	73 054	74 362	67 893	72 949	72 949	72 949
25	93.1	74 254	68 460	72 842	74 143	69 027	72 734	72 734	72 734
26	94.7	74 031	69 513	72 623	73 916	69 998	72 512	72 512	72 512
27	96.0	73 801	70 367	72 398	73 683	70 736	72 283	72 283	72 283
28	96.6	73 565	70 842	72 166	73 444	70 947	72 049	72 049	72 049
29	96.9	73 322	70 936	71 926	73 194	70 925	71 803	71 803	71 803
30	97.2	73 065	70 907	71 674	72 930	70 888	71 544	71 544	71 544
31	97.4	72 795	70 828	71 411	72 657	70 768	71 277	71 277	71 277
32	97.6	72 518	70 704	71 140	72 377	70 640	71 002	71 002	71 002
33	97.7	72 235	70 535	70 860	72 087	70 429	70 717	70 717	70 717
34	97.8	71 939	70 318	70 569	71 785	70 206	70 421	70 421	70 421
35	97.9	71 630	70 087	70 266	71 469	69 968	70 111	70 111	70 111
36	98.0	71 308	69 843	69 950	71 141	69 718	69 789	69 789	69 789
37	98.1	70 973	69 622	-	70 799	69 454	-	-	-
38	98.0	70 625	69 245	-	70 445	69 036	-	-	-
39	97.9	70 265	68 822	-	70 079	68 607	-	-	-
40	97.8	69 893	68 386	-	69 698	68 165	-	-	-

Table A (continued)

Year of age	Activity rate	Number living of 100,000 born alive at beginning of year of age		Number living of 100,000 born alive in year of age			
		In the population	In the labour force	In the population	In the labour force		
x	w_x (2)	$\frac{1}{2}x$ (3)	$\frac{1}{2}w_x$ (4)	$\frac{1}{2}w_x^*$ (5)	L_x (6)	Lw_x (7)	Lw_x^* (8)
41	97.7	69 502	67 934	-	69 297	67 703	-
42	97.6	69 092	67 463	-	68 875	67 222	-
43	97.5	68 657	66 971	-	68 431	66 720	-
44	97.4	68 204	66 463	-	67 972	66 205	-
45	97.3	67 740	65 940	-	67 496	65 674	-
46	97.2	67 252	65 396	-	66 991	65 117	-
47	97.1	66 734	64 826	-	66 461	64 534	-
48	97.0	66 187	64 232	-	65 906	63 929	-
49	96.9	65 624	63 612	-	65 319	63 294	-
50	96.7	65 014	62 924	-	64 689	62 554	-
51	96.5	64 364	62 164	-	64 013	61 773	-
52	96.3	63 662	61 361	-	63 290	60 948	-
53	96.0	62 917	60 483	-	62 518	60 017	-
54	95.6	62 118	59 497	-	61 690	58 976	-
55	95.2	61 261	58 426	-	60 793	57 875	-
56	94.8	60 324	57 298	-	59 833	56 721	-
57	94.3	59 341	56 094	-	58 819	55 466	-
58	93.3	58 297	54 675	-	57 752	53 883	-
59	91.8	57 207	52 939	-	56 638	51 994	-
60	89.9	56 069	50 933	-	55 475	49 872	-
61	87.5	54 880	48 667	-	54 241	47 461	-
62	85.3	53 601	46 302	-	52 923	45 143	-
63	83.1	52 245	43 983	-	51 532	42 823	-
64	80.9	50 819	41 650	-	50 032	40 476	-
65	78.7	49 244	39 279	-	48 387	38 081	-
66	76.5	47 530	36 874	-	46 622	35 666	-
67	74.3	45 714	34 458	-	44 750	33 249	-
68	72.1	43 785	32 045	-	42 774	30 840	-
69	69.9	41 762	29 647	-	40 706	28 453	-
70	67.7	39 649	27 278	-	38,555	26 102	-

Table A (continued)

