

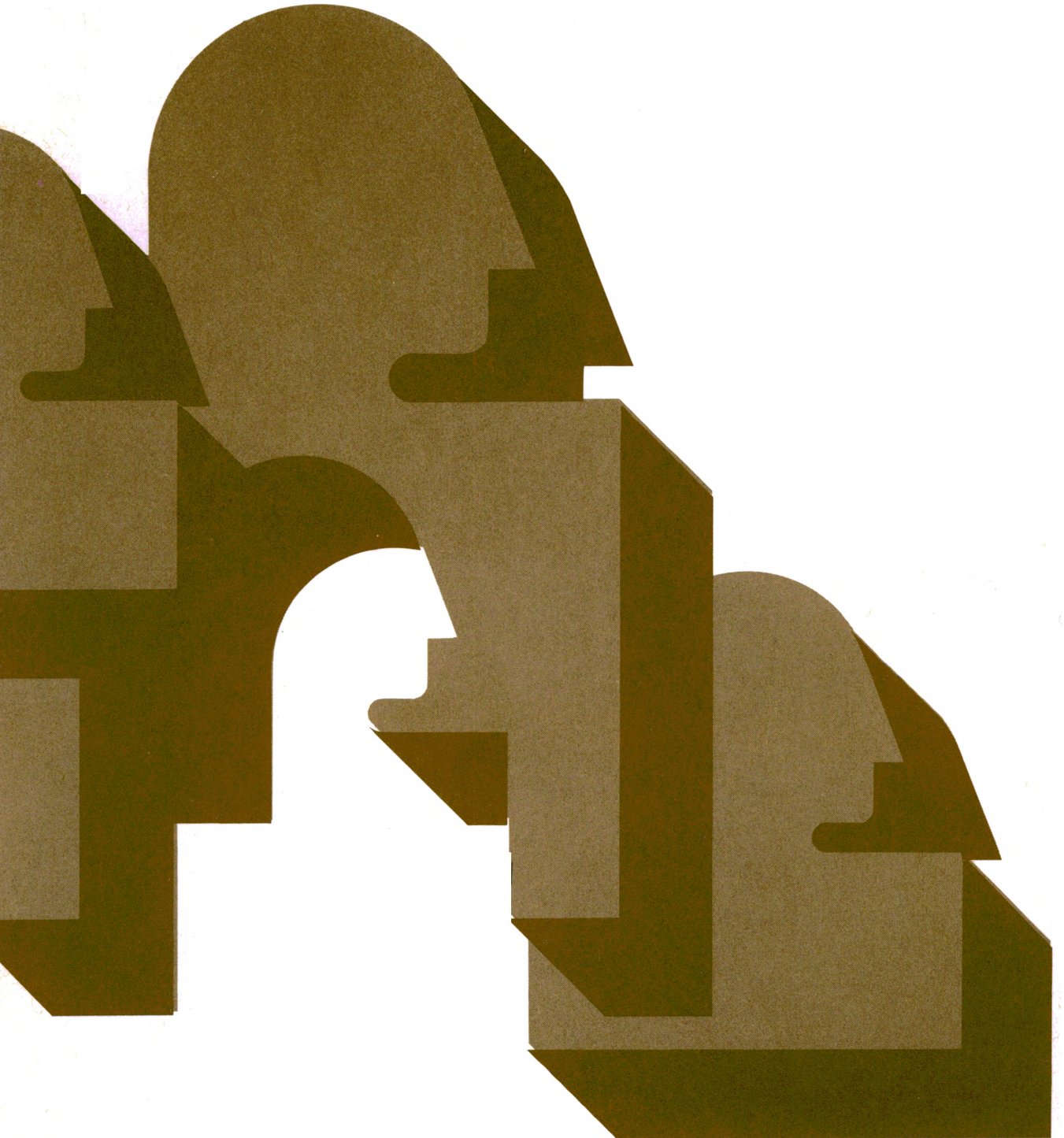
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**Occupational Supply:  
Concepts and Sources  
of Data for Manpower Analysis**

Bulletin 1816

U.S. DEPARTMENT OF LABOR  
Bureau of Labor Statistics

1974



# Occupational Supply: Concepts and Sources of Data for Manpower Analysis

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U.S. DEPARTMENT OF LABOR

Peter J. Brennan, Secretary

BUREAU OF LABOR STATISTICS

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1974

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## Preface

A primary goal of manpower policy is to avert imbalances between supply of and demand for workers with specific skills. Efforts to achieve this goal rely on the availability of adequate information about the number of workers required—demand—and the number available—supply—in an occupation. Although much effort has been expended in estimating and analyzing demand, supply has received relatively little attention. This study reviews the current state of occupational supply information, including uses of such information, conceptual problems, how information requirements vary among occupations with different skill and economic characteristics, and the availability of data to carry out good supply analyses. Recommendations for future research and data collection activities also are offered. Though the discussion concentrates on Federal activities, and emphasizes analysis of the effect of Federal programs and policies on manpower, the concepts and analyses presented are applicable to State and local manpower activities as well.

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## Introduction. The Uses of Supply Information

This bulletin focuses on approaches to studying occupational supply that will produce information needed for decisionmaking in manpower policy and planning, educational planning, and vocational guidance and counseling. Decisionmakers in these activities require a basic core of information on supply. In order to develop effective policies for avoiding potential supply-demand imbalances by altering supply conditions, they also need analysis of the factors that influence supply.

Many forms of government action affecting the supply of workers can be used to correct supply-demand imbalances. The training of new workers in particular occupations can be expanded or contracted. Trained workers outside the labor force, especially women, can be attracted into the market to fill demand. Occupational and geographic mobility can be increased through retraining, relocation allowances, and job information programs.

Selecting the proper type of action and designing an effective program to carry it out depend in part on obtaining adequate information. Policymakers must be able to identify and measure supply-demand imbalances, sometimes by region and industry as well as by occupation. They need to know the number of workers currently available, what occupations to train workers for, how to train them, how many to train, and where to help workers relocate. They must understand the occupation's supply structure—how workers enter the occupation, how long their training takes, where they come from, and why they leave. They also need to understand how supply responds to wage levels, union rules, pension plans, licensing regulations, and other economic and noneconomic factors.

The need for supply information has been recognized by the government in a variety of ways. In manpower legislation, for example, both the Manpower Development and Training Act of 1962 (MDTA) and the Comprehensive Employment and Training Act of 1973 specify that program planners must show evidence that shortages exist in the occupations for which they wish to offer training. Despite Federal and State efforts, however, one of the major difficulties in implementing such

legislation has been the inability of planners to define and identify skill shortages.<sup>1</sup>

An area of government manpower policy that has been increasing in importance is an assessment of the supply of specific kinds of workers to see if supply is in line with the demand generated by the impact of government expenditures or policies. Such information can help planners determine whether sufficient supply will be available when needed, if supply can expand or contract easily in response to government policy, and, if it cannot, what specific labor force problems stemming from supply-demand imbalances need to be resolved.

The need for assessing what manpower is required to implement specific government programs was recognized during the past decade. The Federal effort in health care is a major example. National health proposals of both the Johnson and Nixon administrations recognized that providing better health care requires not only a financing system but also more workers in health occupations to meet the demand generated in part by Federal programs.<sup>2</sup> Health legislation, therefore, included not only programs such as Medicare and Medicaid that increased the availability of health services, but also provided for continuing studies of the health manpower situation and increased funds for training in the Nurse Training Act of 1964 and the Comprehensive Health Manpower Training Act of 1971. Actions to increase supply were based on manpower studies, although not on formal impact studies.

Use of supply information in educational planning occurs primarily at the State and local levels in both public and private institutions. Planners rely on a variety of criteria in selecting and financing programs. Man-

<sup>1</sup> See "Evaluation of the Effectiveness of Institutional Manpower Training in Meeting Employer's Needs in Skills Shortage Occupations" (Salt Lake City, Utah: Olympus Research Corp., June 1972), mimeo.

<sup>2</sup> See, for example, *Report of the National Advisory Commission on Health Manpower* (Washington: Government Printing Office, 1967), 2 vols., and *Health Message from the President of the United States, Relation to Building a National Health Strategy* (92d Cong. 1st sess., House Document No. 92-49, 1971).



power criteria are more important to planners responsible for specific types of occupational training, such as vocational education, apprenticeship, on-the-job training programs, and some areas of higher education, than to planners concerned with general education. Occupational supply-demand information is useful in determining what kinds of training to offer during periods of contracting or expanding demand, so that graduates will be able to find jobs and the economy will have adequate supplies of skilled manpower.<sup>3</sup> Educational planners also are concerned with the supply of teachers and other personnel required to carry out programs. In vocational guidance and counseling, supply information is used

<sup>3</sup> For elaboration of the role of manpower information in vocational-education planning, see Robert C. Young, William Clive, and Benton Miles, *Vocational Education Planning: Manpower Priorities and Dollars* (Columbus: The Ohio State University, Center for Vocational and Technical Education, 1972).

together with information on demand to help the counselee find an occupation in which he has a reasonable chance of finding employment.

This bulletin is designed to aid researchers investigating specific aspects of supply by providing background for conducting supply analyses. While the report provides conceptual background, it does not present actual methods for analysis. The reader is referred to the methodological studies and analyses of individual occupations listed in the final section of the bibliography.

The first chapter presents a model of supply useful for studying the structure of supply in any given occupation. The second chapter explores ways of analyzing supply behavior within the framework of traditional labor market economics. Chapter 3 discusses existing data available for using the analytical models presented in chapters 1 and 2. The concluding chapter presents recommendations for basic research on supply that will lead to better supply information.

## Chapter 1. A Model of Occupational Supply Structure

This chapter presents a model that illustrates the flow of workers into and out of an occupation. The model provides a framework for analyzing an occupation's supply structure and identifying the factors affecting the structure. It helps answer such questions as: What skills are required? Where do entrants learn the skills? How many workers can be expected to enter the occupation? What are the barriers to entry? How many workers will leave the occupation?

In the model described here, supply is defined in terms of the number of individuals working or seeking work in an occupation at a given time. This definition is different from the textbook concept of supply, which describes a functional relationship between wages and workers' willingness to offer their services. Analysis of functional relationships, however, is crucial to an understanding of the factors that influence supply and is discussed in chapter 2.

### DESCRIPTION OF THE MODEL

The model of supply structure illustrated in chart 1 describes the flow of workers into an occupation from various sources and out of an occupation for various reasons. Although not noted on the chart, workers also may move between the sources of entry or separation. A graduate of a specific training program, for example, may remain outside the labor force for a while before entering an occupation. To avoid confusion in statistical presentations, each entrant is classified according to his status at the time of entry. The time frame for most analyses is a calendar year, although other periods such as quarters or academic years may be used if suitable data are available. The following text describes each aspect of the chart.

#### A. Current supply

Current supply is often defined as current employment, primarily because current employment is often the only available information. However, this definition is inaccurate because employment levels result from the interaction of both supply and demand.

Current supply properly includes the number of workers employed plus the number of unemployed persons seeking work in the occupation at a given time. Including the unemployed provides a more complete indication of the actual number of workers available in the occupation.

An alternative supply concept, "potential supply," would include, in addition to the current supply defined above, persons qualified for the occupation who are not members of the current supply. For example, certified teachers who are working in other occupations or who are out of the labor force would be part of the potential supply of teachers because, under certain circumstances, they may enter the current supply of teachers by searching for a teaching job. The potential supply concept is especially important in considering occupations with a shortage or a surplus. In a shortage situation, the potential supply represents a means of relieving the shortage by attracting the potential supply into the current supply of workers. In a surplus, the potential supply may represent the underemployment of trained workers.

Although the discussion in this chapter refers only to the number of *persons* employed and unemployed, the definition can be refined to represent the number of *hours*, *man-days*, or *man-years* of work supplied. Such a refinement may be important when analyzing occupations with large proportions of part-time or seasonal workers.

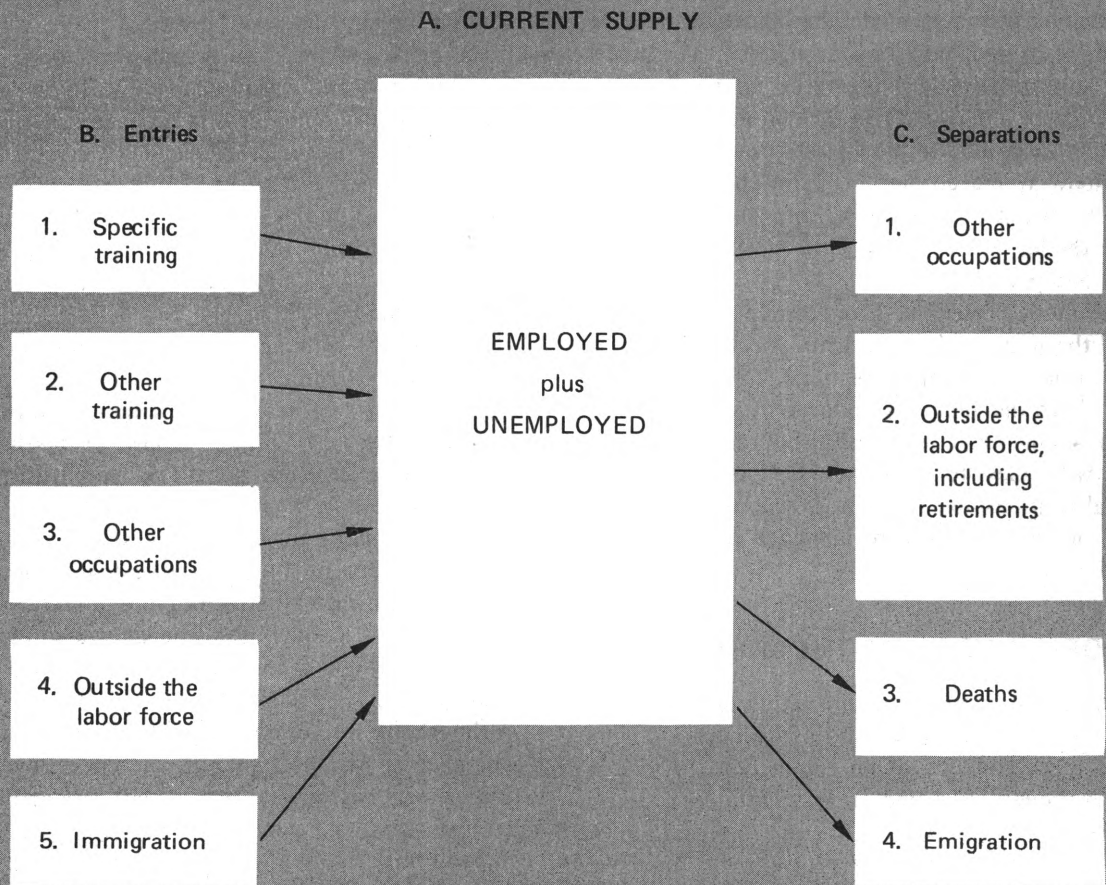
#### B. Entries

1. Entries from *specific training programs* include persons who have completed training designed to qualify them for a specific occupation. This group includes, for example, engineering graduates who enter engineering and vocational school trainees completing automotive mechanics courses who become automobile mechanics.

In some occupations specific training programs are the most important or the only source of entrants. For example, medical and dental schools are the primary sources of new physicians and dentists. Supply analysis for such occupations will concentrate on the number of

Chart 1.

## Flows of Workers Into and Out of an Occupation



enrollments, the proportion of enrollees who complete the training, and the rate of entry of graduates into the occupation.

2. Entries from *other training programs* include graduates of programs that provide training not directly related to the occupation, such as mathematics graduates who enter jobs in engineering or economics. Dropouts from specific training programs who are qualified for other occupations, such as engineering dropouts who become technicians, are also included in this group.

3. Entries who are *transfers from other occupations* may come from several sources: upgrading (e.g., technician to engineer), transfers from related occupations (e.g., automobile mechanic to farm equipment mechanic), and transfers from unrelated occupations (e.g., teacher to salesman).

4. Entries from *outside the labor force* include workers with the necessary training who have been out of the labor force for some period. They may be reentrants, or new entrants with no previous experience. This group is made up almost entirely of women who have left the labor force for family responsibilities, and therefore is an important source of supply in teaching, nursing, and other occupations composed primarily of women. Veterans, retirees who return to work, and persons leaving institutions such as prisons are also included in this group.

5. Entries from *immigration* include workers who enter an occupation after moving into the country. In a State or local area, this group includes migrants from other States or areas.<sup>4</sup> An important type of immigrant or migrant is the individual who worked in the occupation before moving into the area. Immigrants are important nationally only in a few occupations, but migrants may be an important source of supply to a local or regional labor market.

### C. Separations

1. *Transfers to other occupations* include workers who leave the occupation to enter another occupation. A technician who is upgraded to an engineer, for example, is a transfer *out* of the supply of technicians as well as a transfer *into* engineering.

2. Workers may transfer *out of the labor force* for a variety of reasons. Many women leave because of marriage or birth of children, older workers retire, young men leave to enter the Armed Forces, and some workers leave because of illness, injury, or inability to find employment.

3. Separations because of *deaths* are usually stated as a rate or proportion of all workers in the occupation. The death rate depends primarily on the age of the work

force in the occupation, and sometimes on occupational hazards and diseases.

4. Separations from *emigration* include workers who move out of the country. In a State or local area, this group includes workers who migrate to other States or areas. In statistical analyses migrants can be counted as outmigrants from one area and as immigrants to another area. National patterns of emigration are important in only a few occupations, usually highly skilled occupations such as the scientists who emigrated from Europe during the so-called "brain drain." On the State and local levels, however, outmigrants may constitute a significant loss of manpower.

## USING THE MODEL

The step-by-step use of the structural supply model presented here illustrates its application to supply analysis and describes a complete set of data. Emphasis is placed on the types of information and data required. Because complete information is rarely available for actual supply analysis, some attention also is given to the relative importance of each type of data.

### Specifying the model

The first task in using the structural model is to specify the geographic area, occupational coverage, and the time frame of the analysis. A properly specified model serves as a framework for determining the type and detail of data required.

Specifying the model requires a thorough examination of the occupation's skill content, traditional training and hiring requirements, institutional characteristics such as unionism and licensure, personal characteristics of the workers, and a variety of other qualitative and quantitative factors.

The initial investigation may indicate that the occupation is not readily adaptable to structural analysis. If the skills required are minimal or quickly learned, the sources of supply are probably so diverse that the model becomes extremely difficult to specify. Also, diversity may mean that the skill content is not well defined. Problems of collecting information on how workers acquire their skills and on the number of workers available from each source are complicated by a greater number of sources of training. Furthermore, supply components that are the most difficult to analyze, such as occupational transfers, are likely to become more significant. The potential supply of typists, for example,

<sup>4</sup> Commuters, i.e., persons who live in one State or area but work in another, are not included as migrants.

may include all persons in and out of the labor force who know how to type. Unless workers are barred by discrimination, geographic immobility, lack of information, or other barriers, they move in and out of such occupations as job opportunities and relative wages change.

*Defining the geographic area.* In general the geographic definition should approximate the economic labor market area applicable to the particular occupation. The economic labor market area may be defined as the area within which workers compete for jobs and employers compete for workers.

Although the economic labor market area for most occupations is local in nature, market areas for some occupations may encompass larger State or regional areas, or even the entire Nation. Occupations with regional or national market areas are generally those requiring extensive training, such as airplane pilots or college teachers. Large market areas also apply to some occupations with very specialized skills employed in major construction projects such as subways, bridges, and tunnels.

The ultimate usefulness of the analysis is likely to be affected if the area is improperly defined. If the area is too narrowly defined, workers who are part of the economic labor market area may not be included; if the area is too broadly defined, workers outside the market area will be included and may conceal actual supply patterns. Analysis of the supply of clerical workers in Washington, D.C., for example, would exclude large numbers of commuters if the definition were restricted to the District of Columbia and excluded surrounding areas in Virginia and Maryland. On the other hand, too broad a definition, e.g., including the entire States of Maryland and Virginia, would count persons who are really part of the supply for other labor market areas.

Most users will find their flexibility in defining the geographic area severely limited, since most data collection is conducted within politically defined boundaries. Also, supply analysis usually is undertaken to design or evaluate a program for a specific area with arbitrary political boundaries, such as a county or State. In cases where the analysis requires data for an economic area that does not match the political unit for which data are available, the alternative is to select the unit or combination of units that best approximates the area under analysis. In the example of Washington, D.C., the Standard Metropolitan Statistical Area probably approximates the economic labor market area for most occupations.

*Defining the occupation.* Flexibility in defining the

occupation is usually limited because, unless new data collection is undertaken, the definitions in existing data must be used. Although many data are classified according to established systems such as the *Census Classified Index of Industries and Occupations* or the *Dictionary of Occupational Titles*, a variety of other classification systems are also used, sometimes applicable only to a single survey. The Office of Management and Budget, in cooperation with other Federal agencies, is currently developing the Standard Occupational Classification System which will eventually be used in all Federal collection of occupational data.<sup>5</sup>

Selecting the appropriate definition usually involves choosing from among various levels of skill, or between limited and broad areas of specialty. The criteria for selection depend mainly on the particular use of the analysis. Education planners, for example, may wish to focus on the supply of workers with a certain level of education. Unions and professional associations may be interested only in the supply of licensed or certified workers. Manpower analysts assessing the impact of a policy or program may sometimes wish to concentrate on workers with narrowly specialized skills, and at other times on those with a broad range of skills.

Care must be used in selecting a definition. One that is too narrow may lead to overly complicated problems of identifying related training and measuring occupational transfers. Analyzing the supply of chemical engineers, for example, would require data not only on graduates with chemical engineering degrees, but information on transfers between different types of engineering specialties. Because such transfers occur in fairly large numbers and are difficult to measure statistically, it is doubtful that analyzing narrow engineering specialties would provide much significant information on the supply in any one specialty.

Too broad a definition, on the other hand, may fail to produce meaningful supply information, especially information for planning specific education and training programs. For example, while information on the total supply of college graduates may be useful for some types of educational planning, it is of little use in determining the allocation of funds among different types of degree programs.

<sup>5</sup>For discussion of economic criteria of occupational classification, principally high elasticity of technical substitution among members of an occupational class, see Glen Cain, W. Lee Hansen, and Burton A. Weisbrod, "Classification of Occupations: Some Problems of Economic Interpretation," *Proceedings*, American Statistical Association, 1969, pp. 199-203. The relationship between occupational definitions and wage cross-elasticities is discussed in chapter 2 of this bulletin.