Year of age	Activity rate	Number living of 100,000 born alive at beginning of year of age		Number living of 100,000 born alive in year of age		
		In the population	In the labour force	In the population	In the labour force	
x	w ^x	$\frac{L}{w^x}$	$\frac{Lw^x}{w^x}$	L	Lw [*]	
(1)	(2)	(3)	(4)	(6)	(7)	
		x	x	x	x	
		(3)	(4)	(6)	(7)	
					(8)	
71	65.5	37 460	24 953	36 342	23 804	-
72	63.3	35 224	22 693	34 094	21 582	-
73	61.1	32 963	20 503	31 790	19 424	-
74	58.9	30 616	18 376	29 419	17 328	-
75	56.7	28 222	16 324	27 020	15 320	-
76	54.5	25 817	14 368	24 614	13 415	-
77	52.3	23 411	12 514	22 203	11 612	-
78	50.1	20 995	10 768	19 807	9 923	-
79	47.9	18 618	9 144	17 462	8 364	-
80	45.7	16 306	7 655	15 196	6 945	-
81	43.4	14 085	6 303	13 042	5 660	-
82	41.1	11 998	5 099	11 038	4 537	-
83	38.8	10 078	4 054	9 201	3 570	-
84	36.4	8 324	3 158	7 542	2 745	-
85	34.0	6 759	2 405	6 070	2 064	-

Table A (continued)

Year of age x (1)	Number of man-years remaining in year of age and later years			Complete expectation of life at beginning of year of age e^9_x (12)	Expectation of economically active life at beginning of year of age e^{9w}_x (13)	Average remaining years of active life for survivors in labour force at beginning of year of age e^{9w*}_x (14)
	In the population T^*_x (9)	In the labour force Tw^*_x (10)	In the labour force Tw^*_x (11)			
12	4 200 564	3 542,527	3 853 944	54.9	46.3	51.3
13	4 124 068	3 520,802	3 778 901	54.0	46.1	50.4
14	4 047 725	3 492,555	3 704 009	53.1	45.8	49.5
15	3 971 539	3 456,595	3 629 271	52.2	45.4	48.6
16	3 895 513	3 414 553	3 554 689	51.3	45.0	47.7
17	3 819 647	3 367 288	3 480 264	50.4	44.4	46.8
18	3 743 944	3 315 507	3 405 999	49.5	43.8	45.9
19	3 668 412	3 260 142	3 331 902	48.6	43.2	45.0
20	3 593 057	3 201 817	3 257 979	47.7	42.5	44.1
21	3 517 887	3 141 155	3 184 237	46.9	41.8	43.2
22	3 442 908	3 078 323	3 110 683	46.0	41.1	42.3
23	3 368 128	3 013 564	3 037 324	45.1	40.4	41.5
24	3 293 553	2 947 118	2 964 166	44.2	39.6	40.6
25	3 219 191	2 879 225	2 891 217	43.4	38.8	39.7
26	3 145 048	2 810 198	2 818 483	42.5	38.0	38.8
27	3 071 132	2 740 200	2 745 971	41.6	37.1	37.9
28	2 997 449	2 669 464	2 673 688	40.7	36.3	37.0
29	2 924 005	2 598 517	2 601 639	39.9	35.4	36.2
30	2 850 811	2 527 592	2 529 836	39.0	34.5	35.3
31	2 777 881	2 456 704	2 458 292	38.2	33.7	34.4
32	2 705 224	2 385 936	2 387 015	37.3	32.9	33.6
33	2 632 847	2 315 296	2 316 013	36.4	32.1	32.7
34	2 560 760	2 244 867	2 245 296	35.6	31.2	31.8
35	2 488 975	2 174 661	2 174 875	34.7	30.4	31.0
36	2 417 506	2 104 693	2 104 764	33.9	29.5	30.1
37	2 346 365	2 034 975	-	33.1	28.7	29.2
38	2 275 566	1 965 521	-	32.2	27.8	28.4
39	2 205 121	1 896 485	-	31.4	27.0	27.6
40	2 135 042	1 827 878	-	30.5	26.2	26.7

Table A (continued)

Year of age x	Number of man-years remaining in year of age and later years			Complete expectation of life at beginning of year of age e_x^o	Expectation of economically active life at beginning of year of age e_x^w	Average remaining years of active life for survivors in labour force at beginning of year of age e_x^{w*}
	In the population T_x	In the labour force T_w^x	In the labour force T_w^*			
(1)	(9)	(10)	(11)	(12)	(13)	(14)
41	2 065 344	1 759 713	-	29.7	25.3	25.9
42	1 996 047	1 692 010	-	28.9	24.5	25.1
43	1 927 172	1 624 788	-	28.1	23.7	24.3
44	1 858 741	1 558 068	-	27.3	22.8	23.4
45	1 790 769	1 491 863	-	26.4	22.0	22.6
46	1 723 273	1 426 189	-	25.6	21.2	21.8
47	1 656 280	1 361 072	-	24.8	20.4	21.0
48	1 589 819	1 296 538	-	24.0	19.6	20.2
49	1 523 913	1 232 609	-	23.2	18.8	19.4
50	1 458 594	1 169 315	-	22.4	18.0	18.6
51	1 393 905	1 106 761	-	21.7	17.2	17.8
52	1 329 892	1 044 988	-	20.9	16.4	17.0
53	1 266 602	984 040	-	20.1	15.6	16.3
54	1 204 084	924 023	-	19.4	14.9	15.5
55	1 142 394	865 047	-	18.6	14.1	14.8
56	1 081 601	807 172	-	17.9	13.4	14.1
57	1 021 768	750 451	-	17.2	12.6	13.4
58	962 949	694 985	-	16.5	11.9	12.7
59	905 197	641 102	-	15.8	11.2	12.1
60	848 559	589 108	-	15.1	10.5	11.6
61	793 084	539 236	-	14.5	9.8	11.1
62	738 843	491 775	-	13.8	9.2	10.6
63	685 920	446 632	-	13.1	8.5	10.2
64	634 388	403 809	-	12.5	7.9	9.7
65	584 356	363 333	-	11.9	7.4	9.3
66	535 969	325 252	-	11.3	6.8	8.8
67	489 347	289 586	-	10.7	6.3	8.4
68	444 597	256 337	-	10.2	5.9	8.0
69	401 823	225 497	-	9.6	5.4	7.7
70	361 117	197 044	-	9.1	5.0	7.3

Table A (continued)

Year of age x	Number of man-years remaining in year of age and later years				Complete expectation of life at beginning of year of age e^o_x (12)	Expectation of economically active life at beginning of year of age e^w_x (13)	Average remaining years of active life for survivors in labour force beginning of year of age e^{ow}_x (14)
	In the population		In the labour force				
	T_x (9)	Tw_x (10)	Tw^*_x (11)	e^{ow}_x (14)			
71	322 562	170 942	-	8.6	4.6	7.0	
72	280 622	147 138	-	8.1	4.2	6.5	
73	252 126	125 556	-	7.6	3.8	6.1	
74	220 336	106 132	-	7.2	3.5	5.8	
75	190 917	88 804	-	6.8	3.1	5.4	
76	163 897	73 484	-	6.3	2.8	5.1	
77	139 283	60 069	-	5.9	2.6	4.8	
78	117 080	48 457	-	5.6	2.3	4.5	
79	97 273	38 534	-	5.2	2.1	4.2	
80	79 811	30 170	-	4.9	1.9	3.9	
81	64 615	23 225	-	4.6	1.6	3.7	
82	51 573	17 565	-	4.3	1.5	3.4	
83	40 535	13 028	-	4.0	1.3	3.2	
84	31 334	9 458	-	3.8	1.1	3.0	
85	23 792	6 713	-	3.5	1.0	2.8	

Table A (continued)