*Defining the time frame.* The appropriate time frame will depend on the user's needs and the availability of data. "Snapshot" or one-point-in-time analysis, requiring data for only one period, may provide sufficient information for identifying immediate supply problems and for a few other uses.

However, because most users are concerned with planning for the future, they require projected information on supply conditions. The preparation of projections usually depends on the availability of enough historical data for trend analysis. Ideally, the data should permit analysis of the flows of workers into and out of the occupation through a span of time long enough to measure rates of flow with reasonable reliability, and to observe how these rates change in response to various conditions.

### **Estimating current supply**

Estimates of current supply should include the number of persons employed and the number seeking work in the occupation. The availability of employment data is essential to supply analysis, while unemployment data can be more easily omitted because the unemployed are generally a small proportion of total supply. However, omission of information on unemployment deprives the user of one of the best indicators of surplus/shortage conditions.

### **Identifying and estimating entries**

Several methods are useful for identifying the training requirements and the significant sources of entries in an occupation. Each is based on the description of skills and job duties set forth in the occupational definition and on information about traditional entry patterns.

Employer interviews are one source of data. Employers describe their hiring requirements, listing the specific skills needed, the acceptable qualifications, and the kind of on-the-job training provided. Data obtained from employers must be interpreted with care, however. Employers may set forth the *desired* hiring standards—what kinds of workers they would *like* to hire—instead of the standards they actually use. Also, hiring standards are flexible. Comprehensive analysis requires information on how and why employers change hiring standards and internal job structures as labor market conditions change.

Labor unions, professional associations, government regulatory or licensing agencies, and similar organizations can also be sources of data on skill requirements and entry qualifications. Again, data must be carefully

interpreted to avoid using information that is biased because of special interests.

Another method of identifying specific sources of entrants is to examine the characteristics of workers already employed in the occupation. Such information is more likely to reflect actual entry patterns than the biases of interview respondents, especially when identifying occupational transfers and entrants with related training. The investigation should be concerned with the workers' skills, their training and experience, and their type of entry (occupational transfer or labor force reentrant, for example). Complete training information would identify the specific and related training by length, content, type of program, type of institution, and degree or certificate received. Additional data on personal characteristics of entrants such as age and sex, on the reasons for reentry of persons outside the labor force, and on the previous occupations of occupational transfers are useful for identifying and analyzing patterns of entry, reentry, and transfer.

Once the sources of entry have been identified, data must be obtained on the number of entrants from each source. Historical estimates are required for analysis and projection purposes.

Information on the number of entrants from each source of specific or related training usually includes several kinds of data. First, the number of graduates or training completions during the appropriate time period must be known. Second, the number of graduates who actually enter the occupation must be known. These two quantities are then used to compute an entry rate. In some cases entry rates must take into account graduates who are already employed in the occupation before they complete their training, and who therefore cannot be counted as new entrants. Third, complete analysis of entries requires information on factors affecting entry rates, such as relative wages or job opportunities. These factors may then be taken into account in projecting entry rates under different conditions.

Estimating entries from occupational transfers requires longitudinal data that identify the types of transfers and allow the development of rates of transfer into and out of the appropriate occupations. These data may be reduced to flows of workers into the occupation over a given time, such as average annual flows.

Estimating entries from outside the labor force requires information on the "pool" of individuals from which entrants come, and rates of entry. The pool is the difference between the current supply and the potential supply defined earlier, and includes all persons outside the labor force who are qualified for the occupation by their training or experience. For example, a woman trained as a teacher who remains outside the labor force

is part of the pool for teachers. Newly discharged members of the Armed Forces may become members of the pool for the occupations their military training qualifies them to enter.

Measuring the number of entrants from immigration requires data on the occupations of individuals entering the country from abroad, as well as some information or assumption about their expected participation in the labor force. On the State and local levels, much more detailed data are required on migration into and out of the area, and on the labor force and population characteristics of migrants.

In the absence of detailed data on immigration and outmigration, a residual method may be employed to estimate net migration. If all other components of the change in supply from one period to the next can be measured, net migration is assumed to be equal to the difference between the observed change in supply and the changes accounted for by the other components.<sup>6</sup>

### Identifying and estimating separations

Identifying types of separation is a much less com-

plex matter than identifying sources of entry, since there are only four possible types of separation: occupational transfers, labor force separations, deaths, and emigration. Of these four, occupational transfers and emigration are likely to be the most difficult to identify.

Occupational transfers and emigration may be handled by using simple rates of separation, requiring data on the proportion of those workers who transfer out each year. Although data are not always available, a more complete analysis would require identification of the occupations and areas to which workers transfer, rates of transfer for each occupation, and data on the characteristics of the transfers and the reasons they transfer.

Deaths and labor force separations can generally be estimated by applying rates of separation to the total supply. Methods and data requirements for developing the rates are described in chapter 3.

<sup>6</sup> A similar method was used by Jaffe and Carleton to measure occupational mobility. See ch. 3, p. 24.

## Chapter 2. A Functional Model of Occupational Supply

Manpower and educational policies are often intended to treat problems arising from labor markets operating under a variety of imperfections, such as lack of knowledge on the part of workers and employers, barriers to occupational and geographic mobility, and other conditions. To devise effective policies, therefore, decisionmakers need to know how an occupational market functions as well as what the supply structure is. They need to know why entry and separation rates vary, what causes shortages or surpluses, and how workers react to changing wages, job opportunities, and working conditions.

Analysis of supply behavior requires a functional model of the occupational labor market derived from traditional price theory. This type of model expresses supply as the relationship between the wage rate and the number of workers willing to work. Functional models range in complexity from a simple graph of supply and demand curves to an econometric system expressed in mathematical form. Regardless of their complexity, however, all functional supply models share one characteristic: the wage rate is viewed as the primary mechanism for the interaction of supply and demand.

Two points deserve clarification. First, the use of a functional model does not imply that the wage rate is the *only* factor affecting supply. A worker's occupational choice and labor market behavior are obviously influenced by individual preferences, abilities, and non-monetary incentives as well as by economic considerations. The occupational choice of the vast majority of workers may in fact be unaffected by changes in wages. Economic theory asserts only that there are some individuals on the borderline between choices who, all else being equal, do respond to economic stimuli.

Secondly, a functional model cannot *a priori* describe the relationship between wages and the supply of workers, or between wages and the demand for workers. The application of a functional model does not assume, for example, that workers are in fact responsive to changing wages. The degree of responsiveness can be determined only from empirical evidence. If workers are shown to be totally unresponsive to wage changes, this evidence can be represented in a functional model as a vertical or perfectly inelastic supply curve. The existence

of inelastic supply or inflexible wages, therefore, does not render the model inoperative; it only changes its representation of the market.

A functional model can provide many kinds of information about supply. For example, in evaluating the impact of a particular federally supported program, policymakers want to know whether the program will merely drive wages up in certain occupations or whether supply will expand to meet the new demand. Estimates of wage elasticity derived from a functional model will help answer this question. A functional model can also point out the appropriate types of policy by describing the effects of inflexible wages, monopsony, immobility, time lags, and other market conditions on supply.

The remainder of this chapter discusses the use of the functional model, emphasizing data requirements, and presents two important applications of the model: analysis of elasticity, and identifying shortages and surpluses.

### USING A FUNCTIONAL MODEL

The value of the information derived from the structural model discussed in chapter 1 will be increased if causal relationships and predictable behavior patterns can be estimated for the various components of total supply. A functional model is, therefore, a means of expanding the analysis of occupational supply begun with the structural model. Functional analysis requires the same data base as structural analysis, with two important additions. Data on relative wages must be available in order to estimate the relationship between wages and various aspects of supply, and the data must be available in enough time series or cross-section observations for multivariate analysis.

The inclusion of the relative wage concept immediately raises the problem of selecting the appropriate base for comparison. On the aggregate level, comparisons are usually made with "average" earnings for some segment of the labor force, such as prime-age male workers. For models disaggregated to the occupational level, however, the solution is not so convenient. The comparisons must represent the actual alternatives faced by individual



workers. For example, a relative wage estimate comparing earnings of chemists with earnings of factory workers does not represent a realistic choice, at least in the short run. Comparison between chemists and other scientific occupations, or even other professional and technical occupations, would provide a more relevant measure of relative wages. In occupations with a large proportion of women, the relative wage estimate may include some measure of the choice between wages and unpaid household work.<sup>7</sup>

The selection of the relative wage measure suitable for analyzing each type of entry or separation should be guided by the alternatives specified in the structural model. Relative wages appropriate to occupational transfers, for example, should include comparisons between the given occupation and the occupations workers transfer to and from. Entries from specific training should be analyzed using relative wage comparisons for the occupation and the other occupations for which the training is applicable.

Once the proper specification of the relative wage variable is determined, at least two sets of data are required: wage data for the occupation, and wage data for the alternative occupations. The wage data should of course be consistent in form from one occupation to another, and in the same time period and coverage as the other supply data.

## ELASTICITY

One of the most significant applications of functional supply models is the analysis of the elasticity of supply. This topic is discussed in detail here to introduce illustrative functional supply models and to demonstrate their use in policy determination.

Elasticity of supply is a measure of the responsiveness of workers to changing economic incentives, particularly wage rates. The coefficient of elasticity, represented by the Greek letter eta,  $\eta$ , is measured by the percent change in the supply (N) resulting from a 1-percent change in the wage rate (W):<sup>8</sup>

$$\eta_{nw} = \frac{\Delta N}{N} \div \frac{\Delta W}{W}$$

Supply is described as "elastic" if  $\eta$  is greater than 1, "inelastic" if  $\eta$  falls between 1 and zero, and "perfectly inelastic" if  $\eta$  equals zero.

The closely related concept of cross-elasticity measures the effect of changing wages in a related occupation on supply. The coefficient of cross-elasticity is defined as the percent change in supply (N) resulting from a 1-percent change in wages in alternative occupations (A), assuming W remains unchanged:

$$\eta_{na} = \frac{\Delta N}{N} \div \frac{\Delta A}{A}$$

Analysis of elasticity is crucial to successful manpower policy. In analyzing the impact of a government program such as health research, for example, manpower planners want to know if the supply of biochemists can be expanded at a desired rate without disruptive salary increases. The coefficient of elasticity indicates how salary levels will change as the required number of biochemists is supplied. Coefficients of cross-elasticity measure the impact of the increased biochemists' salaries on the supply of other biological scientists, technicians, and other related occupations. Finally, analysis of the factors that determine elasticity can indicate possible policies that will increase elasticity, that is, ways of adjusting supply while minimizing the disturbance of relative wage levels.

Cross-elasticity can also serve as an indicator of the appropriate occupational definition. If the occupation is too narrowly defined, there will be high cross-elasticities with other occupations, indicating the ease of transferring skills.<sup>9</sup> This is an important consideration when using supply information to plan training programs. Analysis of cross-elasticity also reveals how an occupation's supply will react to changing conditions or policies for related occupations. The higher the cross-elasticities, the more likely the occupation will be significantly affected by disturbances in the markets for related occupations.

Elasticity depends primarily on the sensitivity of individuals to relative wages. This sensitivity, however, is likely to be influenced by the skill characteristics of the occupation and by the occupation's supply structure. Occupations with high skill levels, and therefore with rigid training requirements, are likely to have rather inelastic supply in the short run, since there may be no other source of supply besides entrants from specific training programs. Physicians, for example, must be medical school graduates; the only other significant source of new physicians is immigration. Elasticity is further limited by the fact that workers do not easily transfer to other occupations. Their skills may be so specific that they are not transferable to other occupations, or workers may be reluctant to forfeit their

<sup>7</sup> Attempts to quantify this choice are common in the literature on female labor force participation; see Juanita Kreps, *Sex in the Market Place* (Baltimore: Johns Hopkins Press, 1971), chs. 4 and 5.

<sup>8</sup> W may also represent discounted lifetime income, expected instead of actual wages, relative wages, or a number of other wage concepts.

<sup>9</sup> See Cain, Hansen, and Weisbrod, "Classification of Occupations."

investment in costly and lengthy training by leaving the occupation.

On the other hand, elasticity is likely to be rather high in occupations where skills required are minimal or can be readily obtained from a number of different sources. Workers can easily enter the occupation in response to higher wages, and will find it easier to transfer out of the occupation than will workers with very specialized skills. High elasticity indicates that the market adjusts through the wage mechanism and, therefore, policy actions affecting supply are probably unnecessary.

Elasticity is also affected by nonwage incentives and barriers which affect the worker's ability or willingness to enter or leave an occupation. Entrants into training programs, for example, consider not only the relative earnings of the occupation for which they are being trained, but also the direct costs of training and the indirect cost of earnings foregone during the training period. They also consider the "cost" imposed by the limited availability of the desired training because of inadequate facilities or barriers to entry such as union rules or racial discrimination. A variety of similar types of barriers and incentives affect the behavior of workers in nearly every component of supply. These include licensing rules or fees, seniority rights, advancement opportunities, fringe benefits, training subsidies or loans, lack of information about alternative jobs, relocation costs, as well as working conditions and occupational prestige.

Policymakers need to know how nonwage barriers and incentives affect supply, since many educational and manpower policies are directed toward lessening or increasing such factors. Career guidance information such as that in the occupational outlook program of the U.S. Department of Labor,<sup>10</sup> for example, increases workers' knowledge about job alternatives. Recent cut-backs in National Defense Student Loans to students in teacher training decreased nonwage incentives by increasing the difficulty of financing training, thereby reducing the supply of new teachers. Elasticity analysis can provide information on the impact of such policies on supply, and therefore serve as a guide to formulating and evaluating policies.

Two recent examples of applications of functional analysis are concerned with the health manpower field. Since World War II there has been much concern about shortages of health personnel, particularly nurses and physicians in general practice. Christine Bishop has

examined the elasticity of the supply of nurses entering from outside the labor force as a possible means of increasing nursing supply in the short run.<sup>11</sup> Frank Sloan has studied the influence of earnings on physicians' choice of narrow specialization instead of general practice and uses the results to evaluate suggested income incentive policies to increase the supply of general practitioners.<sup>12</sup>

The Bishop study points out that because the reserves of trained workers are generally small, manpower planners tend to concentrate on policies to make professional training opportunities more available and attractive to potential entrants. In occupations composed largely of women, however, significant reserves of workers do exist but have been largely ignored by manpower policy.

Bishop explores the potential for short-run expansion of the supply of nurses by constructing a functional model that estimates the elasticity of the labor force participation rate of nurses with respect to salary, and tests the model on a cross-section sample of married nurses. The model includes factors influencing participation of nurses such as alternative work, homemaking, child-care responsibilities, husband's income, and characteristics of labor demand. The results of testing the model on a limited sample of married nurses are consistent with findings of other researchers. The supply is shown to have a relatively low elasticity with respect to salary, with a coefficient of about 0.54. This finding indicates that the effect of rising relative salaries on supply should be considered in projecting future supply.

Sloan's study uses a similar procedure but produces dissimilar results. Sloan hypothesizes that the shortage of physicians in general practice may be caused by better income opportunities in specialized medicine attracting physicians out of general practice. The objectives of the study are to determine whether lifetime earnings influence physicians' choice of field and, if so, to estimate the elasticity of supply with respect to income. The evidence shows that income differentials do exist, but they do not explain why medical school graduates enter specialties instead of general practice. Choices among various specialties are only somewhat responsive to income differences.

The policy implications of these results are of interest. The low elasticities of supply with respect to income indicate that neither subsidies to practicing physicians nor increases in stipends to residents in

<sup>11</sup> Christine E. Bishop, "Manpower Policy and the Supply of Nurses," *Industrial Relations*, February 1973, pp. 86-94.

<sup>12</sup> Frank A. Sloan, "Lifetime Earnings and Physicians' Choice of Specialty," *Industrial and Labor Relations Review*, October 1970, pp. 47-56.

<sup>10</sup> See the *Occupational Outlook Handbook, Occupational Outlook Quarterly*, and related publications of the Bureau of Labor Statistics.

“shortage” specialties would be useful policy instruments for attracting medical school graduates into these fields.

## IDENTIFYING SHORTAGES AND SURPLUSES

The terms “shortage” and “surplus” unfortunately have taken on a variety of meanings, as evidenced in the debate over the supply of scientists and engineers since the mid-1950’s. Employers, workers, professional associations, educational and manpower planners, and other observers discussed the situation using different, and usually unstated, definitions of a shortage. This debate called attention to troublesome and sometimes serious problems related to engineering and scientific manpower. However, because of lack of understanding of the economic meaning of a shortage, the discussion often obscured the analysis of the problems, their causes, and their solutions. Since this difficulty applies to other occupations as well, a brief review of the concepts of shortage and surplus may help clarify some key issues in supply analysis. The review also illustrates the value of functional analysis in defining and identifying supply-demand imbalances.<sup>13</sup>

In traditional economic terms, a shortage occurs when employers seek to hire more workers than are willing to work *at the given wage rate*. Unless there is some obstacle preventing adjustment of the wage level, the shortage will be eliminated as wages rise and more workers are attracted into the occupation. However, this does not mean that a shortage will always disappear automatically or that no difficulties will arise.

There are a number of factors that may cause disequilibrium to persist. Wages may be inflexible due to legal constraints or rigid internal wage structures. Adjustment may be slowed, and the shortage thus continued, because workers and employers are unaware of wage adjustments occurring elsewhere in the market, or merely because a long period of time is necessary for getting new workers into training and then into the job market. The supply may be highly inelastic, that is, workers are reluctant to enter the occupation in spite of increasing wages because of low social status, poor working conditions, or because the education and

training are long, difficult, or expensive.

One interpretation of the shortage of scientists and engineers that fits well into the economist’s view is the adjustment process described by Arrow and Capron as a “dynamic shortage.”<sup>14</sup> The dynamic shortage is the failure of supply to “catch up” to continually expanding demand. When wages are already rising in response to previous increases in demand, and when the level of demand continues to rise, excess demand, or a shortage, develops, thereby leading to further wage increases. The shortage remains as long as demand continues to increase at a faster rate than that which would allow supply to catch up to current wage levels.

The dynamic shortage explanation is similar to the “incomplete adjustment” model presented by Freeman.<sup>15</sup> If supply is inelastic in the short run, an expansion of demand will cause relative wages to rise. Higher wages lead to a modest increase in the number of entrants and an ensuing modest reduction in relative wages. As this pattern is repeated over time, relative wages and supply approach equilibrium. Freeman’s research shows that this model is a plausible explanation for the continual shortage of mathematicians from 1957 to 1966, in spite of rising relative salary levels.

In the same study, Freeman presents a cobweb model that may be used to explain the recurring shortages and surpluses of B.S. engineers. According to the cobweb model, an increase in demand causes wages to rise, attracting a large number of workers into the occupation. Because workers enter in such large numbers, wages subsequently fall, leading to a reduction in supply in the next period. Wages and the number of entrants continue to oscillate in smaller and smaller magnitudes until equilibrium is reached several periods later.

Whether a market follows the cobweb adjustment or the incomplete adjustment depends on the elasticity characteristics of supply and demand. The cobweb is more likely if demand is inelastic, because the burden of adjustment falls almost entirely on wages. The cobweb is also likely if supply is elastic, because a change in wages will produce a change in the supply large enough to overshoot equilibrium. Incomplete adjustment is likely if workers’ wage expectations are lower than actual wages, because an increase in actual wages cannot attract enough new entrants to reach equilibrium.

Arrow and Capron and Freeman present economic

<sup>13</sup> The bulk of the following review, except where noted otherwise, is taken from A. A. Alchain, K. J. Arrow, and W. M. Capron, *An Economic Analysis of the Market for Scientists and Engineers* (Chicago: Rand McNally, 1958). Additional useful discussions may be found in Hugh Folk, *The Shortage of Scientists and Engineers* (Lexington, Mass.; D. C. Heath and Co., 1970); and W. Lee Hansen, “The Economics of Scientific and Engineering Manpower,” *Journal of Human Resources*, Spring 1967, pp. 191-220.

<sup>14</sup> Kenneth J. Arrow and W. M. Capron, “Dynamic Shortages and Price Rises: The Engineer-Scientist Case,” *Quarterly Journal of Economics*, May 1959, pp. 292-308.

<sup>15</sup> Richard B. Freeman, *The Market for College-Trained Manpower, A Study in the Economics of Career Choice*, (Cambridge: Harvard University Press, 1971), pp. 22-27, and ch. 8.

interpretations of shortages. Several other interpretations are common, however, and are confusing because of their conflict with economic analysis. While such statements may point out legitimate problems, they do not point out shortages in the economic sense. The distinction is important because the economist's prescriptions for removing a shortage, such as removing imperfections which prevent the wage rate from adjusting to its equilibrium level, may do nothing to meet the pleas of those using shortage in another sense.

Another commonly discussed type of "shortage" is the projected demand shortfall.<sup>16</sup> Shortages of workers are projected by comparing independently derived projections of "requirements" and supply for some target year, assuming certain economic conditions. Various types of manpower and educational policies are called for to alleviate such shortages. Some policies are designed to influence flows of workers into certain occupations, either by exhortation or by reducing the costs of entry; others are aimed at reducing demand, such as restructuring jobs or substituting machines and other kinds of manpower for workers in shortage occupations.

Projections unfortunately are made with little or no consideration of how well the wage mechanism operates in the particular market, and rarely make explicit assumptions about relative wages. They usually carry the implicit notion that market adjustment processes are defective or at least subject to extended lags.

Perhaps the most confusing use of the term "shortage" is to describe situations where a significant increase in demand and/or decrease in supply has resulted in a major rise in wages. Then, even if there is no shortage in the economist's sense (i.e., even if the wages rise as much as required to clear the market under the new supply-demand conditions), many employers who formerly hired some of the workers in question and now find the wage so high they no longer hire as many will describe the situation as one of "shortage." Actually, this is merely one way of saying that they cannot hire the workers at the price they used to pay. However, the economist would not describe this change as a shortage

because there is no evidence that wages did not rise sufficiently to eliminate excess demand.

Another use of "shortage" is a normative one. Many observers who have expressed concern that the supply of engineers and scientists, or health workers, or technicians, is insufficient seem really to be saying that the demand (and therefore the supply) *should* in their judgment be higher than it is. They may say, for example, that there is a "shortage" of doctors because an increase in the number of doctors is needed to achieve some given standard. Or, in a case of rapidly rising wages, the situation may be considered a shortage, even though equilibrium exists, because wages are judged by some noneconomic criteria to be "too high."

Manpower discussion has recently turned from shortages to surpluses, but the confusion over the economic meaning of such "imbalances" has not lessened. A surplus is, of course, the opposite of a shortage. In economic terms, a surplus occurs when more workers are willing to work than employers are willing to hire *at the given wage rate*. The surplus will be eliminated if wages are allowed to fall to a new equilibrium level.