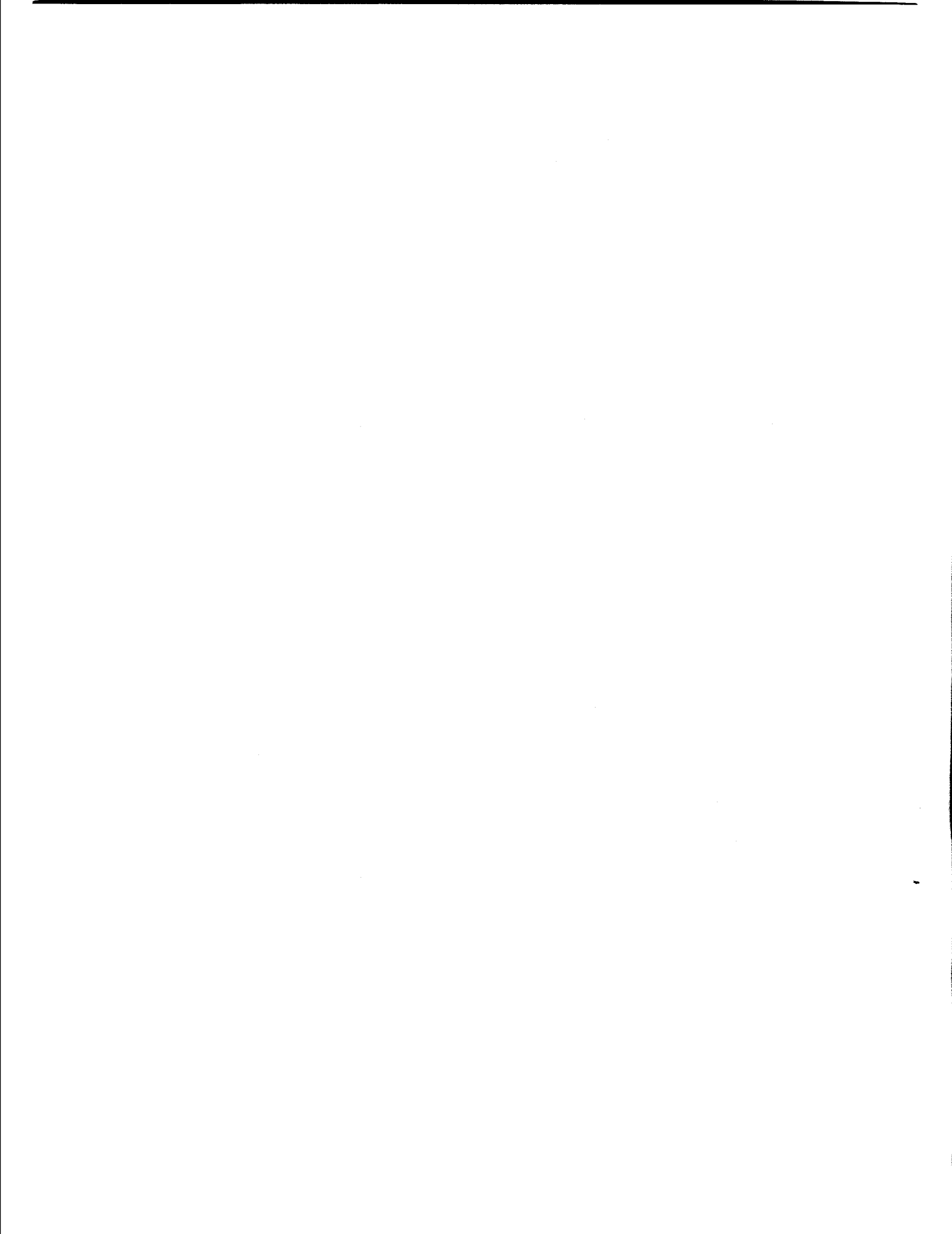
Year of age	Separations from the labour force per 1,000 in the labour force in year of age			Accessions to the labour force per 1,000 living in year of age		Due to retirement
	Total	Due to death	Due to retirement	1000 A _x	1000 Q _x	
x	1000 Q _x ^s	1000 Q _x ^d	1000 Q _x ^r	1000 A _x	1000 Q _x	1000 Q _x ^r
(1)	(17)	(18)	(19)	(16)	(15)	(19)
12	2.0	2.0	-	85.8	2.0	-
13	2.1	2.1	-	101.8	2.1	-
14	2.1	2.1	-	80.8	2.1	-
15	2.1	2.1	-	69.9	2.1	-
16	2.1	2.1	-	60.9	2.1	-
17	2.3	2.3	-	48.9	2.3	-
18	2.3	2.3	-	40.9	2.3	-
19	2.4	2.4	-	32.9	2.4	-
20	2.5	2.5	-	30.9	2.5	-
21	2.7	2.7	-	27.9	2.7	-
22	2.7	2.7	-	24.9	2.7	-
23	2.9	2.9	-	21.9	2.9	-
24	2.9	2.9	-	17.9	2.9	-
25	3.1	3.1	-	15.9	3.1	-
26	3.2	3.2	-	13.0	3.2	-
27	3.2	3.2	-	6.0	3.2	-
28	3.4	3.4	-	3.0	3.4	-
29	3.6	3.6	-	3.0	3.6	-
30	3.7	3.7	-	2.0	3.7	-
31	3.9	3.9	-	2.0	3.9	-
32	4.0	4.0	-	1.0	4.0	-
33	4.2	4.2	-	1.0	4.2	-
34	4.4	4.4	-	1.0	4.4	-
35	4.6	4.6	-	1.0	4.6	-
36	4.8	4.8	-	1.0	4.8	-
37	5.0	5.0	1.0	-	5.0	1.0
38	5.2	5.2	1.0	-	5.2	1.0
39	5.4	5.4	1.0	-	5.4	1.0
40	5.7	5.7	1.0	-	5.7	1.0

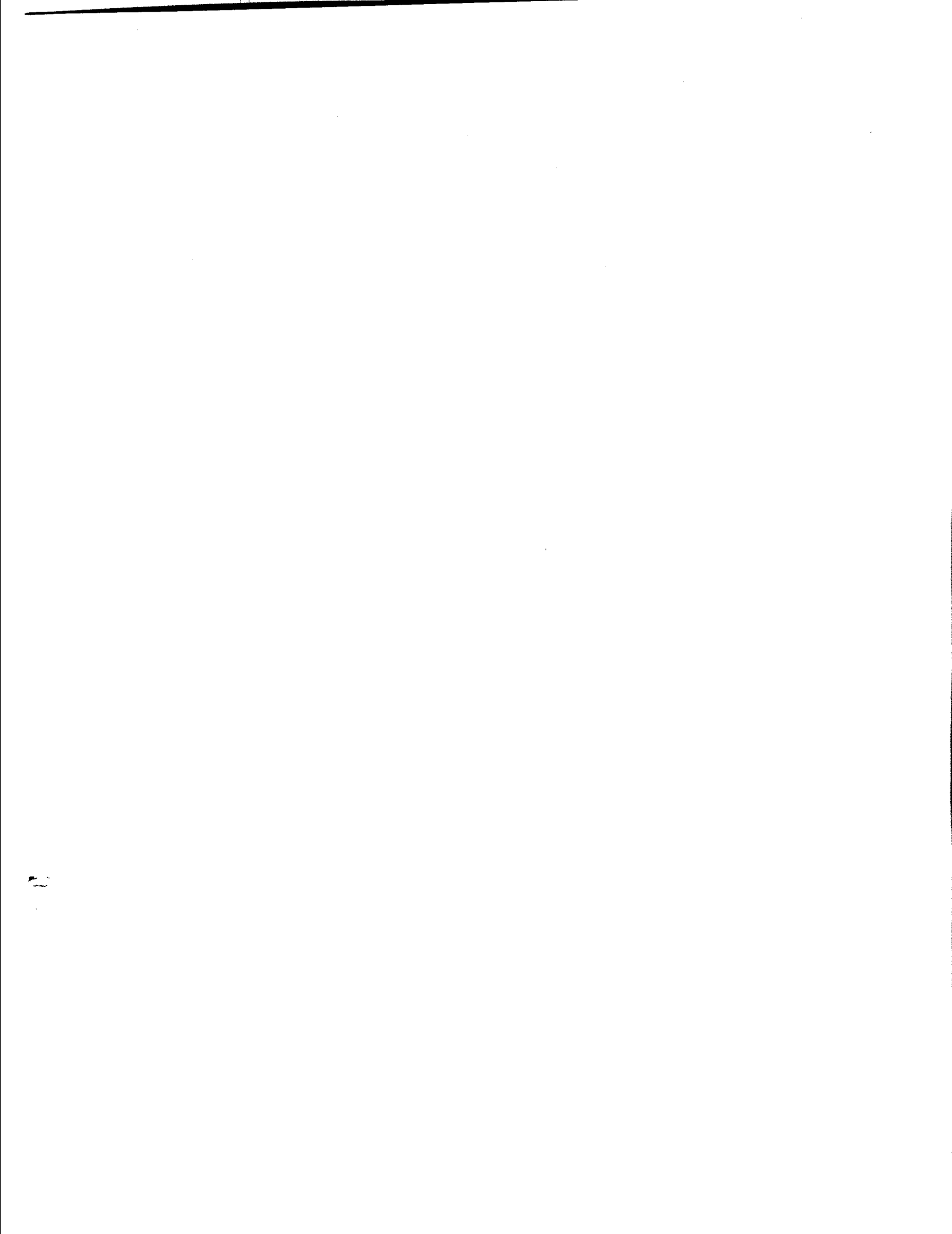
Table A (Cont.)