Many observers point to "surpluses" that are in fact not surpluses at all but situations where relative wages are falling in response to an increase in supply or a decrease in demand. Actions to prevent wages from falling, usually by reducing supply or by increasing demand, are often proposed as remedies to such "surpluses." Such remedies may be beneficial. Reducing supply in a given area or occupation by increasing workers' geographic or occupational mobility, for example, will certainly ease the labor market's adjustment. Some policies are designed to minimize the social costs of unemployment and other side effects of a supply-demand readjustment. The important distinction to be made is that these policies are *not* treating a surplus, since the surplus is eliminated by allowing relative wages to fall to a new equilibrium. The policies are instead addressed to the social costs imposed by the fact of falling relative wages: decreased income, unemployment, immobility, and underutilization of skills.

Identifying supply-demand imbalances and designing policies to treat imbalances and their side effects require careful application of functional analysis. Policymakers must know how wage levels have changed in the past, and how workers and employers have responded to these changes, in order to understand the causes and remedies for any imbalances that might arise.

<sup>16</sup> Discussion from Hansen, "The Economics of Scientific and Engineering Manpower," pp. 195-96. See also Folk, *The Shortage of Scientists and Engineers*; and Alchain, Arrow, and Capron, *An Economic Analysis*, pp. 67-68.

## Chapter 3. Available Supply Data

The results of supply analysis, even with a perfectly specified model, can be only as complete and accurate as the basic data used. Because the level of accuracy and detail for information required varies from one program or policy to another, there is no one minimum standard quality of data applicable to all situations. The major consideration in setting quality standards is the ultimate use of the results. Supply information for vocational guidance purposes, on the one hand, should provide general information about the future supply of workers. Manpower planners, on the other hand, need highly accurate and detailed information on supply in order to design effective programs and policies.

Another consideration in setting quality criteria is the type of occupation being analyzed. The consequences of error are likely to be greater in occupations with inflexible supply structures. If there are only a few sources of entrants, a significant error in estimating supply of these entrants may actually induce supply-demand imbalances when carried through in designing and implementing an effective policy. For example, if the future supply of physicians from immigration is greatly overestimated, the expansion of medical schools and therefore the increasing supply of new doctors may be insufficient to meet future demand for medical care.

The level of detail required in supply data is determined by the specification of the model and the final use of the results. The need for greater detail requires data with greater accuracy. Accuracy and detail, however, are not often found together in most data. Unless the data are based on an extremely large sample, estimates for detailed items usually have unacceptably large errors.

This chapter discusses the national supply data available for use in the structural and functional models, including current supply data, information on entries from training programs and other sources, information on all types of separations, and wage data. The type and frequency of data collection, coverage, level of accuracy, and the limitations of most data sources are discussed. Studies of issues in manpower analysis and studies of specific occupations are also included.

Specific publications containing the data discussed in

this chapter are generally omitted from the text but are listed in the bibliography starting on page 30. Items including State or other subnational data are so designated in the bibliography. The numbers in parentheses following each discussion refer to the specific publications in the bibliography.

### CURRENT SUPPLY

Current supply data include information on employment and unemployment by occupation, and also supplementary data on personal, economic, and demographic characteristics of workers. Most current supply data are collected through surveys of establishments, households, and individuals, or are compiled from administrative and membership records of organizations with a special interest in the occupation, such as professional associations and regulatory agencies.

The concepts used to obtain counts of people in various occupations differ from source to source. The Current Population Survey (CPS), for example, is a survey of a sample of households representing the entire population. Employment estimates include persons 16 years of age and older who are currently employed within the United States and who are not members of the Armed Forces. Employed persons holding more than one job are counted only once and are classified according to the job at which they worked the greatest number of hours.

Surveys of establishments, such as the occupational employment survey program of the Department of Labor, generally have less complete coverage of the labor force than household surveys. Firms with fewer than a minimum number of workers, or those outside metropolitan areas of a given size, may be excluded from the sample. Also, the survey may be confined to a single industry. Establishment data represent the number of jobs, not the number of workers, since persons holding more than one job are counted more than once.

Data from professional associations, regulatory agencies, and similar organizations generally provide only partial coverage, because their purpose is to present

membership counts or counts of licensed persons in particular occupations, whether or not they are currently employed. Therefore, it may be necessary to adjust the data to include workers who are not members of the association, who are not licensed, or who fail to meet some other criteria. Adjustments may also be needed to exclude retired persons, those working abroad, members of the Armed Forces, and other groups. For example, to make the data for physicians from the American Medical Association comparable to data for other occupations surveyed by the Bureau of Labor Statistics, the data must be adjusted to exclude members of the Armed Forces and physicians practicing outside the United States. In addition, physicians who are teaching full time and those who are engaged in research must be subtracted from the total count of physicians.

In most occupational data, individuals are classified according to the jobs at which they are working, rather than the crafts, disciplines, or specialties for which they consider themselves best trained. Thus, a person trained as a teacher but working as a salesman should be counted as a salesworker rather than as a teacher, and would be reported as such by his employer. However, if one were to ask the individual, he might say he was a teacher. This discrepancy partially accounts for the difficulty in reconciling data from surveys of self-reporting individuals with data from employers.

### **Census of Population and Current Population Survey**

The Census of Population provides the most comprehensive and detailed data available on current supply. Data include employment and unemployment for 445 detailed occupations by color, sex, industry, class of worker, earnings, and a variety of other characteristics. Data are also available by State, region, and Standard Metropolitan Statistical Area (SMSA), but not in as much detail as for national data. Special tabulations are available at cost from the Bureau of the Census. (1-3)

Although census data present a wealth of detail, their usefulness is limited because of lack of timeliness: data are collected at 10-year intervals and are about 3 years old by time of publication. Use of census data for long-run trend analysis is further complicated by changes in occupational classification from one census to another.<sup>17</sup>

*The Current Population Survey (CPS)*<sup>18</sup> is the only source of frequent data on employment by occupation. Estimates of employment for nine major occupational groups are published monthly by the Bureau of Labor Statistics. Annual averages of employment and unem-

ployment in considerable occupational detail have been tabulated since 1962, and have been published beginning with 1972. Unemployment estimates for individual occupations and total employment estimates for the smaller occupations (under 100,000 workers) are unreliable, especially when used to construct trends, primarily because of the small sample size for disaggregated data. (4)

### **Occupational employment statistics program**

The occupational employment statistics (OES) survey program of the Department of Labor is designed for use in developing occupational employment estimates by industry, which may be used for producing a time series of estimates of total employment by occupation through the industry-occupation matrix discussed below. The program is currently conducted by State employment security agencies in about 25 cooperating States and the District of Columbia. Surveys are conducted by the States, with comprehensive and detailed technical guidance by the BLS. Resulting data will be for States and some substate areas, although earlier surveys produced national data. Further details on the OES program, including the States and industries covered, are available from the Bureau of Labor Statistics in *Occupational Employment Statistics, 1960-70*, Bulletin 1738, 1972, and from the Bureau's Division of Manpower and Occupational Outlook. (5, 6)

### **Surveys of scientific and technical personnel**

From the mid-1950's to 1970, BLS conducted periodic surveys of scientific and technical manpower. The estimates for scientists, engineers, and technicians covered by these surveys include only wage and salary employees in most of private industry. The National Science Foundation also collects employment data for these workers in colleges and universities and in non-profit organizations. The 1970 BLS survey covered a universe of about 27 million workers from which a

<sup>17</sup> For elaboration of this problem, see John A. Priebe, Jean Heinkel, and Stanley Greene, *1970 Occupational and Industry Classification Systems in Terms of Their 1960 Occupation and Industry Elements*, Technical Paper 26 (Bureau of the Census, July 1972).

<sup>18</sup> For elaboration on the CPS, see *Concepts and Methods Used in Manpower Statistics from the Current Population Survey*, Report 313 (Bureau of Labor Statistics, June 1967), and *The Current Population Survey—A Report on Methodology*, Technical Paper No. 7 (Bureau of the Census, 1963).

sample representing about 16,000 establishments was drawn. These surveys provide the most reliable occupational data available on scientific personnel in private industry. (7, 8)

The collection of data for scientists, engineers, and technicians was part of a program to provide occupational statistics on the Nation's scientific and technical manpower in higher education, private industry, and the Federal Government. However, since 1971, the collection of occupational data for scientists, engineers, and technicians in private industry has been included in the occupational employment statistics program of the Department of Labor.

Employment of scientific, professional, and technical personnel by State governments in January 1964 and 1967 was obtained from sample surveys conducted by the BLS. State data are for the 50 States and exclude State educational institutions. Similar surveys of State government employment were made for 1959 and 1962, but they are not comparable in all their detail with the later surveys. (7, 8)

### **Industry-occupation matrix**

An industry-occupation matrix provides a comprehensive set of data on industry-occupational relationships that can be used in projecting manpower requirements by occupation. A matrix shows the occupational pattern of each industry, i.e., the ratio of each occupation to total employment in an industry. Looked at another way, the matrix shows how total employment in an occupation is distributed by industry.

Although detailed occupational employment data are available only from the decennial census, total employment estimates for detailed industries are available on at least an annual basis. Because each industry utilizes a unique combination of occupational skills, information on employment trends in individual industries can be used together with available data on changing occupational employment patterns by industry to estimate employment by occupation for later periods. If projections of employment by industry are available, the base period occupational ratios, or projected ratios if possible, can be applied to the industry employment projections to yield projections of occupational employment requirements by industry. These estimates may then be summed for all industries to yield national estimates.

The matrix approach is not without its limitations. The most difficult problem is the incorporation of changes in skill inputs, reflected by occupational coefficients in the matrix, resulting from changes in output levels, technology, and prices of both labor and capital

inputs.<sup>19</sup> If the occupational coefficients are sensitive to such changes, and if various skill inputs are substitutable, projected matrices should take into account changing supply and price conditions for these occupations. However, adjustments of coefficients are currently based on extrapolation of past trends and judgments derived from qualitative knowledge of the particular industry or occupation. (9-11)

BLS has developed a comprehensive set of data on the occupational employment composition of all major industry sectors. Publications include data for 1960, 1967, 1970, 1975, and 1980, set up to form a matrix of 162 specific occupations plus groupings of occupations cross-classified with 116 industries. Revised 1970 and 1980 matrices including approximately 400 occupations and 200 industries are currently being prepared.

Data for the industry-occupational matrices are brought together from a wide variety of sources, including the decennial census, the CPS, surveys by BLS and other agencies, and data reported by regulatory agencies. Projected matrices are consistent with trends in production and nonproduction worker employment by industry, and anticipated trends in occupational structure within industries.

BLS is currently developing industry-occupation matrices for the 50 States and the District of Columbia, and one for the New York-Northern New Jersey consolidated area. The matrices will be consistent with the national matrix in format, coding structure, and employment concepts, and will be based primarily on 1970 census data. Work is also proceeding on a matrix system for SMSA's of 250,000 persons or more. These State and SMSA matrices will be completed during 1974. The matrices will eventually incorporate data from the occupational employment surveys.

### **Bureau of Labor Statistics wage surveys**

BLS conducts a variety of establishment surveys to collect occupational wage data. Many of these surveys provide reliable occupational employment data as well, although they may be restricted in industry and establishment-size coverage.

*Industry wage surveys* provide employment data for 50 manufacturing and 20 nonmanufacturing industries. Most are surveyed every 5 years, but a number of low-wage industries are on a 3-year cycle. (12)

<sup>19</sup> See R. C. Hollister, "The Economics of Manpower Forecasting," *International Labour Review*, April 1964, pp. 371-97.

*Area wage surveys* provide annual employment estimates for about 80 occupations, by sex, in six industry divisions. The surveys cover establishments with 50 workers or more (100 or more in some industries) in about 90 metropolitan areas. (13)

#### **U.S. Department of Health, Education, and Welfare**

The *Office of Education*, National Center for Education Statistics, publishes annual employment estimates and 10-year projections of requirements for elementary, secondary, and college teachers, and librarians. The teacher estimates for public schools are provided by the State departments of education, and those for nonpublic schools are provided by individual schools. The estimates for librarians include all full-time librarians and full-time equivalent estimates for those working part time. Special librarians—who work in libraries maintained by commercial and industrial firms—and public librarians in cities of 25,000 or more population are included in the estimates. (14, 15)

The *Public Health Service*, National Center for Health Statistics, publishes a variety of data on health manpower, including two series of *Vital Health Statistics* bulletins (17, 18) and an annual report, *Health Resources Statistics*, which summarizes the most important data series. (16) The Public Health Service is also conducting Project SOAR, a comprehensive analysis of health manpower supply, output, and requirements by the Division of Manpower Intelligence, Bureau of Health Manpower, National Institutes of Health. (19)

#### **Other Federal agencies**

The Federal regulatory agencies such as the Interstate Commerce Commission (ICC), Federal Aviation Agency (FAA), and Federal Communications Commission (FCC) provide a rich source of annual occupational employment statistics for regulated industries. Data are generally derived from mandatory company reports filed with the agencies.

Annual information on over 200 occupations and occupational groups is on file with the regulatory agencies. However, some of the broader occupational classifications on file are not consistent with generally accepted occupational classifications from the Bureau of the Census. Nevertheless, the employment trends indicated in the broad occupational categories provide helpful information in discerning changes in employment in occupations within the broad categories.

The occupational estimates derived from the government regulatory agencies include many different occupa-

tional concepts. For example, estimates from the FAA are full-time equivalents, but those from the ICC are an annual average based on the number of employees on the payroll at midmonth for 12 months.

The Interstate Commerce Commission publishes occupational employment data for railroads, the Pullman Company, the Railway Express Agency, electric railways, water carriers, and oil pipelines engaged in interstate transportation. (22, 23)

Occupational employment data for scheduled airlines are compiled primarily from company reports filed with the Civil Aeronautics Board. These data are published annually by the Federal Aviation Administration and the Air Transport Association of America. (20, 26)

Occupational employment information in the telephone industry is available from annual reports of the Federal Communications Commission and the U.S. Independent Telephone Association. The U.S. Department of Labor publishes an annual wage survey in the communication industry containing data compiled from annual reports filed with the FCC by Bell System telephone carriers having annual revenues that exceed \$1 million. Before 1965, the annual revenue test was \$250,000. Annual occupational employment data for the independent telephone segment of the telephone industry are published by the U.S. Independent Telephone Association. The combination of the two reports covers all employment in the telephone industry, except for officials and managerial assistants employed by the Bell System. (21, 25, 27)

Occupational employment data for the telegraph industry are published annually in the BLS industry wage survey of the communications industry. The data are compiled from annual reports filed with the FCC by all companies in the telegraph industry having annual revenues that exceed \$50,000. Data for the six international telegraph carriers include carriers engaged in nonvocal international telegraph communications by radio or by ocean cable. Although many of the occupational groups are in general use by radio, telegraph, or ocean cable carriers, a few are exclusive to one carrier group. For example, radio operators are employed only by radio telegraph carriers, and cable operators only by ocean cable carriers. (25)

The U.S. Civil Service Commission (CSC) compiles data on Federal Government employment (excluding the Central Intelligence Agency and the National Security Agency). Data on white-collar employees cover over 450 occupational series for each of 25 agencies, including one catchall category. Data on blue-collar workers include nearly 1,500 separate occupations combined into 36 specific job families and a "miscellaneous occupations" job family. Data from these and unpub-



lished CSC sources can be used to construct employment trends starting in 1958 for about 400 occupations. (24)

The CSC's occupational classification system generally is not directly comparable with that of the census because of the finer occupational detail and more functional framework found in the CSC system. However, occupations in the CSC system are classifiable into the census system through the *Classified Index of Industries and Occupations*.

#### State employment security agencies

The job order, applicant, and placement activities of the employment security offices of the several States are a valuable source of information on occupational supply. Although the available occupational detail and frequency of reporting on these activities may vary from one State to another, the agencies do provide a generally uniform input in the Employment Service Automated Reporting System (ESARS). It should be noted that data based on the activities of local employment security offices do not measure total manpower needs or job applicants available in any particular labor market. Nevertheless, the data are useful and represent an important part of occupational supply, i.e., that proportion registered with the agencies.

Table 12 of ESARS provides quarterly data on job applicants and nonagricultural job openings by detailed occupation for the Nation, all States, the District of Columbia, and 125 Standard Metropolitan Statistical Areas. The occupational detail follows the first three digits of the *Dictionary of Occupational Titles* (D.O.T.). Approximately 150 occupations are also defined by the six-digit D.O.T. codes, and another 55 are defined by the full nine-digit codes.

Data in table 12 are reported according to the cumulative count of total job applicants as of the final day in the quarter. A separate count is also provided for applicants who are female, veterans, under 22 years of age, 45 years of age and over, minorities, and poor.

Data on nonagricultural job openings also are presented in table 12 according to the cumulative total received since the start of the fiscal year. The cumulative count of mandatory job listings is also reported, along with the cumulative count of openings which have been filled. Separate counts of unfilled job openings, covering both short- and long-term (30 days or more) openings are also provided as of the final day in the quarter. These latter data, particularly for the long-term, reflect unmet demand or inadequate supply at offered wages or salaries. If this is due to the unavailability of qualified job applicants rather than unsatisfactory working or

wage conditions, it can indicate the need for job training.

ESARS data on job applicants and openings have been available since January 1972. In constructing a time series, however, there are some difficulties involved because table formats, occupational detail, and other items have changed over the 3-year operation of ESARS.

#### Professional associations

*Dentists.* Employment information for dentists is published biennially (annually before 1969) by the American Dental Association (ADA). These estimates include all practicing dentists whether or not they are members of ADA. Data on nonmembers are collected through the State licensing boards. (29)

*Nurses.* Employment information concerning nurses is published annually by the American Nurses Association. Nursing estimates are developed from licensure records by the ANA in cooperation with State boards of nursing. (34)

*Optometrists.* The American Optometry Association periodically publishes reports that contain estimates of current manpower as well as future manpower needs. This information is based on licensure and registration data from each of the 50 States and the District of Columbia. The estimates for 1965 through 1970 include only those optometrists who are actively practicing their profession. (35)

*Osteopaths.* Employment estimates for osteopaths are available from the annual report of the American Osteopathic Association. Estimates exclude retirees and those for whom status was not reported. (36)

*Pharmacists.* Employment data before 1967 are published by the National Association of Boards of Pharmacy in the *NABP Bulletin*. Since 1967, employment data for pharmacists are published by the NABP in *Licensure Statistics and Census of Pharmacy*. The data from both sources represent a count of registered pharmacists in practice obtained from NABP census and licensing data. (43, 44)

*Physicians.* Since 1963, employment estimates for physicians by specialty, major professional activity, and geographic area have been available in *Distribution of Physicians in the U.S.*, published by the Department of Survey Research, American Medical Association. (30-33)

*Podiatrists.* Employment estimates for podiatrists are

developed from State licensure records by the American Podiatry Association. In 1970 the U.S. Department of Health, Education, and Welfare surveyed a sample of podiatrists from State licensure records to determine how many were practicing. (37, 17)

*Veterinarians.* *Dimensions of Veterinary Medicine* and the various editions of the *AVMA Directory*, a biennial publication, give employment data for licensed veterinarians. Both of these reports are published by the American Veterinary Medicine Association (AVMA), and exclude military personnel and those who are retired. (38, 39)

*Architects.* Unpublished data on employment of architects are available from the Architectural Institute of America and the National Council of Architectural Registration. Data include only single registrants from their base State of original licensing and may include some retired architects.

*Chemists.* Data on employment status and characteristics of chemists are available from membership surveys by the American Chemical Society. (28)

*Engineers.* The Engineers Joint Council has conducted surveys of engineering society members to obtain information on employment status, highest degree attained, age, and other characteristics. (40-42)

## OCCUPATIONAL TRAINING DATA

Occupational training encompasses all types of learning processes, from simply "picking up" a skill to graduate-level training. Existing data cover only a portion of all occupational training, limited primarily to formal training conducted by institutions such as colleges and technical schools, or sponsored by unions, government agencies, and similar organizations.

### Colleges and universities

More data are available on workers who attend college than on workers trained by other methods. The primary source of data is the National Center for Educational Statistics of the Office of Education (OE). Annual reports include enrollments, degrees conferred, and projections.

Opening fall enrollment data include aggregate information on all students by sex, attendance status, level of enrollment, and type of program; and on institutions by

State, level, and by public and private control. Data on enrollments in graduate education are also available, including detail by field of specialization, level of study, sex, State, institutional level and control, and by individual institution. (48, 50, 51)

Enrollments also are estimated by the Bureau of the Census in the decennial census and the Current Population Survey (CPS). These data include information on demographic, social, and economic characteristics of persons enrolled and not enrolled. Although census and CPS data are generally comparable with OE figures, there are some differences resulting from differing collection dates and methods, and definitions of terms.<sup>20</sup>

Office of Education data on earned degrees include the number of bachelor's and higher degrees conferred in each academic field by each institution; and aggregate data on the number of degrees by level of degree, field of specialization, sex of recipient, State, and control and level of institution. (49) Projections information includes estimates for enrollments, graduates, faculty, and expenditures. Detailed methodological descriptions are available as well. (52)

Data on doctoral degrees are also collected by the National Academy of Sciences, which publishes the number of research doctorate recipients by field, subfield, and institution. These data differ from OE data in that they are counts of individuals, not degrees conferred, they exclude performance doctorates not requiring a research dissertation, and classification by field and subfield are different. Also, data are by fiscal year instead of academic year. Reports include a statistical profile of doctorate recipients, including information on personal characteristics, post-doctoral employment or study, and sources of financial support for graduate study. (45, 46)

The Office of Education also collects data on specific types of programs, such as health occupations education programs, and a variety of supplementary information. Additional data and research on aspects of higher education are available from the American Council on Education, the National Academy of Sciences, the National Science Foundation, and similar organizations. (47, 53)

<sup>20</sup> See Charles E. Johnson, Jr., and Larry E. Suter, "Measuring School and College Enrollments: A Comparison of Census Bureau and Office of Education Data," American Statistical Association, *Proceedings of the Social Statistics Section*, 1972, pp. 306-11.

## Junior colleges (community colleges)

Junior colleges serve a variety of educational needs. For some students they provide the first 2 years of academic training leading to a bachelor's degree; such students transfer to a 4-year college for the last 2 years of undergraduate work. Junior colleges provide adult education not necessarily oriented to completion of a formal college education or to vocational preparation.

Junior colleges also provide "terminal occupational education" through programs designed to prepare students for entry into specific occupations immediately upon graduation. These programs vary from 6 months to 3 years, but most are for 2 academic years. Types of career education include science and engineering technologies, public services, emphasizing transportation planning and social service-aide occupations; business and commercial fields, especially food service and distribution; allied health and medical fields; and many other types of training such as data processing and graphic arts.

Data on associate degrees and on completions of occupational curriculums below the baccalaureate level are collected annually in the Higher Education General Information Survey (HEGIS) of the Office of Education. The survey includes extensive summary data as well as data on individual institutions for (1) associate degrees meeting bachelor's-degree-credit criteria, (2) awards in organized occupational curriculums for work at the technical or semiprofessional level, and (3) awards in organized occupational curriculums for work below the technical or professional level. Data are reported by type and length of curriculum, State or area, and sex of recipient. (54)

## Federal manpower programs

A variety of manpower programs train workers for employment in hundreds of occupations. The Manpower Development and Training Act (MDTA) of 1962, succeeded by the Comprehensive Employment and Training Act (CETA) of 1973 enacted the largest group of Federal manpower programs. The MDTA was passed primarily to retrain workers whose skills were obsolete; however, that portion of the program initially devoted to youth was expanded, and major emphasis was placed on training the disadvantaged. Additional manpower programs include Job Opportunities in the Business Sector (JOBS), Work Incentive Program (WIN), Public Service Careers, Neighborhood Youth Corps, and others.

Two basic types of training were authorized under the MDTA: institutional instruction (classroom), and,

until fiscal year 1970, on-the-job training (OJT). Most training has been through institutional programs conducted primarily in public vocational schools. MDTA programs were sponsored jointly by the Department of Health, Education, and Welfare and the Department of Labor. Under OJT, training was provided at the jobsite by an employer under contract with the Department of Labor. Private businesses, trade associations, labor unions, and public agencies sponsored such programs.

General information on the policies and development of these programs, as well as summary data on enrollments, is available in the annual *Manpower Report of the President*. Detailed data, when available, are compiled by the agencies responsible for the programs. Much of the data are compiled for administrative purposes and are therefore unpublished, and may not be in a format suitable for supply analysis. (55, 56)

The Comprehensive Employment and Training Act of 1973 provides a new charter for Federal manpower programs. This legislation decentralizes and decategorizes many programs initially authorized by MDTA and by Title I of the Economic Opportunity Act of 1964, including institutional and on-the-job training, Public Employment Programs, and Job Corps. Beginning with fiscal year 1975, programs will be planned and administered by State and local prime sponsors, with funding and technical support from the U.S. Department of Labor. Information on participants in CETA programs will be compiled by the States.

## Vocational education

Vocational education includes secondary and post-secondary vocational and technical programs funded under the Vocational Education Act of 1963. Vocational education generally prepares students for a specific occupation, although many programs prepare students for employment in several related occupations.

Published data include enrollments by State in programs by educational field (e.g., agriculture, health) by fiscal year, and are available from the Office of Education. Unpublished data on enrollments and completions by specific occupational program are compiled by the Bureau of Adult, Vocational and Technical Education, Office of Education. (57-61)

## Apprenticeship programs

Apprenticeship training combines theory and on-the-job instruction to prepare journeymen in skilled crafts. The Department of Labor registers but does not finance such programs, and it provides technical assistance to

employers and unions in establishing programs. Most of the registered apprentices are in one of three trade areas: construction, metalworking, and printing.

A list of apprenticeable occupations included in apprenticeship programs registered with State agencies or the Bureau of Apprenticeship and Training of the Department of Labor is available in *The National Apprenticeship Program*, Manpower Administration, 1972. Published data on apprenticeship include the total number of individuals in training and the number of new registrations, cancellations, and completions during the year. (62)

In addition to federally registered programs, there are many high quality apprenticeship programs whose sponsors have chosen not to register. No information is available, however, on the number of such programs or the number of apprentices involved.

### **Employer training (except apprenticeship)**

In most instances, training is informal and takes place mainly in the work environment. Most workers "just pick up" their current skills informally on the job. Many firms, especially larger ones, have formal on-the-job training, often in conjunction with classroom work. While the numbers trained in such programs may be small, they are likely to be significant in certain industries and occupations.

Statistics on completion of employer training are not currently available. However, BLS, with the support of the Manpower Administration, recently conducted a pilot survey of occupational training in industry to study the feasibility of collecting data on enrollments and completions, and to determine the best method of collecting the data. Proposals to conduct comprehensive data collection for training in the metalworking industries are currently being reviewed. (63-65, 67-70) An additional feasibility study was conducted for the Manpower Administration at the University of Wisconsin. (66)

### **Armed Forces**

The Armed Forces offer training in electronics, aircraft maintenance, metalworking, and other skills to help young men obtain civilian jobs upon separation. Military personnel also may enroll in voluntary off-duty academic and technical programs. Approximately 200 such correspondence courses range from elementary school through the second year of college.

Project Transition, an Armed Forces-wide training program, prepares men who have between 1 and 6

months left in the service for employment in civilian life. In operation since 1969, Project Transition is a joint effort of private industry and the government providing training for many skills. Participants volunteer and may take only courses offered at the bases where they are stationed. When openings are limited, preference is given to those who have combat disabilities and then to those who have no civilian skills. Although some statistics are available, data on the number trained and entering civilian jobs are not available. (71-73)

### **Private vocational schools**

Private vocational schools prepare students for employment in many areas, but the three main types of schools are business, trade and technical, and cosmetology and barber schools. Schools vary in size from 10 to over 1,200 students; the length of courses and types of programs offered also vary. Some schools have many courses leading to certificates in several different occupations. Business schools, for example, may offer refresher courses in shorthand, a full program in beginning secretarial work, and the fundamentals of accounting. The major areas in which private vocational schools offer training are automobile maintenance, data processing, drafting, electronics, medical services, and radio-television. In addition, business schools teach all types of clerical work—typing, shorthand, filing—as well as accounting, data processing, and related fields.

The number of graduates of private vocational schools is not presently available. The only potential source of data is the "Survey of Programs and Enrollments in Post-Secondary Schools" currently in process by the Office of Education's National Center for Educational Statistics. This survey will collect enrollments and completions data by type of curriculum from a large sample of post-secondary vocational schools. (74, 75)

## **FOLLOWUP DATA**

Data on occupational training are most useful when accompanied by followup information, because not all graduates of a training program actually enter the occupation. Followup data consist of occupational entry rates for individuals who have completed or dropped out of various kinds of training programs.

Followup data are more important for analyzing some occupations than for others, depending on the extent of the training and various characteristics of the

individuals involved. Entry rates of M.D. recipients into the medical profession, for example, may be assumed to be near 100 percent since very few individuals would fail to utilize years of intensive training. For occupations where training is less rigorous, however, only a fraction of graduates may enter the occupation. In addition, entry rates are likely to be significantly different for men and women.

Followup data are available from a wide variety of sources. However, very few sources encompass the Nation as a whole and even fewer are available on a recurring basis. The main producers of followup information are State or area education and manpower agencies, individual schools, and private organizations such as the College Placement Council and the Bureau of Social Science Research.

The most comprehensive source of followup data on college students is the American Council on Education surveys of college freshmen of 1961 and 1966. The 1961 cohort originally included over 127,000 freshmen surveyed at college entry, of whom a sample were resurveyed in 1966 and 1971. The 1966 cohort included 254,000 freshmen surveyed at college entry, of whom a sample of 60,000 were resurveyed in 1971. The surveys asked questions on high school and college education, including major of bachelor's and higher degrees received, current employment and occupational status, work activity, type of employer, and other items. These longitudinal data allow analysis of occupational entries and career development over the decade following college entry. Numerous studies based on the ACE surveys are listed in the bibliography. (78-83, 90, 95)

Additional followup studies of college students and graduates are available from surveys conducted by college placement offices, professional societies, and other organizations. For the most part these data are fragmentary in their coverage, limited to graduates from a single institution or field. (76, 77, 86, 91-94, 96-102, 108, 109, 115, 117-125) However, a few are national in scope. (84, 87-89, 103-107, 110-114, 116)

Followup information on vocational education is available in the annual *Summary Data for Vocational Education* by the Bureau of Adult, Vocational and Technical Education, U.S. Office of Education (OE). This report lists completions and job placements in related fields by type of program. Unpublished data in greater detail are available from OE. A large number of followup studies for States, areas, and individual programs are also available; a sampling of these are listed in the bibliography. (126-133)

Followup data for Federal manpower programs including MDTA, JOBS, WIN, and others are compiled by

the Manpower Administration and published in summary form in the annual *Manpower Report of the President*. Unpublished data are also available from MA. As with vocational education, a variety of studies for States, areas, and programs are also available. Several of these are listed in the bibliography; a more comprehensive list is available in *Manpower Research and Development Projects*, published annually by MA. (134-139) Some followup data are also available for veterans, high school students, and other groups. (85, 140-153)

## OCCUPATIONAL TRANSFERS

The measurement of occupational transfers requires longitudinal data that allow comparison of the occupational status of a given population for at least two points in time. Longitudinal data are generally from either multiphase surveys which trace the occupational histories of a given population, or single-time surveys in which respondents report their current and previous occupations. The multiphase approach has the advantage of avoiding errors in recall, and allows analysis of characteristics which change over time and cannot be objectively measured by recall, such as workers' skill level. The major disadvantage of multiphase surveys which is not true of single-time surveys is attrition of the sample between phases. Attrition is largely the result of failure to locate all individuals in the original sample. This introduces a bias in the data, because the mobility characteristics of nonrespondents are likely to be different from those of persons remaining in the sample.

Occupational transfers may be expressed as gross rates, i.e., the total proportion of workers who transfer into the occupation or the total proportion who transfer out. Gross rates can be broken down according to occupation. The gross rate of transfer into engineering, for example, would include all persons entering engineering; this rate can be broken down to show rates of entry from technician occupations, from college faculties, and so forth. Transfers may also be expressed as a net rate, i.e., total transfers into the occupation minus total transfers out of the occupation. The type of calculation usually depends on the kind of data available.

Existing data sources are generally inadequate for estimating transfers (mobility) among detailed occupations. Computation of reliable mobility rates for detailed occupations covering the whole labor force requires data from a very large sample. Most sources allow computation of rates for major occupational groups only; the major exception is the 1970 census, discussed in detail below.

The earliest economic studies of occupational mobility relied on methodologies that treated nonlongitudinal data as if they were longitudinal. Jaffe and Carleton<sup>21</sup> used cohort analysis to trace the changing occupational distribution of age groups from one census to another, and estimated net occupational mobility between major occupational groups by calculating other components of change (new entries, deaths, and retirements) and treating mobility as a residual. A similar procedure was used by Aronson to estimate mobility for several detailed occupations for 1950-60.<sup>22</sup>

The Jaffe-Carleton study was a major contribution to the mobility literature. The methodology provides long-term net mobility information which primarily reflects the changing age and occupational structure of the labor force. The results must be interpreted with caution because, as the study itself points out, mobility is measured indirectly, as a residual after accounting for the other components of occupational change, and the study does not examine economic and other factors influencing mobility. Also, models were developed only for males and do not incorporate labor force withdrawal and reentry patterns typical of women workers. However, the study does provide a methodological framework which can be utilized in making long-range occupational projections which include net mobility.

Until fairly recently, most studies that attempted direct measurement of mobility concentrated on specific geographic areas and occupational groups, or on mobility between major occupational groups. The 1954 "six city study," for example, analyzed work histories for a sample of over 13,000 workers in six metropolitan areas.<sup>23</sup> At about the same time the Bureau of Labor Statistics studied the occupational mobility of a sample of Ph.D. scientists drawn from the 1948 register, *American Men of Science*.<sup>24</sup> While many similar studies exist, most are nonrecurring and several are out of date. (159-161, 177-186)

One fairly comprehensive data source for college trained workers is the 1962 Postcensal Survey of Professional and Technical Manpower. This project surveyed a large sample of persons recorded in the 1960 census 25-percent sample as college graduates or as last employed in scientific and technical occupations. The

<sup>21</sup>A. J. Jaffe and R. O. Carleton, *Occupational Mobility in the United States, 1930-60* (New York: King's Crown Press, Columbia University, 1954).

<sup>22</sup>Robert L. Aronson, *Components of Occupational Change in the United States, 1950-60*, Technical Monograph Series No. 1 (Cornell University, New York State School of Industrial and Labor Relations, October 1969).

<sup>23</sup>Gladys Palmer, *Labor Mobility in Six Cities* (New York: Social Science Research Council, 1954).

goal of the study was to determine the relationship between training and subsequent occupations, but the data are also suitable for tracing occupational transfers of persons employed in 1960. (162-171) A similar survey was conducted in 1972 for the 1970 census and the data are currently being analyzed by the National Science Foundation. The first of a series of reports, "Persons in Engineering, Scientific, and Technical Occupations: 1970 and 1972," showing preliminary data, was issued in July 1973. (169)

The Current Population Survey is often discussed as a potential source of occupational mobility data, and has been used as such. The January 1966 CPS collected information on labor force status and occupation in January 1965 of all persons employed during the survey month. The published results show mobility rates for major occupational groups and a few detailed occupations, by sex and color of worker. Unpublished tabulations can be used to compute rates for detailed occupations. However, the data must be used with great care because the CPS sample is not large enough to provide rates for detailed occupations with the desired reliability. (154-156, 158)

A promising source of occupational mobility data is the 5-percent sample of the 1970 census, which provides information on occupations in 1970 and occupations in 1965. Data are published only for 10 major occupation groups for the Nation and States. However, unpublished tabulations for detailed occupations obtained by the Bureau of Labor Statistics are currently being analyzed. The results of this study will be made public when available. These data are compiled from the three 1-percent Public Use Sample Files, and include 3.7 million individuals or 60 percent of the respondents in the 5-percent census sample. (157)

The new census data will result in occupational mobility rates suitable for supply analysis in the models presented earlier in this report. The data, however, are subject to the usual problems of the census. The rates are already 3 years old at the time of publication, and represent transfers that occurred as long ago as 1965. Furthermore, no similar data will be available until the 1980 census. The data are subject to another disadvantage of longitudinal information collected in a single survey: inaccuracies are inevitable when 1965 occupational information is based totally on the respondent's memory.

Another potentially fruitful source of occupational mobility data is the National Longitudinal Surveys conducted for the U.S. Department of Labor by Herbert

<sup>24</sup>*Occupational Mobility of Scientists*, Bulletin 1121 (Bureau of Labor Statistics, 1953).

Parnes of the Center for Human Resources Research.<sup>25</sup> These data represent one of the largest longitudinal samples in existence, with about 5,000 persons in each of four age-sex groups interviewed annually for five years. The sample contains a wealth of detail, including personal, economic, and demographic characteristics. Occupations follow the detailed 1960 census classifications. (172-176)

## GEOGRAPHIC TRANSFERS

Measurement of occupational entries and separations from geographic transfers requires the same type of data as measurement of occupational transfers, i.e. longitudinal data. Much of the discussion of occupational mobility data therefore applies to geographic mobility data as well.

Calculation of geographic mobility rates is complicated by the fact that geographic and occupational transfers often occur simultaneously. That is, a worker changes residence and occupation at the same time. It is not always evident which type of transfer is primary and which is incidental. Analysis of mobility patterns to determine why, as well as how many, workers move requires information on labor force status, occupation, and other characteristics of movers both before and after they move.

Geographic mobility occurs on two levels: movements across international boundaries (immigration and emigration), and movements within a nation (internal migration). While a great deal of data are available on both levels for total populations and the total labor force, very little occupational detail is available.

### Immigration and emigration

The files of the Immigration and Naturalization Service (INS), U.S. Department of Justice, constitute a basic source of data on occupations of immigrants. Data are published by major occupational group in the INS annual reports, and can be obtained in greater detail from INS. According to INS sources, no data are available on persons who emigrate from the United States.

INS immigration data show only the occupation at time of entry, and not after residence in the United States. A recent study funded by the Manpower Administration furnishes followup data on occupations in 1972 of immigrants entering during the 1970 fiscal year. The report presents analyses by major occupation group, age, sex, and other characteristics. (191)

The National Science Foundation has tabulated INS

data for scientists, engineers, physicians, and surgeons for 1949-70. The NSF publication includes an analysis of the effect of changing immigration laws, and some data on foreign-born scientists derived from the NSF Register. (188-190) The National Institutes of Health have also utilized INS files in a recent study of immigrant nurses. (192)

The American Medical Association provides information on immigration of physicians derived from licensure records. (187) The National Institutes of Health also compile information on foreign medical graduates. (193)

### Internal migration

The two major recurring sources of migration data, the Current Population Survey and the Continuous Work History Sample of the Social Security Administration, are not currently usable for migration analysis by detailed occupation. The CPS annually reports interstate and intrastate mobility for the total population and for adult males by major occupation group. The Social Security Administration reports workers by industry but not by occupation.

Geographic mobility data by detailed occupation for the total labor force are available only from the decennial censuses. Earlier censuses do not include the occupational mobility feature of the 1970 census, but do report geographic mobility by major occupation group status in the census year. (198, 199)

As with occupational mobility, most studies of geographic mobility have relied on special surveys of specific areas or occupations, or have analyzed only major occupational groups. A major study on the mobility of college faculty, for example, relied on a special mail survey of over 7,500 faculty members. Another study dealt only with comparison of mobility rates for professional, technical, and kindred workers with other major occupational groups. (194-197)

## ENTRANTS FROM OUTSIDE THE LABOR FORCE

Labor force accession rates are available for estimating the total number of labor force entrants by age and sex. The rates are most important for females since they identify the patterns of reentry or delayed entry that are characteristic of women. Accession rates are derived

<sup>25</sup>For details on the surveys, see Herbert S. Parnes, "Longitudinal Surveys: Prospects and Problems," *Monthly Labor Review*, February 1972, pp. 11-15. Individual reports are listed in the bibliography.

from working life tables in the same manner as death and separation rates, which are discussed in the following section.<sup>26</sup>

Existing accession rates, however, cannot be used to estimate labor force accessions by occupation unless assumptions are made about the occupational distribution of entrants. For example, female reentrants may be assumed to be distributed by occupation in the same manner as total female employment.

More precise estimates of accessions by occupation require longitudinal data on labor force and occupational status by age and sex. The major sources of such data are the 1970 census and the National Longitudinal Surveys mentioned earlier. Neither of these sources has yet been utilized for analyzing labor force accessions by occupation. (199, 172-176)

Some labor force mobility data are available for specific groups or occupations. The American Nurses Association, for example, collects data on the work activity of licensed professional nurses. Similar data are available for teachers, scientists, and a number of other occupations. (200-203)

## SEPARATIONS FROM THE LABOR FORCE AND DEATHS

Information on labor force separations and deaths consists of occupational separation and death rates calculated from working life tables and occupational age-sex distributions. Detailed descriptions of the development of the rates are contained in *Tomorrow's Manpower Needs*.<sup>27</sup>

A working life table is an actuarial device for summarizing the mortality and labor force experience of a particular population over a given period of time. The currently available tables contain national annual rates of death, labor force separation,<sup>28</sup> and labor force accession by age and sex. In addition, the tables for females show rates for separations related to marriages and to birth of children. These tables are developed from mortality statistics collected by the Department of Health, Education, and Welfare, and labor force participation data collected in the Current Population Survey

<sup>26</sup>For further details see also *Tomorrow's Manpower Needs*, Vol. 1, Bulletin 1606, (Bureau of Labor Statistics, 1969), pp. 48-50.

<sup>27</sup>*Tomorrow's Manpower Needs*, Vol. 1, pp. 47-58.

<sup>28</sup>Labor force separations are usually called "retirements," a misleading label since retirement is only one type of separation. The term "retirement" will be used here in the colloquial sense, i.e., the worker's final withdrawal from the labor force. The term "separation" includes retirements and all other types of separation except deaths.

and tabulated by the Bureau of Labor Statistics.<sup>29</sup> (204-208)

Occupational separation and death rates are calculated by applying age-sex specific rates from the working life tables to the age-sex distribution of the workers in the occupation. This method assumes that separation and mortality patterns are the same for all occupations. The resulting rates therefore vary among occupations only as age-sex distributions vary.

Actual separation and death patterns, of course, vary with working conditions, pension benefits, occupational hazards and diseases, and a variety of other occupational factors. In addition, although labor force participation rates of women are known to vary considerably by level of education and therefore by occupation, these patterns are not reflected in existing occupational separation rates.<sup>30</sup>

A serious difficulty with existing separation and death rates is the timeliness of occupational age-sex distribution data. Age-sex distributions change over time reflecting a variety of factors such as rapid growth or decline of the occupation, or the entrance of an unusually large cohort of new workers. Separation and death rates computed from decennial census data on age-sex distributions cannot adequately reflect such changes, as the data base is at least 13 years old before new data become available.

Age-sex distributions for the total labor force can be updated from annual Current Population Survey data, and projected through cohort analysis. This approach would seem to be useful for occupations as well, since age-sex data on entrants from various training programs are either available or could be estimated with reasonable accuracy. Unfortunately, attempts to apply the cohort technique have been frustrated by the absence of data on age and sex of workers who enter or leave through occupational transfers. 1970 census occupational mobility data will provide a means of estimating the age-sex characteristics of occupational transferees. (199)

Age-sex distributions also can be updated using data from some noncensus source. Such information is available for many occupations on either a recurring or nonrecurring basis. Death and separation rates for optometrists, for example, have been calculated using age distribution data from a 1968 survey of active optometrists conducted by the National Center for Health Statistics of the U.S. Public Health Service. (18)

A third problem with existing death and separation

<sup>29</sup>For discussion of the development of working life tables, see Howard N. Fullerton, "A Table of Expected Working Life for Men, 1968," *Monthly Labor Review*, June 1971, pp. 49-55.

<sup>30</sup>See *Handbook on Women Workers*, Bulletin 294 (U.S. Department of Labor, Women's Bureau, 1969), pp. 204-209.



rates is applicability. Because rates are developed from national census data, they are strictly applicable only to national estimates of census-defined occupations. However, most rates can be applied with reasonable accuracy to noncensus-defined occupations as long as the difference in census and noncensus definitions does not affect a large group of workers with unusual age, sex, or retirement patterns.

The problem of geographic applicability is more difficult. National rates may be used for States or areas assuming (1) that the age distribution for the occupation in a State or area is the same as in the Nation, and (2) that mortality trends and retirement patterns by age within the State or area are the same as in the Nation. Most evidence indicates that the second assumption is more valid than the first.<sup>31</sup>

One approach to this problem is to develop State or area rates from the national working life tables and occupational age-sex distribution by State. Rates derived in this fashion are currently being prepared for the 50 States and the District of Columbia from 1970 census data, and will be published during 1974 by the Bureau of Labor Statistics. (216)

In addition to standard life table methodology, several other methods exist for estimating death and retirement rates. Many of these were developed for particular occupations or are based on old data. (209-15, 217)

## OCCUPATIONAL EARNINGS

Occupational earnings data, like employment data, are available from a variety of sources, primarily government agencies and private associations. Also, earnings data may be collected from individuals or from employers.