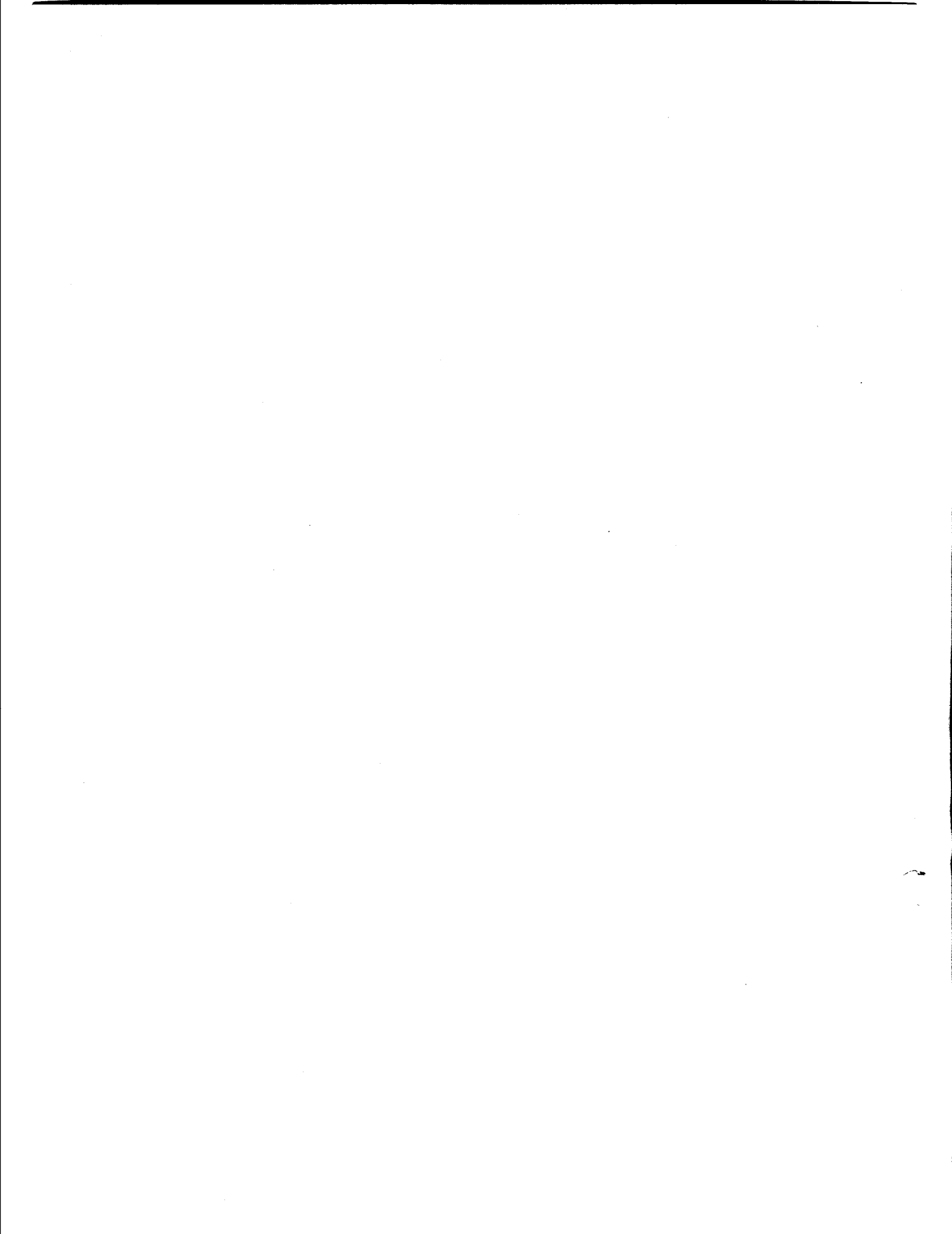
Year of age	Mortality rate per 1,000 living in year of age		Accessions to the labour force per 1,000 living in year of age		Separations from the labour force per 1,000 in the labour force in year of age		
	1000 Q _x (15)		1000 A _x (16)		Total 1000 Q ^s (17)	Due to death 1000 Q ^d (18)	Due to retire- ment 1000 Q ^r (19)
x							
(1)							
41	6.1	-	-	-	7.1	6.1	1.0
42	6.4	-	-	-	7.5	6.4	1.1
43	6.7	-	-	-	7.7	6.7	1.0
44	7.0	-	-	-	8.0	7.0	1.0
45	7.5	-	-	-	8.5	7.5	1.0
46	7.9	-	-	-	9.0	7.9	1.1
47	8.4	-	-	-	9.4	8.4	1.0
48	8.9	-	-	-	9.9	8.9	1.0
49	9.6	-	-	-	11.7	9.6	2.1
50	10.4	-	-	-	12.5	10.4	2.1
51	11.3	-	-	-	13.4	11.3	2.1
52	12.2	-	-	-	15.3	12.2	3.1
53	13.2	-	-	-	17.3	13.2	4.1
54	14.5	-	-	-	18.7	14.5	4.2
55	15.8	-	-	-	19.9	15.8	4.1
56	17.0	-	-	-	22.1	17.0	5.1
57	18.1	-	-	-	28.5	18.0	10.5
58	19.3	-	-	-	35.1	19.1	16.0
59	20.5	-	-	-	40.8	20.3	20.5
60	22.2	-	-	-	48.3	21.9	27.4
61	24.3	-	-	-	48.8	23.9	24.9
62	26.3	-	-	-	51.4	26.0	25.4
63	29.1	-	-	-	54.8	28.7	26.1
64	32.9	-	-	-	59.2	32.6	26.6