Many earnings concepts are used, including wage and salary rates, straight-time hourly earnings, average hourly earnings (including overtime, premium, and holiday pay), and professional income. Care must be taken when using the data to consider the particular concept involved.

The major producers of earnings data among Federal agencies are the Bureau of the Census and the Bureau of Labor Statistics. Census of Population data include the median earnings in 1969 of workers by detailed occupation in 1970. Data are available by sex, race and Spanish origin, State, and other detail for 1970 and earlier censuses. (229) The major limitations are the lack of information on the hours of work per year, and

mismatching of earnings and occupations for respondents who changed occupations between 1969 and the census week.

The Bureau of the Census also collects data on total money earnings of civilian workers by major occupation group, in the Current Population Surveys. (230) Although uses of these data for supply analysis are limited because of lack of detailed occupational categories, data for farmers and farm managers and for private household workers may be useful. Data are also cross-classified by race, sex, class of worker, full- and part-time work, work experience, and major industry group.

Bureau of Labor Statistics occupational earnings data are generally from employer surveys. The *Area Wage Surveys* (formerly *Occupational Wage Surveys*) produce annual straight-time hourly or weekly earnings data, by sex, for about 80 occupations. The survey universe includes firms with 50 employees or more in six industry divisions. Data are published for the total United States, for regions, and for about 90 metropolitan areas; some information is given on scheduled weekly hours, shift differential practices, fringe benefits, and wage trends. (234)

The *National Survey of Administrative, Technical, and Clerical Pay* is prepared in cooperation with the U.S. Civil Service Commission and the Office of Management and Budget, and provides data on private industry pay for use in setting Federal civil service pay levels. The survey reports wage and salary levels and distributions for about 80 occupation-work levels covering 12 broad occupational groups. The survey covers seven industry categories, excluding establishments with fewer than a minimum number of workers for each industry. Data are shown by industry, for establishments of 2,500 or more, for changing salary levels over time, and for average weekly scheduled hours. (236)

*Current Wage Developments* contains data on salary levels and trends for the Nation and for regions and city-size groups, for city public school teachers, Federal employees, and firemen and policemen. Data are compiled from various sources such as the National Education Association and the U.S. Civil Service Commission, and also appear in separate *Salary Trends* bulletins. (237)

Another major source of earnings information is the series of annual *Union Wages and Hours* bulletins, which list union wage rates and wage rate indexes by occupation, skill level, and metropolitan area. Separate annual bulletins are issued for building trades, printing trades, local transit, and local trucking. (238)

The BLS also conducts periodic wage surveys of about 50 selected manufacturing and 20 nonmanufacturing industries. Most are surveyed every 5 years, but a

<sup>31</sup>For elaboration see *Tomorrow's Manpower Needs*, Vol. 1, pp. 52-54.

## ANALYTICAL STUDIES

number of low-wage industries are surveyed on a 3-year cycle. The surveys provide data on straight-time first-shift wage rates, methods of payment, frequency distributions for individual workers in selected occupations and for broad employment groups, weekly work schedules, shift differentials, and fringe benefits. (235)

Federal regulatory agencies often publish wage and earnings statistics for industries they regulate. Data are generally derived from company reports to the agencies. Examples include the Federal Aviation Administration (scheduled airlines), U.S. Maritime Administration (merchant marine), and the Interstate Commerce Commission (railroads). (223, 239, 240) Other Federal agencies also issue earnings information for occupations or industries in their areas of concern, such as higher education salary data published by the Office of Education and the National Science Foundation, and income data for physicians, osteopaths, and dentists published by the Social Security Administration. (227, 231-233)

A variety of private associations publish data on earnings, wage rates, and salary scales. The quality of the data varies from source to source, so each must be evaluated independently. The National Education Association is probably the most significant private source of data; the NEA published results of biennial surveys of elementary and secondary schools as well as data on higher education. (224-226) The American Chemical Society published an annual report on chemists' salary levels. (218) A number of other private sources are listed in the bibliography. (219-222, 228, 241)

While the field of manpower analysis, and especially the area of supply analysis, is relatively new, there is already a considerable body of analytical literature. The studies may be roughly divided into three categories: discussions of issues and concepts, studies on individual occupations and occupational groups, and methodological studies. The final section of the bibliography of this paper lists specific studies in all three categories. Though the list does not pretend to be complete, it includes a variety of views and types of analysis as well as a variety of occupations.

The first category includes the issues and concepts discussed in the earlier sections of this study, such as defining shortages and surpluses and information needs for policymaking. Additional issues include the nature of forecasting, the relationship between education and occupation, and various approaches to occupational and manpower analysis such as the human capital concept and relative wage analysis. (242-260)

Studies of individual occupations and occupational groups cover a broad range of technical and econometric sophistication, but are concentrated on three occupational areas: science and engineering, teaching, and health care. Many of these studies put theoretical concepts to work in empirical analysis of occupational supply behavior. (261-323) Methodological studies, overlapping the first and second categories somewhat, deal mainly with how to use concepts and data resources. Issues of accuracy and completeness of results are considered. (324-339)

## Chapter 4. Directions for the Future

The preceding sections have examined various concepts of occupational supply, types of analysis, and the quantity and quality of existing supply data. Many questions have been raised that cannot be answered without new research and, in some cases, new data.

This section discusses specific work in the further development of supply information. Suggestions include improvements of existing studies and methodologies, utilization of new and unexploited data resources, and collection of new data needed to improve the analyses of supply in specific occupations.

*Inventory of supply information.* Supply data and analyses are widely scattered among reports of Federal, State, and local government agencies, academic institutions, professional associations, and other producers and users of occupational information. The variety of items found in the bibliography of this paper illustrates the problem.

Any specific supply study should include a survey of previous research and existing data resources. In view of the variety of sources, however, this task is complicated by the lack of a centralized guide to existing information. Indexes to professional journals cover only a small portion of the information. Many unpublished sources such as Ph.D. dissertations or special tabulations of census data are not listed in standard references. Few analysts are able to conduct a comprehensive survey of applicable information sources within reasonable time and cost limits.

Supply analysis can be facilitated by establishing an inventory of existing information resources. The inventory should list sources of data, including a description of their format, quality, detail, type of collection, and any other relevant information. Where feasible, actual data should be included, especially if they are from unpublished or other difficult-to-obtain sources. The inventory should also list existing studies of individual occupations, supply concepts, and other topics, along with descriptions of material in each study. Inclusion of State and local sources is especially important in view of the responsibility of State and local planners for analyzing occupational supply and demand relationships when planning training programs under the Comprehen-

sive Employment and Training Act of 1973 and other programs.

Analysts using the inventory could quickly locate existing analyses, determine whether adequate data are available, and discern whether additional research and data collection are required to answer their particular needs.

*Occupational mobility.* Occupational mobility represents probably the largest gap in existing supply information. This gap will be narrowed considerably through analyses of mobility rates computed from special tabulations of the 1970 census data for detailed occupations. These rates will be used in conjunction with rates for major occupation groups, computed from published data, to identify mobility patterns and to estimate the effect of age and sex on mobility. Rates for detailed occupations will be used to estimate the number of job openings and entrances to specific occupations resulting from mobility.

Mobility rates and patterns derived from other data sources should be developed and compared with the census rates. The National Longitudinal Surveys and the Post-Censal Surveys are the primary candidates for analysis, but other sources for particular occupations and geographic areas should be included as well.

*Labor force accessions.* Special tabulations of 1970 census occupational mobility data can be used to estimate occupational entry rates of persons outside the labor force. Data include the 1970 occupations of individuals unemployed and not in the labor force in 1965. Tabulations of detailed occupations by sex and age can be used to estimate the occupational distribution of labor force accessions.

*Functional analysis.* Sufficient data exist for many occupations to make functional analysis possible. In fact, analyses have already been conducted for engineers, scientists, college teachers, secondary and elementary teachers, nurses, physicians, and many other occupations. Such studies should be continually updated as new data and insights become available.

The need for updating is particularly apparent now

since older studies reflect neither the 1970 census data nor changing economic conditions beginning with the 1970 recession. Most studies during the 1960's analyzed supply behavior under conditions of continually expanding demand. New insights should become apparent as supply behavior is observed under different demand conditions.

In addition to estimating wage elasticity, functional analysis can be used to study the responsiveness of workers to changing job opportunities, educational stipends, and a variety of other factors. Recent research has suggested that wage differentials do not adequately explain entry into many occupations, but that entrants are responsive to changing employment opportunities as measured by the occupation's rate of growth or decline, and the number of job vacancies or unemployed workers. Although this explanation has been tested with some success for engineers, additional applications to other occupations may provide useful results.

*Labor force separations.* Currently available labor force separation rates assume the same separation patterns for all occupations. However, college-educated workers, especially women, display labor force participation rates significantly higher than those of workers with less education. The use of current separation rates, therefore, overestimates the number of separations for college-degree occupations, especially if a large proportion of the workers are female.

New working life tables by age, sex, and educational attainment would eliminate much of this error. Two tables for each sex would be most useful, one for college-educated workers and one for others, since the largest differential in labor force participation occurs between these two groups, and most occupations are easily identifiable as having college or noncollege educational requirements. While new rates for men would be useful, they are more crucial for female workers. The differentials in labor force participation are larger for

women, and they tend to be concentrated in relatively few occupations. Calculation of new tables would assume no difference in mortality patterns among education groups, since no mortality data by education level are available.

As discussed in chapter 2, existing labor force separation rates do not account for differences in retirement patterns resulting from factors other than the occupation's age-sex composition. The 1970 census mobility data allow direct observation of labor force separations by occupation, and is currently being used by the Bureau of Labor Statistics to evaluate existing rates derived from working life tables.

*New data collection.* Though the potential of new data in the areas of mobility and labor force separations and accessions is not yet developed, no such opportunities exist in other areas because data sources are lacking.

Probably the largest data gap is in the area of entry rates. As discussed in chapter 3, most rates are computed from followup studies that are out of date, lacking detail, covering only a portion of the relevant population, or are concentrated on a limited geographic area. In the area of college graduates, supply analysis could be strengthened by periodic repetition of the type of survey reported in *Five Years After the College Degree*<sup>32</sup>, and in *Five and Ten Years After College Entry*<sup>33</sup>. New surveys would not only allow existing entry rates to be updated, but would also allow comparison of rates from period to period. Collection of followup data for noncollege-degree occupations is also necessary.

<sup>32</sup> Laure M. Sharp, and others, *Five Years After the College Degree*, 5 parts (Washington, D.C.: Bureau of Social Science Research, 1965-67).

<sup>33</sup> Ann S. Bisconti and Helen S. Astin, *Five and Ten Years After College Entry* (Washington, D.C.: American Council on Education, Research Reports, Vol. 8, No. 3, 1973).

## Bibliography

The following bibliography lists specific sources of the supply information described in chapter 3, and is therefore arranged in the same order as the sections of that chapter. Although many useful data sources are not included here, the listing is intended to provide a representative sampling in all areas. Some sections, however, are more complete than others: section VII on

labor force separations and deaths probably covers most existing sources, while section III on followup studies gives a necessarily limited selection from hundreds of studies. In general, no attempt was made to include State and local data in any sections, although many items may be useful for subnational analyses. The sections of the bibliography are as follows:

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## I. Current Supply Data

### A. Census and Current Population surveys

1. U.S. Department of Commerce, Bureau of the Census. 1970 Census of Population, *Classified Index of Industries and Occupations*, 1971.

Defines the industrial and occupational classification systems for the 1970 Census of Population, and lists the industry occupational titles which constitute each classification category. The system includes approximately 19,000 industry and 23,000 occupational titles.

2. \_\_\_\_\_, \_\_\_\_\_. Census of Population: 1970 Subject Reports, Final Report PC(2)-7A, *Occupational Characteristics*, 1973.

Employment and unemployment data for detailed occupations by color, sex, class of worker, earnings, and a variety of other characteristics. Data for earlier censuses are available in publications of the same title for the appropriate census years.

3. \_\_\_\_\_, \_\_\_\_\_. Census of Population: 1960 Subject Reports, Final Report PC(2)-7E, *Characteristics of Professional Workers*, 1964.

Contains items similar to PC(2)-7A but in greater detail for professional workers. Not published for 1970 census or censuses before 1960.

4. U.S. Department of Labor, Bureau of Labor Statistics. *Employment and Earnings*, monthly.

Monthly national data on employment and unemployment by major occupational group collected in the Current Population Survey are presented in table A-18; annual averages appear in the January issue. The October 1973 issue contains 1972 annual averages for nearly 150 occupations or combinations of occupations; data for subsequent years will appear annually in the March issue.

### B. Occupational employment statistics program

5. U.S. Department of Labor, Bureau of Labor Statistics. *Occupational Employment Statistics, 1960-70*. Bulletin 1738, 1972.

Discusses the BLS occupational employment statistics program and presents data from the 1968 metalworking survey, the 1970 printing and publication survey, and the 1970 radio-TV communications equipment manufacturing survey. Further discussion of the radio-TV survey is available in the June 1968 *Monthly Labor Review*.

6. \_\_\_\_\_, \_\_\_\_\_. *Occupational Employment, Special Industry Machinery, except Metalworking, June 1971*. Report 430-3, April 1974.

### C. Surveys of scientific and technical personnel

7. National Science Foundation publications:

*Science and Engineering in American Industry, Final Report on a 1953-54 Survey*. NSF 56-16, 1956.

*Science and Engineering in American Industry, Report on a 1956 Survey*. NSF 59-50, 1960.

*Scientific and Technical Personnel in American Industry, Report on a 1959 Survey*. NSF 60-62, 1960.

*Scientific and Technical Personnel in Industry, 1960*. NSF 61-75, 1961.

- Scientific and Technical Personnel in Industry, 1961.* NSF 63-32, 1964.
- Scientists and Engineers in the Federal Government, October 1958.* NSF 61-43, 1961.
- Scientific and Technical Personnel in the Federal Government, 1959 and 1960.* NSF 61-26, 1962.
- Scientific and Technical Personnel in the Federal Government, 1961 and 1962.* NSF 64-4, 1965.
- Scientific and Technical Personnel in the Federal Government, 1964.* NSF 67-21, 1967.
- Reviews of Data on Science Resources, No. 14, "Scientific and Technical Personnel in the Federal Government 1966."* NSF 68-16, April 1968.
- Scientific and Technical Personnel in the Federal Government, 1968.* NSF 70-24, 1970.
- Scientific, Technical and Health Personnel in the Federal Government, 1969.* NSF 70-44, 1970.
- Employment of Scientific and Technical Personnel in State Government Agencies, Report on a 1959 Survey.* NSF 61-17, 1961.
- Unemployment Rates and Employment Characteristics for Scientists and Engineers, 1971.* NSF 72-307, 1972.
- Scientists and Engineers in Colleges and Universities, 1961.* NSF 65-8, 1965.
- Science and Engineering Staff in Universities and Colleges, 1965-75.* NSF 67-11, 1967.

8. Bureau of Labor Statistics publications:

- Andrews, Edith W., and Maurice Moylan. "Scientific and Professional Employment by State Governments," *Monthly Labor Review*, August 1970, pp. 40-45. Reprint includes appendix tables A-1 through A-29.
- Employment of Scientific and Technical Personnel in Industry, 1962.* Bulletin 1418, June 1964.
- Employment of Scientific and Technical Personnel in State Government Agencies, 1962.* Bulletin 1412 (1964), and 1964, Bulletin 1557 (1967).
- Employment of Scientists and Engineers, 1950-70.* Bulletin 1781, 1973.
- Scientific and Technical Personnel in Industry, 1961-66.* Bulletin 1609 (1969); 1967, Bulletin 1674 (1970); 1969, Bulletin 1723 (1971); and 1970, pamphlet (1972).

D. Industry-occupation matrix

9. U.S. Department of Labor, Bureau of Labor Statistics. *Occupational Employment Patterns for 1960 and 1975.* Bulletin 1599, 1968.
- This bulletin provides a detailed description of the procedures followed in developing the 1975 matrix.
10. \_\_\_\_\_, \_\_\_\_\_. *Occupational Employment Statistics 1960-67.* Bulletin 1643, 1970.
- This bulletin discusses the methods used in developing the 1967 and 1970 matrices.
11. \_\_\_\_\_, \_\_\_\_\_. *Tomorrow's Manpower Needs, Vol. I-III,* Bulletin 1606, February 1969, and *Vol. IV (Revised),* Bulletin 1737, 1971.
- These four volumes provide up-to-date manpower projections and a guide to their use in developing State and area manpower projections. The industry-occupation matrix tables and other manpower data are presented in Vol. IV.



**E. Bureau of Labor Statistics wage surveys**

12. *Directory of Industry Wage Surveys and Union Wages and Hours Studies, 1960-73, 1973.*

Lists industries covered in the BLS industry wage survey program, including publication titles, bulletin numbers, and a limited description of their content.

13. *Area Wage Surveys, Metropolitan Areas, United States and Regional Summaries, 1970-71.* Bulletin 1685-92, 1973. Annual since 1950, various bulletin numbers. Before Bulletin 1465 (1965-66) the series were called Occupational Wage Surveys. Data for individual metropolitan areas are published in individual volumes.

**F. U.S. Department of Health, Education, and Welfare**

14. Office of Education. *Digest of Educational Statistics.* Annual since 1962.

Contains historical data on enrollments, teacher employment, degrees conferred, and other items. Compiled from a variety of original sources listed in the footnotes to each table.

15. \_\_\_\_\_ . *Projections of Educational Statistics.* Annual since 1964.

Contains historical data and projections of enrollments, teacher employment, and other items.

16. Public Health Service. *Health Resources Statistics.* Annual since 1967.

Contains estimates of employment in health occupations and descriptions of accreditation and education requirements. Also includes information on hospital, outpatient, and other health facilities.

17. \_\_\_\_\_ . *Vital Health Statistics*, Series 12, including the following items:

*Employees in Nursing and Personal Care Homes, United States, May-June 1964.* PHS Pub. No. 1000, Series 12, No. 5, September 1966.

*Employees in Nursing and Personal Care Homes: Number, Work Experience, Special Training, and Wages, May-June 1964.* PHS Pub. No. 1000, Series 12, No. 5, September 1966.

*Employees in Nursing Homes: United States, April-September 1968.* DHEW Pub. No. (HSM) 73-1700, Series 12, No. 15, October 1972.

"Podiatry Manpower Survey, United States, 1970," National Center for Health Statistics, *Monthly Vital Statistics Report*, vol. 19, no. 11, Supplement, Feb. 8, 1971.

18. \_\_\_\_\_ . *Vital Health Statistics*. Series 14, including the following items:

*Health Manpower, United States, 1965-67.* PHS Pub. No. 1000, Series 14, No. 1.

*Pharmacy Manpower, United States 1966.* PHS Pub. No. 1000, Series 14, No. 2.

*Opticians Employed in Health Services: United States, 1969.* Series 14, No. 4. DHEW Pub. No. (HSM) 72-1052, June 1972.

*Ophthalmology Manpower: A General Profile, United States, 1968.* Series 14, No. 5. DHEW Pub. No. (HSM) 73-1800, December 1972.

*Inpatient Health Facilities as Reported from the 1969 MFI Survey.* Series 14, No. 6. DHEW Pub. No. (HSM) 73-1801, December 1972.

*Ophthalmology Manpower: Characteristics of Clinical Practice, United States, 1968.* Series 14, No. 7. DHEW Pub. No. (HSM) 73-1802, March 1973.

*Optometrists Employed in Health Services, United States, 1968.* Series 14, No. 8. DHEW Pub. No. (HSM) 73-1803, March 1973.

*Ophthalmology Manpower: Utilization of Supplementary Personnel, United States, 1968.* Series 14, No. 9. DHEW Pub. No. (HSM) 73-1803, March 1973.

*Podiatry Manpower: A General Profile, United States, 1970.* Series 14, No. 10. DHEW Pub. No. (HRA) 74-1805, 1973.

19. \_\_\_\_\_, National Institutes of Health, Bureau of Health Manpower, Division of Manpower Intelligence. *The Supply of Health Manpower: 1970 Profiles and Projections to 1990.* Forthcoming 1974.

This report is the first phase of project SOAR (Supply, Output, and Requirements), a comprehensive review of health manpower for use in planning health programs.

#### **G. Other Federal agencies**

20. Air Transport Association of America. *Air Transport Facts and Figures.* Annual.

Contains occupational employment figures compiled from airline industry reports filed with the Civil Aeronautics Board.

21. Federal Communications Commission. *Annual Report.*

Contains occupational employment data for the telephone industry.

22. Interstate Commerce Commission. *Transport Statistics in the United States.* Annual.

Contains occupational employment data for railroads (part 1), carriers by water (part 5), oil pipelines (part 6), motor carriers (part 7), freight forwarders (part 8), and private car lines (part 9).

23. \_\_\_\_\_. *Wage Statistics of Class I Railroads in the United States.* Statement No. A300. Annual.

Contains occupational employment statistics for Class I railroads. Before 1966 see Statement M-300.

24. U.S. Civil Service Commission. *Occupations of Federal White-Collar Workers, and Occupations of Federal Blue-Collar Workers.* Annual.

25. U.S. Department of Labor, Bureau of Labor Statistics. *Industry Wage Survey: Communications.* Annual since 1961.

Contains occupational employment and wage data for telephone and telegraph industries. Compiled from annual reports of Bell System carriers to the FCC.

26. U.S. Department of Transportation, Federal Aviation Administration. *Statistical Fact Book of Aviation.* Annual.

Contains employment and other detailed information on scheduled airlines.

27. U.S. Independent Telephone Association. *Independent Telephone Statistics.* Annual.

Contains occupational employment data for the non-Bell System sector of the telephone industry.

#### **H. Professional associations**

28. American Chemical Society. *American Chemical Society Member Employment Status,* Staff Report, Division of Professional and Manpower Studies. Annual.

Contains data on employment status and characteristics of chemists derived from ACS membership records.

29. American Dental Association. *Distribution of Dentists in the U.S. by State, Region, District, and County*. Annual before 1969, biennial since 1969.

Estimates of the number of practicing dentists compiled through ADA membership lists and State licensing boards.

30. American Medical Association, Department of Survey Research. *Distribution of Physicians, Hospitals, and Hospital Beds in the U.S.* Annual 1963-69.

Contains data on physicians by specialty and major professional activity, for regions, States, counties, metropolitan areas, and the Nation.

31. \_\_\_\_\_, \_\_\_\_\_. *Distribution of Physicians in the United States*. Annual since 1970.

32. \_\_\_\_\_. *Journal*.

Annual licensure issue contains physician employment data.

33. \_\_\_\_\_. *Programs and Publications*. November 1971.

Brief bibliography of AMA reports containing data on physicians.

34. American Nurses Association. *Facts About Nursing*. Annual.

Contains estimates of nursing employment developed from licensure records of State boards of nursing.

35. American Optometry Association. *Journal*. Optometric Manpower Issue. Annual.

Contains estimates of optometric employment derived from AOA membership records and analytical articles on manpower issues.

36. American Osteopathic Association. *A Statistical Study of the Osteopathic Profession*. Annual.

Contains employment estimates for osteopaths.

37. American Podiatry Association publications:

Belleau, Wilfred. *Podiatry as a Career*, 1965. Revised.

Contains 1962 employment data.

Blauch, Lloyd E. *Numbers and the Podiatry Profession*.

Contains 1963 employment data.

\_\_\_\_\_. "1964 Surveys of the Podiatry Profession. The Podiatrists: Distribution, Education, Organization Relationships," *Journal of the American Podiatry Association*, March 1965.

Contains 1964 employment data for podiatrists.

38. American Veterinary Medicine Association. *AVMA Directory*. Biennial.

Contains numbers of veterinarians compiled from licensure statistics. Excludes military and retired veterinarians.

39. \_\_\_\_\_ . *Dimensions of Veterinary Medicine*. Biennial.  
Contains employment data for licensed veterinarians.
40. Engineers Joint Council. *American Engineering Manpower 1969*. November 1971. Earlier publications include data for 1964 and 1967.  
Presents data from the 1969 National Engineers Register survey of engineering society members conducted by the Engineers Joint Council and the National Science Foundation. Includes data by degree level, type of employer, specialty, age, and other characteristics.
41. \_\_\_\_\_ . *Engineering Employment and Unemployment, 1971*. November 1971.  
Contains data on employment and unemployment of engineers by degree level, age, citizenship, year of degree, and other characteristics. Based on a survey of 60,000 engineering society members.
42. \_\_\_\_\_ . *A Profile of the Engineering Profession*. March 1971.  
Presents highlights of the 1969 National Engineers Register survey, including data on personal and educational characteristics of engineers.
43. National Association of Boards of Pharmacy. *Licensure Statistics and Census of Pharmacy*. Annual since 1967.  
Contains counts of registered pharmacists from licensure statistics as well as additional data from NABP censuses.
44. \_\_\_\_\_ . *NABP Bulletin*.  
Bulletins before 1967 contain data on the number of registered pharmacists compiled from licensure records.

## II. Occupational Training Data

### A. Colleges and universities

45. National Research Council, National Academy of Sciences. *Doctorate Production in United States Universities, 1920-62*. Publication No. 1142, 1963.  
Degree recipients by field, subfield, sex, and institution.
46. \_\_\_\_\_ , \_\_\_\_\_ . *Doctorate Recipients from United States Universities*. Annual since 1966.  
Degree recipients by field, subfield, institution, and degree level beginning with 1958. Data differ from those of the Office of Education in that 1) they are counts of individuals, not degrees conferred, 2) they include only research doctorates and exclude performance doctorates not requiring a research dissertation, 3) classification by field and subfield are different, and 4) data are by fiscal year instead of academic year.
47. U.S. Department of Health, Education, and Welfare, Health Resources Administration. *1973 Inventory of Health Occupations Education Programs in Two-Year and Four-Year Colleges and Universities*. In process 1974.  
A survey of degree, diploma, and certificate programs in health professions except nursing, M.D.'s or O.D.'s, and scientists. Includes administration, technical and clerical occupations, nursing-related service personnel, and several other health professions. Data include type of award, enrollment by race and sex, entrance requirements, cost, and other items. Conducted for HEW by the Association of Schools of Allied Health Professions.

48. \_\_\_\_\_ , Office of Education. *Digest of Educational Statistics*. Annual since 1962.  
Contains data on enrollments, degrees, and other items. Compiled from various sources indicated in table footnotes.
49. \_\_\_\_\_ , \_\_\_\_\_ . *Earned Degrees Conferred*. 2 vols.: *Summary Data* and *Institutional Data*. Annual by academic year since 1947-48. -  
The first volume reports the number of degrees by level of degree, field of specialization, sex of recipient, State, and control and level of institution. The second volume provides a listing of bachelor's and higher degrees conferred in each academic field by each institution.
50. \_\_\_\_\_ , \_\_\_\_\_ . *Fall Enrollment in Higher Education*. 2 vols.: *Summary Data* and *Institutional Data*. Annual.  
Includes opening fall enrollments by type of program, institutional level and control, attendance status, and sex of student. Historical data are available beginning with 1946.
51. \_\_\_\_\_ , \_\_\_\_\_ . *Students Enrolled for Advanced Degrees*. 2 vols.: *Summary Data* and *Institutional Data*. Annual since 1959.  
Data on enrollments classified by field of specialization, level of study, attendance status, sex, State, institutional level and control, and by individual institution.
52. \_\_\_\_\_ , \_\_\_\_\_ . *Projections of Educational Statistics*. Annual since 1964.  
Lists projections of enrollments, graduates, faculty, and expenditures for higher education, as well as similar projections for elementary and secondary schools.
53. \_\_\_\_\_ , \_\_\_\_\_ . *Publications of the National Center for Educational Statistics*. (OE) 73-11000. Annual.  
Lists regular publications of the Office of Education, National Center for Education Statistics. Headings include Elementary and Secondary Education, Higher Education, Library Statistics, Adult and Vocational Education, and others.

**B. Junior colleges**

54. U.S. Department of Health, Education, and Welfare, Office of Education. *Associate Degrees and Other Formal Awards Below the Baccalaureate*. (OE-54045). Annual by academic year since 1965-66.  
Contains extensive summary data as well as data on individual institutions for 1) associate degrees meeting bachelor's degree credit criteria, 2) awards in organized occupational curriculums for work at the technical or semiprofessional level, and 3) awards in organized occupational curriculums for work below the technical or professional level. Data are reported by type and length of curriculum, State or area, and sex of recipients.

**C. Federal manpower programs**

55. U.S. Department of Health, Education, and Welfare, Office of Education. *Inventory of Vocational Education Statistics in Federal Agencies*. (OE-80069), 1970.  
Lists by agency sources of data on occupational training, including MDTA, health training programs, and many other programs.
56. U.S. Department of Labor. *Manpower Report of the President*. Annual since 1963.  
Statistical appendix presents summary data on Federal manpower programs, including total

enrollments, completions, and post-training employment. Manpower policy developments of each year are discussed in the text of the report. For further information see *Index to the Manpower Reports of the President, 1963-72*.

#### D. Vocational education

57. U.S. Department of Health, Education and Welfare, Office of Education. *Annual Report on Vocational and Technical Education*. Annual 1965-69.

Contains data on enrollments by State and field in vocational education programs.

58. \_\_\_\_\_, \_\_\_\_\_. *Enrollment in Vocational Education Occupation Programs*. Vocational Education Information No. 11. Annual since FY 1966.

Contains enrollments by detailed occupational programs for fiscal years.

59. \_\_\_\_\_, \_\_\_\_\_. *Inventory of Vocational Education Statistics in Federal Agencies*. (OE-80069), 1970.

60. \_\_\_\_\_, \_\_\_\_\_. *Vocational Education and Characteristics of Students and Teachers, 1967*. (OE-80073), 1973.

61. U.S. Department of Labor, Bureau of Labor Statistics. *Tomorrow's Manpower Needs*, Bulletin 1606, Supplement 3, 1973.

Contains conversion tables for matching occupational classifications of BLS projections to vocational education program codes.

#### E. Apprenticeship programs

62. U.S. Department of Labor. *Manpower Report of the President*. Annual since 1963.

Contains summary data on annual new registrations, cancellations, and completions of apprenticeship training since 1947.

#### F. Employer training (except apprenticeship)

63. Foster, Howard G. "Non-apprentice Sources of Training in Construction," *Monthly Labor Review*, February 1970, pp. 21-26.

Reports the results of a survey of 784 construction craftsmen and over 70 businessmen in upstate New York, including data on percent of respondents receiving training from various sources.

64. Neary, H. James. "The BLS Pilot Survey of Training in Industry," *Monthly Labor Review*, February 1974, pp. 26-32.

Describes the results of the BLS pilot survey of training in metalworking industries, including methods of data collection and the survey design. The pilot survey was conducted to determine whether reliable data could be collected on training enrollments and completions in industry.

65. Somers, Gerald G. *Availability of Data on Company Training Programs: A Feasibility Study*. Madison: University of Wisconsin, 1971.

Includes limited pilot survey data on company training.

66. \_\_\_\_\_, and Myron Roomkin. *Training and Skill Acquisition: A Pilot Case Study*. Madison: University of Wisconsin, 1972.

Reports on a study conducted for the Manpower Administration of the U.S. Department of Labor, aimed at determining the training procedures, the sources, costs, and benefits of skill acquisition and transferability of skills in one company. The study had the additional purpose of refining methodological techniques in surveys of company training programs.

67. U.S. Department of Health, Education, and Welfare, Bureau of Health Resources Development. *Survey of Preparatory Education Programs in Hospitals*. In process 1974.

A survey of occupational preparatory and advanced training programs in hospitals, including nursing, laboratory services, and several other areas. Data include type of award granted, entry requirements, enrollment, cost, and relationship to the Manpower Development and Training Act (MDTA) and Jobs in the Business Sector (JOBS). Conducted for HEW by the American Hospital Association.

68. U.S. Department of Labor, Manpower Administration. *Formal Training of Adult Workers*. Manpower/Automation Research Monograph No. 2, 1964.

Reports on a 1963 survey of workers between the ages of 22 and 64 who had completed less than three years of college. Respondents were asked how much education they had; whether they had taken occupational training in high school, technical school, correspondence schools, company training programs, apprenticeship, or the Armed Forces; and whether they used their training in their current job. The sample was the April 1963 Current Population Survey sample of 35,000 households.

69. \_\_\_\_\_, \_\_\_\_\_. *Training of Workers in American Industry*. Research Division, Report No. 1, 1962.

Reports the results of a 1962 survey of 700,000 establishments to determine the extent and nature of industry training efforts.

70. \_\_\_\_\_, \_\_\_\_\_. *Transferring Military Experience to Civilian Jobs*. Manpower/Automation Research Monograph No. 8, 1968.

Study of post-military experience of Air Force veterans who left the service during 1965 and 1966.

#### **G. Armed Forces**

71. Clark, Harold F., and Harold S. Sloan. *Classrooms in the Military: Account of Education in the Armed Forces of the United States*. New York: Columbia University Teachers College, Bureau of Publications, 1964.

72. U.S. Department of Defense, Office of Assistant Secretary. *Selected Manpower Statistics*. Annual.

Data on persons discharged from the Armed Forces, by broad military job classification.

73. \_\_\_\_\_, \_\_\_\_\_. *Transitional Manpower Programs*, 1970.

Contains information on Project Transition.

#### **H. Private vocational schools**

74. U.S. Department of Health, Education, and Welfare, Office of Education. *Directory of Postsecondary Schools with Occupational Programs, 1971*. DHEW Publication No. (OE)73-11410, 1973.

A comprehensive list of all schools offering postsecondary occupational training, including private vocational schools as well as 2- and 4-year colleges.

75. \_\_\_\_\_, \_\_\_\_\_. *Survey of Programs and Enrollments in Postsecondary Schools*. In process 1974.  
Survey of a sample of schools drawn from the *Directory* cited above.

### III. Followup Data

#### A. Colleges and junior colleges

76. American Institute of Physics. *1967-68 Graduate Student Survey*. AIP Publication No. R-2071, January 1969.  
Reports on a survey of 9,000 students enrolled in graduate physics departments, including information on age, sex, and citizenship; graduate education; undergraduate major; geographic region; type of employment accepted by new master's and doctor's degree recipients; and number of job offers.
77. \_\_\_\_\_. *Summary Report: Survey of Physics Bachelor's Degree Recipients, 1967-68*. Publication No. R-211, December 1968.  
Based on results of a survey of 2,890 bachelor degree recipients, the report provides data on regional distribution, post-baccalaureate plans, age distribution, sources of support for graduate study, type of employment accepted, and median salary.
78. Astin, Alexander. *The College Drop Out: A National Profile*. Washington, D.C.: American Council on Education, 1972.  
Examines what happens to the college dropout, his entry into the labor force, transfer rates, and likelihood of return to college.
79. \_\_\_\_\_, and Robert J. Panos. *The Educational and Vocational Development of College Students*. Washington, D.C.: American Council on Education, 1969.  
Presents data on college freshmen of 1961 who were followed up in 1965, examines changes in career choices over the 4-year period as well as predictors of career choice.
80. Astin, Helen, and Ann S. Bisconti. *Career Plans of College Graduates of 1965 and 1970*. Bethlehem, Pa.: College Placement Council, Inc., 1972.  
Reports on entry to employment by type of employer, undergraduate major, occupation, and other items. Based on data from the American Council on Education.
81. Astin, Helen, and Ann S. Bisconti. *Undergraduate and Graduate Study in Scientific Fields*. Washington, D.C.: American Council on Education, ACE Research Reports, Vol. 8, No. 3, August 1973.  
This report examines the flow of a national cohort of college freshmen of 1961 over a decade, focusing on patterns of undergraduate study, attrition, degree attainment, advanced study, and employment. Findings on the progress and goals of 1966 freshmen are included as a means of comparison with the 1961 cohort. Contains 78 separate cross-tabulations.
82. Astin, Helen, Elaine El-Khawas, and Ann S. Bisconti. *Beyond the College Years*. Washington, D.C.: American Council on Education, 1974.  
Report prepared for the National Science Foundation and the National Institutes of Health, uses correlation and regression analysis to examine factors associated with career outcomes and presents data on career flows.



83. Bayer, Alan, Jeannie Royer, and Richard Webb. *Four Years After College Entry*. Washington, D.C.: American Council on Education, ACE Research Reports, Vol. 8, No. 1, 1973.
- Followup of a sample of the freshmen class of 1967.
84. Berger, Alan S. *Longitudinal Studies on the Class of 1961, The Graduate Science Students*. Report No. 107. Chicago: National Opinion Research Center, January 1967.
- Using a sample of 4,394 seniors from 135 accredited institutions, the report deals with three major areas: actual graduate enrollment in science fields, the percentages of those actually enrolling, and the career activities of graduate students in the selected science fields.
85. Blank, Arthur, Margaret Koneisky, Leonard Kogan, and Lawrence Podell. *The Graduates Restudied: A Comparison of the Follow-up of New York City High School Graduates of 1970 and 1971*. New York: Center for Social Research, The Graduate School and University Center, The City University of New York, 1972.
86. Boercker, Fred, Lindsey R. Harmon, and William C. Kelly. "Employment Status of Recent Recipients of the Doctorate," *Science*, May 22, 1970, pp. 930-39.
87. Calvert, Robert Jr. "Liberal Arts Graduates—What Do They Have to Report?" *Journal of College Placement*, February-March 1969.
- Based on a study conducted through the Survey Research Center of the University of California at Berkeley, the article describes the employment activities of 11,000 graduates from the classes of 1948, 1953, and 1958 from 100 liberal arts institutions. Data are presented about their salaries, how they feel about their careers, how hard they work, who helped them obtain their jobs, how they feel about a liberal arts education, and whether they have a clear career direction.
88. College Placement Council, Inc. *Careers of College Graduates Within the Private Sector*. Forthcoming 1974.
- Career patterns of men and women currently employed in private companies compared to those of men and women in other sectors. Focuses on dynamics of career choice in these settings, including reasons for choices, academic achievement, and degree attainment.
89. \_\_\_\_\_. *The College Graduate: Turnover and Mobility*. Report No. 3, Bethlehem, Pa., 1970.
- Using National Opinion Research Center data for 33,000 graduates of the class of 1961, the report studies labor force mobility and job changing during the five years after graduation. Detail includes degree field, type of employer, and sex. Earlier reports in the series dealt with graduates' attitudes toward business, and job satisfaction.
90. \_\_\_\_\_. *College-Year Plans and Long-Run Career Outcomes of College Graduates*. Forthcoming 1974.
- Actual occupations of college graduates compared with college-year plans. Analyses flow directly from *Career Plans of College Graduates of 1965 and 1970* (see entry 80 above), but provide greater detail in classification of majors and careers.
91. \_\_\_\_\_, and Sandia Corporation. "A Statistical Report: Placement and Recruitment," *Journal of College Placement*, April 1965.
- This survey of 644 placement officers indicates types of placement services provided, number of students assisted, types of jobs and size of placement staff, and an analysis of turnover among the placement staff.

92. Council, Kathryn A. *Attrition: A Campus Profile*. Raleigh: North Carolina State University, Student Affairs Research, October 1972.
- Reports attrition rates by type of program for NCSU students entering in 1965.
93. Dickinson, Carl, and Betty Newbegin. "The Occupations They are Choosing," *Journal of College Placement*, February-March 1968.
- Data for this study are from a questionnaire followup of 1,171 male graduates of the University of Washington who completed bachelor's degrees between March and December 1966. Tables show the type of employer chosen by major field, monthly starting salaries, and percentages entering graduate study.
94. \_\_\_\_\_, \_\_\_\_\_. "Pursuing the Engineer," *Journal of College Placement*. October-November 1957.
- A survey of 345 engineering graduates at the University of Washington who completed their degree requirements between December 1965 and December 1966. The effects of various factors on engineers' career choice are studied, such as academic performance, campus interviewing, salary, location, and type of work.
95. El-Khawas, Elaine, and Ann S. Bisconti. *Five and Ten Years After College Entry*. Washington, D.C.: American Council on Education, ACE Research Reports, Vol. 9, No. 1, 1974.
- Descriptive report including 1971 data on college freshmen of 1961 and 1966.
96. Engineering Manpower Commission. *Engineering and Technology Graduates*. New York: Engineers Joint Council. Annual.
- Survey of 2-year associate degrees granted for completion of engineering and technology curriculums.
97. \_\_\_\_\_. *Placement of Engineering Graduates*. New York: Engineers Joint Council. Annual.
- Data from a survey of over 200 engineering schools provide information on the placement status of 24,000 technical and 14,500 nontechnical graduates who received bachelor's degrees. Number and percentages of graduates entering employment, graduate school, and military service are given.
98. \_\_\_\_\_. *Prospects for Engineering and Technology Graduates 1968*. New York: Engineers Joint Council, September 1968.
- Based on 208 engineering schools and 52 other technological institutions, this survey provides information on the placement status of 26,815 graduates in 1968. Gives entrance rates of graduates into labor force, graduate schools, and military service.
99. Ginsberg, Eli. "The Conservation of Talent--Lessons for Management," *Journal of College Placement*, October-November 1965.
- A study of the career development of 342 male students who had been awarded graduate fellowships by Columbia University during the early post-World War II years (1945-51).
100. Hunt, Donald C. *Their First Jobs After College*. Detroit: University of Detroit. Annual.
- Bachelor's graduates from the University's Schools of Architecture, Arts and Sciences, Commerce and Finance, and Engineering report their experiences. Charts give data on degrees, sources of job references, starting salaries, reasons for job selection, and correlation of hometown to final job location.

101. Kauffman, Warren E. "The Class of 1963," *Journal of College Placement*, April 1964.
- A nationwide study of 51,000 graduates of 102 colleges and universities. Data are available on those who accepted employment as of June 1963, the proportion going on to graduate school, the number still seeking employment, and the number entering military service.
102. Mercer, Charles. *Public Post-Secondary Education in the U.S.* Center Monograph No. 3. Chapel Hill: University of North Carolina, Center for Occupational Education, 1969.
103. National Opinion Research Center. *Patterns of Change in the Long Run Career Fields of June 1961 College Graduates.* September 1965.
- Changes in career fields of 41,000 college students are analyzed to three years after graduation. One hundred fields are examined concerning the students from 135 institutions.
104. National Research Council, National Academy of Sciences. *Careers of Ph.D.'s—Academic versus Non-Academic—A Second Report on Follow-up of Doctorate Cohorts 1935-1960.* Career Patterns Report No. 2, Publication 1577, 1968.
- By studying the careers of 10,000 holders of third-level research degrees, systematically selected from the graduating classes of 1935, 1940, 1950, 1955, and 1960, this report focuses on the factors associated with choice of employment in academic or other settings, with particular emphasis on the circumstances surrounding a change in employer category.
105. \_\_\_\_\_, \_\_\_\_\_. *Doctorate Recipients from United States Universities.* Annual since 1966.
- Gives number of degrees, post-doctoral plans, employment, and field of work, by specific field of degree. Includes historical data beginning in 1958.
106. \_\_\_\_\_, \_\_\_\_\_. *Education and Employment Patterns of Bioscientists, a Statistical Report.* February 1971.
- Contains data from many sources on enrollments, degrees earned, and employment. Identifies areas where data are not readily available. Bibliography.
107. National Science Foundation. *Two Years After the College Degree—Work and Further Study Patterns.* NSF 63-26, 1963.
- Reports on a 1960 survey of over 40,000 1958 baccalaureate degree recipients. Includes data on work and further study activities.
108. Newark College of Engineering, Placement Office. *Senior Survey.* Annual.
- Reports placement of engineers by type of work, salary, type of employer, and location.
109. Pervin, Lawrence. "Counseling the College Dropout," *Journal of College Placement*, October-November 1965.
- This study at Princeton University analyzes career accomplishments of college dropouts from three classes - 1940, 1951, and 1960. A study of those returning to college is included, indicating an increase in successive years.
110. Schwartz, Mildred A. *United States College-Educated Population: 1960.* Report No. 102. Chicago: National Opinion Research Center, October 1965.
- Answers questions such as what proportion of those with college degrees are actively employed, what percentage are employed in the field of their degree. The report shows contrasts among degree levels and age/sex groups.

111. Sharp, Laure M. "Graduate Study and Its Relation to Careers: The Experience of a Recent Cohort of College Graduates," *Journal of Human Resources*, Fall 1966, pp. 41-58.

Data on entrance rates of those with graduate school background. Employment patterns are given for those in the study. Based on the *Five Years After the College Degree* data (see below).

112. \_\_\_\_\_. "The Meaning of the Bachelor's Degree: Some Recent Survey Findings," *Sociology of Education*, Winter 1963, pp. 93-109.