65	36.5	-	-	-	63.4	36.0	27.4
66	40.2	-	-	-	67.8	39.6	28.2
67	44.2	-	-	-	72.5	43.6	28.9
68	48.4	-	-	-	77.4	47.7	29.7
69	52.8	-	-	-	82.6	52.0	30.6
70	57.4	-	-	-	88.0	56.5	31.5

Table A (continued)

Year of age	Mortality rate per 1,000 living in year of age		Accessions to the labour force per 1,000 living in year of age		Separations from the labour force per 1,000 in the labour force in year of age		
	1000 Q _x (15)		1000 A _x (16)		Total 1000 Q ^s (17)	Due to death 1000 Q ^d (18)	Due to retire- ment 1000 Q ^r (19)
x							
(1)							
71	61.9		-		93.3	60.8	32.5
72	67.6		-		100.0	66.5	33.5
73	74.6		-		107.9	73.3	34.6
74	81.6		-		115.9	80.1	35.8
75	89.1		-		124.3	87.5	36.8
76	98.0		-		134.4	96.1	38.3
77	107.9		-		145.4	105.8	39.6
78	118.4		-		157.1	116.0	41.1
79	129.8		-		169.7	127.0	42.7
80	141.8		-		185.0	138.5	46.5
81	153.7		-		198.4	150.0	48.4
82	166.4		-		213.1	162.2	50.9
83	180.3		-		231.1	175.3	55.8
84	195.0		-		248.5	189.2	59.3
85	210.2		-		266.0	203.6	62.4







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