Gives limited statistical information on the value of a college education as it concerns entrance into the labor market. Based on data from *Two Years After the College Degree* (see National Science Foundation above).

113. \_\_\_\_\_, *et.al. Five Years After the College Degree*. Washington, D.C.: Bureau of Social Science Research, 5 volumes:

Part I: *Graduate and Professional Education*. 1965.

Part II: *Occupational Outcome (Text Tables: Appendix Tables)*. 1965.

Part III: *A Methodological Note*. 1966.

Part IV: *Military Service*. 1967.

Part V: *Geographic Mobility*. 1967.

Based on a survey in 1963 of 1958 bachelor's degree recipients including a subsample of individuals surveyed in the National Science Foundation study, *Two Years After the College Degree*, who obtained further graduate and professional education during 1958-63. Describes occupational entry and other characteristics by type of training.

114. \_\_\_\_\_, and Thelma Myint. *Graduates of Vocational-Terminal Programs in Junior Colleges, Results of a Follow-up Study of the Class of 1966*. Washington, D.C.: Bureau of Social Science Research, September 1970.

Data are presented on entrance rates, starting salary, type of employer, and other items for junior college graduates.

115. Snelling, W., and R. Boruch. *Science in Liberal Arts Colleges: A Longitudinal Study of 49 Selective Colleges*. New York: Columbia University Press, 1972.

A followup study of recipients of bachelor's degrees in science.

116. Spaeth, Joe L., and Norman Miller. *Trends in the Career Plans and Activities of June 1961 College Graduates*, March 1965.

The Office of Education and the National Institutes of Health sponsored this study emphasizing the choice of field for the careers of 1961 college graduates.

117. Stamm, Alfred M. "1967 Social Work Graduates: Salaries and Characteristics," National Association of Social Workers, *Personnel Information*, March 1968.

Of 3,817 graduates of the 64 schools of social work, 1,937 responded to the survey. Ten tables provide information on the graduates by age and sex, prior employment, plan for future education, type of practice, type of employer, and salary by employment, sex, type of practice, and prior experience.

118. Taplin, Lois. *Employment Patterns of Xavier University Graduates—1964*. Xavier University Placement Office, 1967.

Gives entrance rates for 1964 graduates of Xavier University. Different types of occupations are analyzed for the relationship—if any—to the college major.

119. Underhill, Ralph. *Occupational Values and Post-College Career Change*. Chicago: National Opinion Research Center, June 1967.
- A response to questionnaires sent each year for 3 years to 15,850 male college graduates. Career variations are examined in relation to occupational choice and values. This follow-up provides information on the entrance into the work force of these graduates.
120. U.S. Department of Labor, Women's Bureau. *College Women – 7 Years After Graduation, 1966*, Bulletin 292, 1966.
- A 7-year followup of women who graduated in 1957. The present status of the graduates concerning employment, education, and salaries is presented.
121. \_\_\_\_\_, \_\_\_\_\_. *15 Years After College*. Bulletin 283, 1962.
- An exploratory survey of 580 alumnae from 4 colleges in 1945. It gives detailed employment patterns of graduates and nongraduates.
122. \_\_\_\_\_, \_\_\_\_\_. *Trends in Educational Attainment of Women*. Annual since 1965.
- Tables and charts provide information on female high school graduates, college degrees conferred, and the labor force participation rates of women from 1952 to the present.
123. University of Illinois. *1960 Engineering Graduates—Where Are They Now?* Urbana: University of Illinois, College of Engineering, 1965.
- A 5-year followup study of 1960 graduates. Statistics on salaries, regional distribution, types of employers, job turnover, and the number of graduates obtaining advanced degrees.
124. University of Michigan. *Annual Report of Engineering Placement*. Ann Arbor: Engineering Placement Service, College of Engineering. Annual.
- Reports positions accepted by engineering graduates by location, type of work, type of employer, as well as data on placement activities.
125. "The Young Architect – A Profile," *Architectural Record*, December 1972, pp. 81-85.
- Reports results of a survey of 1,500 graduates of architectural schools in the classes of 1965, 1967, and 1969. Includes percent who are registered architects, type of employer, and other items.
- B. Vocational education**
126. Connecticut State Department of Education, Division of Vocational Education. *Graduate Follow Up, Statistical Data on Connecticut Students Completing Vocational Education Programs*. Annual since 1967.
- Data by type of training, secondary and post-secondary schools, number of graduates employed in related and in unrelated occupations, number out of the labor force, and mean hourly wages.
127. Duis, Harold. "Employment of Vocational Program Graduates," *American Education*, February 1968.
- Gives data on entrance rates of graduates from vocational training programs into different occupational classifications.
128. Eninger, Max. *The Process and Product of T & I High School Level Vocational Education in the United States*. Pittsburgh: American Institutes for Research, September 1965.
- Followup of trade and industrial vocational education program graduates.

129. Gentry, N. Dale. *Follow-up Vocational Studies at North Idaho Junior College*. Moscow, Idaho: University of Idaho, College of Education, The State Occupational Research Unit, July 1967.

Data are presented on students' labor market entry rates, a breakdown of occupations, transfer rates, and percentages left unemployed. Data for graduates of programs in automobile body and fender repair, automobile mechanics, and industrial electronics.

130. Little, J. Kenneth, and Richard W. Whinfield. *Followup of 1965 Graduates of Wisconsin Schools of Vocational, Technical and Adult Education*. Madison: University of Wisconsin, Center for Studies in Vocational and Technical Education, Industrial Relations Research Institute, June 1970.

Data available on completions, percentages of graduates achieving employment, and types of employment, from a sample of 1,500 Wisconsin students.

131. Priebe, Donald. "A Follow-up of Vocational Agriculture Graduates," *Agriculture Education*, June 1968.

This study examines the employment patterns—rates of entry, choice of field, geographic breakdown—of vocational agriculture graduates.

132. Reich, Carol. "Vocational Specialization and Occupational Placement: A Follow-up Study," *Vocational Guidance Quarterly*, June 1973, pp. 281-87.

Using a coding scheme based on the *Dictionary of Occupational Titles*, statistical tests on a sample of vocational students resulted in a poor relationship between training and placement.

133. Somers, Gerald G. *The Effectiveness of Vocational and Technical Programs: A National Follow-up Study*. Madison: University of Wisconsin, Center for Studies in Vocational and Technical Education, 1971.

Based on a 1969 survey of a national sample of 1966 vocational and technical program graduates, reports labor force and employment status by type of program, major occupational classification, and personal characteristics.

### C. Federal manpower programs

134. Brown, Thomas C. *Occupational Mobility Through MDTA Training*. U.S. Department of Labor, Office of Manpower, Automation, and Training, Manpower Evaluation Report E-2, 1964.

Mobility patterns by occupational group and the effectiveness of Manpower Development and Training Act programs in meeting needs. Based on Labor Department records.

135. Bureau of Social Science Research. Manpower Development and Training Act Projects:

*Follow-up Study of MDTA Experimental and Demonstration Project at North Carolina A&T College*. Leslie J. Silverman, BSSR 369, 1966.

*Follow-up Study of MDTA Experimental and Demonstration Project Conducted by the Michigan Catholic Conference*. Angeles Buenaventura, BSSR 369, 1967.

*Follow-up Study of MDTA E&D Project at Bluefield State College*. N. March Hoffman, BSSR 369, 1967.

*Follow-up Study of MDTA E&D Project Conducted by Tuskegee Institute*. Louise A. Johnson, BSSR 369, 1967.

*Follow-up Study of MDTA E&D Project Conducted at Agricultural and Industrial State University of Nashville*. Louise A. Johnson, BSSR 369, 1967.

*Follow-up Study of Project Uplift, the MDTA E&D Project Conducted by Florida A&M University*. Leslie J. Silverman, BSSR 369, 1967.

*Follow-up Study of MDTA Projects Conducted by Morgan State College.* Diantha Stevenson, BSSR 369, 1967.

These followup studies contain statistical information on completions in the projects, percentages of persons obtaining desired employment, breakdowns of the occupations selected, and background data on the affected people in the projects.

136. Fahey, Frank. *Follow-up Study of Project Able.* U.S. Department of Labor, Manpower Administration, 1967.

Evaluates the results of an MDTA project to retrain and reemploy workers displaced by the closing of the Studebaker plants in South Bend, Indiana. Occupational detail included.

137. *Follow-up of Graduates of Experimental and Demonstration Projects in the Washington, D.C. Area, 1966-67.* Washington, D.C.: Catholic University of America, Bureau of Social Research, 1967.

Employment patterns of graduates of experimental MDTA programs for disadvantaged youth.

138. Lunden, H. H. *How Fare M.D.T.A. Ex-Trainees—An 18 Month Follow-up Study of 500 Such Persons.* St. Louis: University of Missouri, December 1967.

Data on 500 trainees from MDTA programs. Entry rates into labor force, type of occupation, and type of employer are listed.

139. U.S. Department of Labor, Manpower Administration. *Manpower Research and Development Projects.* Annual since 1971.

Lists completed research and development projects funded by the Manpower Administration, with annotations.

#### D. Veterans

140. National Committee for Children and Youth. *Recruitment, Training Placement and Follow-up of Rejected Armed Forces Volunteers in Baltimore, Maryland and Washington, D.C.,* 1967.

A study of the entrance rates into the labor market of rejected Armed Forces volunteers in Washington and Baltimore.

141. Sharp, Laure M. "Second Careers for Retired Military Personnel: Report on a Recent Survey," *Manpower Training Facts*, May 1965, pp. 7-10.

Data from a survey on employment entrance rates for retired military personnel.

142. Sharp, Laure M., and Albert D. Biderman. *Employment of Retired Military Personnel.* BSSR 361. Washington, D.C.: Bureau of Social Science Research, 1966.

A detailed study of the employment practices of those leaving the military. Occupational information is given by age, race, and rank. Excerpts are published in the *Monthly Labor Review*, January and February, 1967.

143. Sharp, Laure M., and Rebecca Krasnegor. *Five Years After the College Degree, Part IV, Military Service.* Washington, D.C.: Bureau of Social Science Research, 1967.

For annotation, see entry 113 above.

144. U.S. Department of Labor, Manpower Administration. *Transferring Military Experience to Civilian Jobs: A Study of Selected Air Force Veterans.* Manpower/Automation Research Monograph No. 8, 1968.

A followup study of Air Force veterans' choice of employment following military service.

145. Weinstein, Paul A. *Labor Market Activity of Veterans: Some Aspects of Military Spillover*. College Park: University of Maryland, 1969.

#### E. Other

146. Calvert, Robert Jr. "The Returning Peace Corps Volunteer—What Happens to Him?" *Journal of College Placement*, April-May 1966.

The director of the Peace Corps Career Information Service describes the fields of continuing education or employment selected by more than 6,000 returnees. By the end of 1967, according to estimates, nearly 18,000 returned volunteers had been offered placement services.

147. Fifield, Marvin, and Larry E. Watson. *A Follow-up Study of Pocatello and Idaho Falls High School Graduates (1954-1963)*. Moscow, Idaho: University of Idaho, College of Education, The State Occupational Research Unit, June 1967.

Examines the entrance rates of graduates into the labor force, detailed occupational classification, and continued education.

148. Perrella, Verá C., and Elizabeth Waldman. "Out of School Youth—2 Years Later," *Monthly Labor Review*, August 1966, pp. 860-66.

A 1965 resurvey of young men in a 1963 Current Population Survey study of early work experience. Assesses the relative progress of graduates and dropouts. Concludes that whatever the measure used—unemployment rate, earnings, or steadiness of employment—men with more education made greater advances over the 2-year period between the surveys.

149. *Project Talent—One Year Follow-up Studies*. Pittsburgh: University of Pittsburgh, School of Education, 1966.

From an original study in 1966 of a 5-percent sample of high school students (440,000) in 1,353 schools, the report compiles information on each group one year after graduation. It studies the nature of their employment and job satisfaction, the nature and extent of their post-high school education, and long-range career plans.

150. *Project Talent—A 5-year Follow-up Information on High School Graduates of 1960*. Pittsburgh: University of Pittsburgh, School of Education, July 1969.

A continuing followup of the high school graduates, their activities during the 5 years after graduation, examining employment and continuing education.

151. U.S. Department of Health, Education, and Welfare, Office of Education. *National Longitudinal Study of the High School Class of 1972*. In process 1974.

Study is designed to followup a sample of 20,000 high school seniors of 1972 for several years to examine their post-secondary educational and occupational status, and its relation to high school training experience.

152. U.S. Department of Labor, Bureau of Apprenticeship and Training. *Career Patterns of Former Apprentices*. Bulletin No. T-147, March 1959.

Results of a survey of 3,278 workers who completed apprenticeship training in 1950, including data on the relationship of occupation to apprenticeship training, wage rates, veteran status, and other items. Occupations covered include eight construction trades, three metalworking trades, mechanic and repair trades, printing, and others.



153. Waldman, Elizabeth. *Employment of High School Graduates and Dropouts in 1966*. Special Labor Force Report No. 85. Bureau of Labor Statistics, July 1967.

Compares labor force entry rates of graduates and dropouts. Based on data from the October 1966 Current Population Survey. Some data for major occupational groups are included.

#### IV. Occupational Transfers

##### A. Census, Current Population Surveys, and Bureau of Labor Statistics Surveys

154. Bancroft, Gertrude, and Stuart Garfinkle. *Job Mobility in 1961*. Special Labor Force Report No. 35. Bureau of Labor Statistics, August 1963.

Reports job changing and labor force mobility data from the February 1962 Current Population Survey.

155. Rosenfeld, Carl, and Vera C. Perrella. *Why Women Start and Stop Working: A Study of Mobility*. Special Labor Force Report No. 59. Bureau of Labor Statistics, September 1965.

Analyzes factors affecting labor force mobility of women 18-64 years of age, including age, presence of children, marital status, major occupational group status, and husband's income. Based on April 1964 Current Population Survey data.

156. Saben, Samuel. *Occupational Mobility of Employed Workers*. Special Labor Force Report No. 84. Bureau of Labor Statistics, June 1967.

Contains estimates of mobility for major occupational groups derived from January 1966 Current Population Survey data.

157. U.S. Department of Commerce, Bureau of the Census. Census of Population: 1970. Subject Reports. Final Report PC(2)-7E, *Occupation and Residence in 1965, 1973*.

Contains occupational mobility data for 10 major occupational groups.

158. \_\_\_\_\_, \_\_\_\_\_. Current Population Reports, *Lifetime Occupational Mobility of Adult Males*, Series P-23, No. 11. March 1962 and annually thereafter, various dates.

Presents data on occupational mobility of males by major occupational group.

159. U.S. Department of Labor, Bureau of Labor Statistics. *Occupational Mobility of Scientists*. Bulletin 1121, 1953.

Contains detailed mobility data for a sample of Ph.D. chemists, biologists, and physicists drawn from the 1948 *American Men of Science* register.

160. \_\_\_\_\_, \_\_\_\_\_. *Mobility of Molders and Coremakers, 1940-1952*. Bulletin 1162, 1954.

Studies the work experience, training, and personal characteristics of workers, including some data on occupational transfers. Based on a survey of 1,800 journeymen in eight metropolitan areas.

161. \_\_\_\_\_, \_\_\_\_\_. *The Mobility of Tool and Die Makers, 1940-1951*. Bulletin 1120, 1953.

Studies the work experience, training, and personal characteristics of workers, including some data on occupational transfers. Based on a survey of over 1,700 workers in seven large metalworking areas.

## B. Postcensal surveys

162. Cain, Glen, and W. Lee Hansen, *Occupations of Engineers: Economic Aspects*. Madison: University of Wisconsin, Social Systems Research Institute, January 1967 (unpublished).

163. Kincannon, C. L. "The Census Role in Scientific and Technical Manpower Programs for the 70's," American Statistical Association, *Proceedings of the Social Statistics Section, 1972, 1973*, pp. 181-89.

This article describes the survey design, sample design and selection, data collection, and data processing procedures for the 1972 Postcensal Manpower Survey.

164. Schwartz, Mildred A. *The United States College-Educated Population: 1960*. Chicago: National Opinion Research Center, Report No. 102, October 1965.

For annotation see entry 110 on p. 44.

165. Seltzer, Norman. "Post-censal Studies Program: Background and Content," American Statistical Association, *Proceedings of the Social Statistics Section, 1963, 1964*, pp. 175-80.

166. \_\_\_\_\_. "The 1972 Postcensal Survey of Professional, Scientific, and Technical Manpower," American Statistical Association, *Proceedings of the Social Statistics Section, 1972, 1973*, pp. 178-80.

167. Stambler, Howard V., and Annie Lefkowitz. "Education and Training of Technicians," *Monthly Labor Review*, November 1964, pp. 1278-80.

168. U.S. Department of Commerce, Bureau of the Census. *Characteristics of America's Scientists and Engineers: 1960 and 1962*. Technical Paper 21, 1969.

Presents detailed national statistics on employment and economic and social characteristics of scientists and engineers.

169. \_\_\_\_\_, \_\_\_\_\_. *Current Population Reports, Series P-23, No. 45*, "Persons in Engineering, Scientific, and Technical Occupations: 1970 and 1972," July 1973.

This is the first of a series of reports on the 1972 professional, technical, and scientific manpower survey. It presents preliminary data on employment status, age, sex, and education of persons identified in the 1970 census as working in engineering, scientific, and technical occupations.

170. U.S. Department of Labor, Bureau of Labor Statistics. *Technician Manpower: Requirements, Resources, and Training Needs*. Bulletin 1512, 1966.

171. Warkov, Seymour, and John Marsh. *The Education and Training of America's Scientists and Engineers: 1962*. Chicago: National Opinion Research Center, Report No. 104, 1965.

## C. National longitudinal surveys

172. Parnes, Herbert S. "Longitudinal Surveys: Prospects and Problems," *Monthly Labor Review*, February 1972, pp. 11-15.

Discusses the surveys and lists additional articles and reports based on survey data.

173. U.S. Department of Labor, Manpower Administration. *Career Thresholds*. Manpower Research Monograph No. 16, 4 vols., 1970-72.

Reports survey results for men 14-24 years of age.

174. \_\_\_\_\_, \_\_\_\_\_. *Dual Careers*. Manpower Research Monograph No. 21, 2 vols., 1970-72.  
Reports survey results for women 30-44 years of age.
175. \_\_\_\_\_, \_\_\_\_\_. *The Pre-Retirement Years*. Manpower Research Monograph No. 15, 3 vols., 1970-72.  
Reports survey results for males 45-59 years of age.
176. \_\_\_\_\_, \_\_\_\_\_. *Years for Decision*. Manpower Research Monograph No. 24, 3 vols., 1971-73.  
Reports survey results for women 14-24 years of age.

#### D. Other

177. College Placement Council, *The College Graduates—Turnover and Mobility*. 1970.  
Followup study of 1961 graduates examining turnover rates 3 years after graduation. Study separates men and women, different classes of employers, undergraduate majors, etc. Types of turnover include labor market dropouts, and type of employer.
178. Day, James F. *Teacher Retirement in the United States*. North Quincy, Mass.: Christopher Publishing House, 1971.  
A detailed investigation of retirements, job transfers, and mobility in the teaching profession.
179. Hiestand, Dale L. *Career Changes: Professional and Graduate Students After Thirty-Five*. New York: Columbia University Press, 1970.  
Discusses mobility in careers of graduate students at least 35 years old.
180. Lyons, Thomas F. *Nursing Attitudes and Turnover, The Relation of Social-Psychological Variables to Turnover, Propensity to Leave and Absenteeism Among Hospital Staff Nurses*. Iowa City: Iowa State University, Industrial Relations Center, 1968.  
A study of patterns and causes of job transfers and mobility among hospital nurses.
181. National Research Council, National Academy of Sciences. *Profiles of Ph.D.'s in Sciences – Summary Report on Follow-up of Doctorate Cohorts, 1935-1960*. Career Patterns Report No. 1, Publication 1293, 1965.  
A study of a sample of 10,000 doctorate holders in health-related sciences. Studies were made of employer categories, the geographic spread and postdoctoral migration, and on-the-job functions. Mobility is analyzed by geographic area, occupation, and field of specialization.
182. Somers, Gerald. *Labor Mobility: An Evaluation of Pilot Projects in Michigan and Wisconsin*. Madison: University of Wisconsin, Industrial Relations Research Institute, 1972.  
Data are given on studies done in Michigan and Wisconsin on mobility in the labor force. Information is available by age and different occupations by major occupational group.
183. U.S. Department of Health, Education, and Welfare, Office of Education. *Teacher Turnover in Public Elementary and Secondary Schools, 1959-60*. OE-23002-60, Circular 675, 1963.  
Contains turnover rates by age and sex.

184. U.S. Department of Labor, Bureau of Labor Statistics. *Labor Mobility and Private Pension Plans—A Study of Vesting, Early Retirement, and Portability Provisions*. Bulletin 1407, 1964.
- Statistical data concerning the effects of different pension plans on occupational mobility and job transfers.
185. \_\_\_\_\_, \_\_\_\_\_. *The Operation of Severance Pay Plans and Their Implications for Labor Mobility*. Bulletin 1462, 1966.
- Provides data on the effect on severance and pension plans as deterrents to occupational mobility.
186. \_\_\_\_\_, Manpower Administration. *Career Mobility for Professionals in Human Service Agencies*. MDTA Experimental and Demonstration Findings No. 8, 1969.
- Lists data on different human service occupations in terms of occupational transfers and mobility.

## V. Geographic Transfers

### A. Immigration and emigration

187. American Medical Association. *Foreign Medical Graduates in the United States, 1970*. 1971.
- Monograph presents data on specialty, activity, location, year of graduation, country of birth, age, and sex of foreign physicians in the United States, by country of graduation. Includes bibliography.
188. Grubel, H. G., and A. D. Scott. "Immigration of Scientists and Engineers to the U.S., 1949-61," *Journal of Political Economy*, August 1969, pp. 368-78.
- Brings together data from several sources in order to form a comprehensive picture of the "brain drain" into the United States.
189. National Science Foundation. *Scientists, Engineers, and Physicians from Abroad – Trends through Fiscal Year 1970*. NSF 72-312, 1972.
190. \_\_\_\_\_. *Immigrant Scientists and Engineers in the United States. A Study of Characteristics and Attitudes*. NSF 73-302, 1973.
- Reports on a survey conducted by NSF in mid-1970 of a sample of those admitted between February 1964 and January 1969 and who filed address reports with the Immigration and Naturalization Service in 1969.
191. North, David S., and William G. Weissert. *Immigrants and the American Labor Market*. Washington, D.C.: Trans-Century Corporation, April 1973 (unpublished).
- Followup data on occupations in 1972 of immigrants entering the U.S. in fiscal year 1970. Sponsored by Manpower Administration.
192. U.S. Department of Health, Education, and Welfare, Health Resources Administration, Bureau of Health Resources Development. *Survey of Foreign Nurse Applicants for Registered Nurse Licensure in the U.S.A.* Single-time survey for Bureau of Health Resources Development by American Nurses Association. In process 1974-75.
- Survey to determine the number of foreign nurse graduate applicants and the proportion of them successfully passing State board examinations for registered licensure. Number of applicants, by State, and data on characteristics and major obstacles to success on the examinations derived from in-depth interviews in eight States.

193. \_\_\_\_\_, National Institutes of Health. *The Foreign Medical Graduate: A Bibliography*. DHEW Publication No. (NIH) 73-440, November 1972.

Citations of information about foreign medical graduates in the United States, including their education abroad, flow into the United States, and their training and utilization in the United States. Includes only publications prior to September 1972.

#### **B. Internal migration**

194. Brown, David G. *The Mobile Professors*. Washington, D.C.: American Council on Education, 1967.

A study of how, where, and why college professors move within the academic labor market, based on a survey of 7,500 faculty members. Analyzes factors affecting mobility, including types of institutions, salaries, race and sex discrimination, balkanization of submarkets, and job search methods. The author presents recommendations for more effective use of academic manpower.

195. Ladinsky, Jack. "The Geographic Mobility of Professional and Technical Manpower," *Journal of Human Resources*, Fall 1967, pp. 475-94.

Analysis of professional worker migration based on the 1960 Census Public Use Sample suggests that age is the most important factor affecting mobility, followed by income, education, regional location, sex, family size, and marital status.

196. Saben, Samuel. *Graphic Mobility and Employment Status, March 1962-March 1963*. Special Labor Force Report No. 44. Bureau of Labor Statistics, August 1964.

197. Sharp, Laure M., and Rebecca Krasnegor. *Five Years After the College Degree, Part V, Geographic Mobility*. Washington, D.C.: Bureau of Social Science Research, 1967.

For annotation, see entry 113 on p. 45.

198. U.S. Department of Commerce, Bureau of the Census. *Census of Population: 1960, Subject Reports, Final Report PC(2)-2B, Mobility for States and State Economic Areas*, 1963.

Contains data on economic, demographic, and social characteristics, including major occupational groups, of the population classified by mobility status.

199. \_\_\_\_\_, \_\_\_\_\_. *Census of Population: 1970, Subject Reports, Final Report PC(2)-7E, Occupation and Residence in 1965, 1973*.

Geographic mobility data for major occupational groups, comparable 1960 data are in Final Report PC(2)-2B, *Mobility for States and State Economic Areas*.

## **VI. Entrants from Outside the Labor Force**

200. American Nurses Association. *The Nation's Nurses: Inventory of Registered Professional Nurses*. 1965.

Data on work activity and labor force mobility characteristics of R.N.'s.

201. National Education Association. *Status of the American Public School Teacher, 1970-71*. Research Report 1972-R3, 1972.

Data on reentrants.

202. National Science Foundation. *American Science Manpower*. Biennial, 1954-70.

Data on work activity of scientists in the National Register of Scientific and Technical Personnel.

203. U.S. Department of Commerce, Bureau of the Census. Census of Population: 1970, Subject Reports, Final Report PC(2)-6C, *Persons Not Employed*, 1973.

Data on occupational characteristics of persons not in the labor force or unemployed. Comparable 1960 data in Final Report PC(2)-6C, *Labor Reserve*.

## VII. Separations from the Labor Force and Deaths

### A. Working life tables

204. Fullerton, Howard N., "A Table of Expected Working Life for Men, 1968," *Monthly Labor Review*, June 1971, pp. 49-55.

Examines 1968 Current Population Survey data and provides estimates of expected working life for males of various ages in 1968. Includes a note on the technical construction of the tables.

205. U.S. Department of Labor, Bureau of Labor Statistics. *Tables of Working Life: Length of Working Life for Men*. Bulletin 1001, 1950.

Tables of working life for men in 1950. Includes an extensive description of working life patterns and a detailed exposition of the techniques used in the preparation of tables of working life.

206. \_\_\_\_\_, \_\_\_\_\_. *Tables of Working Life for Women, 1950*. Bulletin 1204, 1957.

207. \_\_\_\_\_, Manpower Administration. *The Length of Working Life for Males, 1900-60*, Manpower Report No. 8, July 1963.

Tables of working life for men in 1940, 1950, and 1960.

208. \_\_\_\_\_, \_\_\_\_\_. *Work Life Expectancy and Training Needs of Women*. Report No. 12, May 1967.

Tables of working life for women in 1960.

### B. Additional information

209. Bolt, Richard H., Walter L. Kolton, and Oscar H. Levine. "Doctoral Feedback into Higher Education," *Science*, May 14, 1965, pp. 918-28.

Includes estimates of death and separation rates developed from the National Science Foundation's Register.

210. Folk, Hugh and Donald E. Yett. "Methods of Estimating Occupational Attrition," *Western Economic Journal*, Vol. 6, No. 4, September 1968, pp. 297-302.

Comparison of several methods for estimating nonwage-related types of attrition, including age-specific occupational employment rates. Comparison of computations for nurses and engineers, 1950-56.

211. Fullerton, Howard N. "A New Type of Working Life Table for Men," *Monthly Labor Review*, July 1972, pp. 20-27.

Uses a "generation" life table in which the life spans of cohorts are followed through time, instead of a "period" life table based on mortality rates applicable to each age observed at one point in time. Includes tables, data sources, and technical appendix.

212. \_\_\_\_\_. "Sensitivity of Generation Tables of Working Life for Men to Different Projections of Labor Force Participation," American Statistical Association, *Proceedings of the Social Statistics Section 1972*, pp. 250-54.
213. Guralnick, Lillian. *Mortality by Occupation and Industry among Men 20 to 64 Years of Age: United States, 1950*. U.S. Department of Health, Education, and Welfare, Public Health Service, Vol. 3, No. 2, 1962.  
Death rates by occupation and industry, 1950 census industry and intermediate occupational classifications. Useful for identifying unusual occupational and industrial mortality patterns.
214. \_\_\_\_\_. "Occupational and Social Class Differences in Mortality," *Proceedings of the 1955 Annual Conference*, Millbank Memorial Fund, 1956, pp. 61-73.
215. U.S. Department of Health, Education, and Welfare, Public Health Service. *Mortality by Occupation and Cause of Death Among Men 20-64 Years of Age: United States, 1950*. Vital Statistics Special Reports, Vol. 53, No. 3, September 1963.  
Death rates by occupation and cause of death, 1950 census intermediate occupational classification. Discussion of limitations of the rates. Useful for identifying unusual occupational mortality patterns.
216. U.S. Department of Labor, Bureau of Labor Statistics. *Tomorrow's Manpower Needs*, Bulletin 1606, Vol. 1, February 1969, and Supplement 4, forthcoming 1974.  
Vol. 1 discusses the development of death and separation rates, and shows rates for individual occupations by sex in appendix A. Supplement 4 contains estimates of occupational separations for States.
217. Wolfbein, Seymour L. *Changing Patterns of Working Life*, U.S. Department of Labor, Manpower Administration, August, 1963.  
Tables of working life for men, 1960, and summary data for women. Text discusses retirement patterns, changes in patterns over time, and in employment and training patterns for older workers.

## VIII. Occupational Earnings

218. American Chemical Society. *1972 Report on Chemists' Salaries*. 1972. Annual since 1962.  
Salary data reported from a comprehensive survey of ASC members, including detail by degree status, type of employer, sex, work activity, field, and region. Data on chemical engineers and chemists are also reported annually in the ASC journal *Chemical and Engineering News*.
219. College Placement Council, Inc. *Men's Salary Survey and Women's Salary Survey*. Annual.  
Data include high, low, and average beginning salaries in business and industry, by type of curriculum and type of employment (industry), for recent college graduates. Data are collected from college placement offices, covering male graduates in accounting, business, humanities-social sciences, marketing, seven areas of engineering, agricultural science, chemistry-math-physics, and computer science, and female graduates in accounting, business communications, community service work, EDP, engineering, health, home economics, libraries, mathematics, merchandising, research, and secretarial services.

220. Endicott, Frank S. *Trends in Employment of College and University Graduates in Business and Industry*. American Society for Personnel Administration. Annual since 1946.
- Survey of beginning monthly salaries in 185 companies representing large- and medium-sized firms in 22 States and 20 industries. Salaries are for bachelor's and master's degree holders in engineering, accounting, sales, business administration, liberal arts, production management, physics, chemistry, mathematics, economics, and other fields.
221. Engineering Manpower Commission. *Professional Income of Engineers*. New York: Engineers Joint Council. Annual.
222. ————. *Salaries of Engineering Technicians*. New York: Engineers Joint Council. Annual.
223. Interstate Commerce Commission. *Wage Statistics of Class I Railroads in the United States*, Statement No. A-300. Annual.
224. National Education Association. *Economic Status of the Teaching Profession, 1971-72*, Research Report 1972-R2, 1972. Annual by academic year since 1962-63.
- Contains salary data from biennial NEA surveys and from the Office of Education. Details include sex, size or type of school, region, academic rank, degree, and comparisons with other occupations.
225. ————. *Faculty Salary Schedules in Colleges and Universities, 1971-72*. Research Report 1972-R10, 1972. Annual by academic year since 1967-68.
- Reports mean, minimum, and maximum salaries by rank, type of institution, size of enrollment, region, degree, and individual institution. Data are confined to 4-year institutions offering bachelor's or higher degrees, and are available from 1965-66.
226. ————. *Faculty Salary Schedules in Community - Junior Colleges, 1971-72*. Research Report 1972-R9, 1972. Annual by academic year since 1967-68.
- Contains data similar to that reported for colleges and universities, but confined to institutions offering less than a bachelor's degree.
227. National Science Foundation. *American Science Manpower*. Biennial 1954-70.
- Reports employment, earnings, and other characteristics of persons listed in the National Register of Scientific and Technical Personnel.
228. Professional and business associations. The following associations or periodicals conduct salary surveys for occupations of special interest to them:
- Advertising Age* (magazine)
  - American Dental Association
  - American Dental Assistants Association
  - American Dental Hygienists Association
  - American Insurance Association/American Mutual Insurance Alliance
  - American Marketing Association
  - American Medical Association
  - American Medical Record Association
  - American Osteopathic Association
  - American Speech and Hearing Association
  - Business Automation*, EDP Salary Survey
  - Flight Engineers International Association
  - Life Office Management Association, Actuarial Student Salary Survey



National Association of Certified Dental Laboratories  
National Farm and Power Equipment Dealers Association  
Public Personnel Association, *Pay Rates in Public Service*

229. U.S. Department of Commerce, Bureau of the Census. Census of Population: 1970 Subject Reports, Final Report PC(2)-7A, *Occupational Characteristics*, 1973.
- Includes median 1969 earnings for males and females in the experienced civilian labor force as well as employment and data on worker characteristics. Data from 1960 census are in a 1963 publication of the same title.
230. \_\_\_\_\_, \_\_\_\_\_. *Current Population Reports*, Series P-60. Earnings by major occupation group derived from Current Population Surveys.
231. U.S. Department of Health, Education, and Welfare, Office of Education. *Higher Education Salaries*. Annual by academic year.
- Salary data by type of institution, length of contract (e.g. 9-month and 12-month), and academic rank.
232. \_\_\_\_\_, \_\_\_\_\_. *Statistics of State School Systems*. Annual by academic year.
- Average salary levels of instructional staff in public elementary and secondary schools, by State.
233. \_\_\_\_\_, Social Security Administration. *Income of Physicians, Osteopaths, and Dentists from Private Practice, 1965-69*. DHEW Pub. No. (SSA)73-11852, Staff Paper No. 12, 1972.
- Compiles published data from the Internal Revenue Service on incomes of physicians, osteopaths, and dentists. Emphasizes trends in their income components since the advent of Medicare and Medicaid. Data from other sources are also used to analyze comparative income trends.
234. U.S. Department of Labor, Bureau of Labor Statistics. *Area Wage Surveys*. 2 vols., *Metropolitan Areas, United States and Regional Summaries*, and *Selected Metropolitan Areas*, plus separate volumes for individual cities. Annual since 1950, various bulletins. Before Bulletin 1465 (1965-66) the series were called Occupational Wage Surveys.
- Earnings data by sex, by city, region, and U.S. for about 90 metropolitan areas, covering 76 occupations in six industry divisions. Also includes information on scheduled weekly hours, shift differential practices, fringe benefits, and wage trends.
235. \_\_\_\_\_, \_\_\_\_\_. *A Directory of Industry Wage Surveys and Union Wages and Hours Studies, 1960-73*, 1973.
- Lists industries covered in the BLS wage survey program including publication titles, bulletin numbers, and a limited description of their content.
236. \_\_\_\_\_, \_\_\_\_\_. *National Survey of Administrative, Technical, and Clerical Pay*. Annual since Winter 1959-60, various bulletins.
- Data on salary levels and distributions for 80 occupation-work levels, including accounting, legal services, personnel management, engineering and chemistry, buying, clerical supervisory, drafting, and clerical jobs. Averages are shown for annual, monthly, or weekly rates, excluding overtime pay. Data are shown for total United States, for metropolitan areas combined, for establishments of 2,500 or more, and for major industry divisions.
237. \_\_\_\_\_, \_\_\_\_\_. *Salary Trends*, including the following:
- Salary Trends: City Public School Teachers, 1925-65*, Bulletin 1504, 1966.

*Salary Trends: Federal Classified Employees, 1939-64*, Bulletin 1444, 1965.

*Salary Trends: Firemen and Policemen, 1924-64*, Bulletin 1445, 1965.

Additional data, except for teachers, appear in annual *Current Wage Developments*. Current data for teachers appear biennially in CWD. Data include salary levels and trends for regions and city-size groups, as well as national data. Except for Federal workers, coverage is limited to cities of 100,000 or more. Data are compiled from various sources, including the U.S. Civil Service Commission, the National Education Association, and the International City Management Association, firefighter and police unions, and BLS surveys.

238. \_\_\_\_\_, \_\_\_\_\_. *Union Wages and Hours*. Annual since 1936 for building trades, 1950 for printing, 1946 for local transit, and 1943 for local trucking; various bulletins.

Data include averages and distributions of union scales of wages and hours by industry, region, and city. Wage rates and wage rate indexes are shown by skill level (e.g., journeymen) as well as by occupation. Data reflect only the wage rates set in union - management contracts, and not actual hourly earnings.

239. U.S. Department of Transportation, Federal Aviation Administration. *FAA Handbook*. Annual.

240. U.S. Maritime Administration, Division of Manpower Studies. Unpublished data on merchant marine base pay.

241. University of Texas. *Survey of Hospital and Medical School Salaries*, 1970 and 1968.

## IX. Analytical Studies

### A. Issues in occupational and manpower analysis

242. Becker, Gary. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. New York: National Bureau of Economic Research, Columbia University Press, 1964.

Becker's volume is one of the major works in the field of human capital economics. Education and manpower development are treated as investments in human capital, with costs and return as criteria for investment decisions.

243. Bezdek, Roger H., and Barry Getzel. *Forecasting the Job Content and Skill Requirements of the U.S. Economy*. Economic Research Group, Working Paper No. 10. Urbana: University of Illinois, Center for Advanced Computation, 1972.

Examines the problem of estimating education and training requirements for specific occupations, utilizing the *Dictionary of Occupational Titles* and related research by Eckhaus (see below).

244. Bolino, August C. *Occupational Education as a Source of Economic Growth*. Springfield, Va.: National Technical Information Service, November 1972.

Surveys the history and status of all types of occupational education. Prepared for the Manpower Administration.

245. Boulding, Kenneth E. "An Economist's View of the Manpower Concept" in *Proceedings of the Conference on the Utilization of Scientific and Professional Manpower*. New York: Columbia University Press, 1954, pp. 11-33.

Boulding labels the manpower concept as "repulsive, dangerous, disgusting, fascistic, communistic, incompatible with the ideals of liberal democracy, and unsuitable company for the minds of the young." His vigorous attack relies on a classical "hidden hand" interpretation of the market, and

concludes that manpower planning will at best interfere with the market's natural tendency toward equilibrium. Comments summarized by Robert M. MacIver.

246. Bowles, Samuel. *Migration as Investment: Empirical Tests of the Human Investment Approach to Geographical Mobility*. Discussion Paper No. 51. Cambridge: Harvard University, Program on Regional and Urban Economics, 1969 (mimeo).

A simple migration model, tested with data on net migration from the U.S. South for 1955-60, supports the hypothesis that geographic mobility is primarily a response to economic incentives, and therefore is consistent with the human capital approach to analysis.

247. Bowman, Mary Jean. "Educational Shortage and Excess," *Canadian Journal of Economics and Political Science*, November 1963, pp. 446-61.

Bowman reviews traditional rising prices, relative income, and status approaches to identifying manpower shortage and excess, as well as the more recent rate-of-return approach, emphasizing their normative as well as economic content. She concludes that shortage and excess have no valid meaning unless social costs and returns are considered, and that the most reliable indicators of imbalances are to be found by examining the allocation processes themselves. A brief digression on the situation for teachers is included.

248. Eckaus, R. S. "Economic Criteria for Education and Training," *Review of Economics and Statistics*, May 1964, pp. 181-90.

Eckaus criticizes the rate-of-return approach to developing economic criteria for educational planning. He then proposes an alternative method of computing educational requirements using estimates from the *Dictionary of Occupational Titles* of education and training requirements by occupation, and projections of occupational employment needs.

249. Fine, Sidney A. "A Re-examination of Transferability of Skills," 2 parts, *Monthly Labor Review*, July 1957, pp. 803-10; and August 1957, pp. 938-48.

Part I examines the assumptions and concepts involved in skill transferability and reviews earlier research. Part II draws upon occupational classification of the U.S. Employment Service to provide guidelines for a systematic approach to the study of transferability of skill.

250. Hansen, W. Lee. "The Economics of Scientific and Engineering Manpower," *Journal of Human Resources*, Spring 1967, pp. 191-220.

Hansen attempts to define some of the issues in the discussion of "shortages" by surveying the various positions taken, alternative approaches to research, and the analytical efforts of economists. He then explores in more detail the projection approach, and proposes a rate-of-return approach to analyzing occupational supply and identifying shortages and surpluses. Comment by David Brown and Claus A. Moser.

251. \_\_\_\_\_. "Labor Force and Occupational Projections," in *Proceedings of the 18th Annual Winter Meeting*. Madison: Industrial Relations Research Association, 1966.

Hansen reviews and critiques the various types and uses of projections, emphasizing the need for supply projections to make the requirements estimates more meaningful. He contends that what is most needed is not more projections but more research on occupational choice and the operation of the labor market.

252. \_\_\_\_\_. "Total and Private Rates of Return to Investment in Schooling," *Journal of Political Economy*, April 1963, pp. 128-40.
- Hansen discusses rate of return as an empirical measure of shortages.
253. Hollister, R. G. "The Economics of Manpower Forecasting," *International Labour Review*, April 1964, pp. 371-97.
- Hollister presents a theoretical analysis of certain aspects of manpower forecasting, in particular the use of present occupational distribution in forecasting, and the effects of supply and technological factors on the occupational distribution.
254. Kotz, Arnold, ed. *Occupational Education: Planning and Programming*. Menlo Park, Calif.: Stanford Research Institute, 1967. 2 volumes.
- This work reviews new approaches to planning and programming occupational education, with major emphasis on PPB. Contains articles by Garth Mangum, Norman Medvin, Thayne Robson, and others. Prepared for the U.S. Office of Education.
255. March, Georgianna B., ed. *Conference on Occupational Data Requirements for Educational Planning*. Madison: University of Wisconsin, Center for Studies in Vocational and Technical Education, 1966. Summarized in *Journal of Human Resources*, Summer 1966, pp. 54-66.
- The conference gave voice to two distinctive schools of thought. The first felt the need for occupational data was urgent and stressed its availability as a prerequisite to intelligent planning. The second denied the usefulness of such data, emphasizing weak methodologies and problems inherent in obtaining accurate job vacancy data.
256. Mestre, Elroy R. *Economic Minorities in Manpower Development*. Lexington, Mass.: Heath Lexington Books, 1971.
- Chapter 2 reviews problems of manpower development in the American economy such as the level of economic activity and economic security, with emphasis on mobility and minorities. Mestre presents good arguments for the usefulness of manpower policy for eliminating or offsetting market imperfections, structural imbalances, adverse effects of cutbacks, and promoting economic security.
257. Miller, Ann R. *Current Occupation and Past Training of Adult Workers*, Statistical Evaluation Report No. 7, Bureau of the Budget, March 1968 (mimeo).
- Analyzes unpublished data from the April 1963 Current Population Survey. Examines the feasibility of collecting data on the relationship of training and occupation, for improving supply projections and studying changing occupational structures. Prepared for the Interagency Committee on Occupational Classification.
258. Stigler, George. "The Economics of Information," *Journal of Political Economy*. June 1961; and "Information in the Labor Market," *Journal of Political Economy*, Supplement, October 1962.
- Stigler examines the relationship between labor market information and career choice.
259. Strauss, George. "Apprenticeship: An Evaluation of the Needs," in Arthur M. Ross, ed., *Employment Policy and the Labor Market*. Berkeley: University of California Press, 1965.
- Evaluates the data on apprenticeship and examines concepts such as the problem of defining who is an apprentice.

260. Young, Robert C., William V. Clive, and Benton E. Miles, *Vocational Education Planning: Manpower Priorities and Dollars*. Columbus: The Ohio State University, Center for Vocational and Technical Education, 1972.

This volume discusses the role of supply-demand data in manpower and vocational education planning. Includes bibliography.

**B. Studies of individual occupations and occupational groups**

261. Altman, Stuart H. *The Present and Future Supply of Registered Nurses*. DHEW Publication No.(NIH)72-134. U.S. Department of Health, Education, and Welfare, Public Health Service, 1971.

Altman presents an extensive discussion of the changing market for nurses during the post war years. He examines the breakdown of some noncompetitive characteristics of the hospital industry, the decline of hospital nursing schools and the growth of associate degree programs, rising nurse salaries, unionization, and increased mobility of female workers. He derives a model of nursing supply from models of family labor supply and aggregate labor supply of women. Projections of future supply are included.

262. Altman, Stuart H., and Alan Fechter. "The Supply of Military Personnel in the Absence of a Draft," *American Economic Review*, May 1967, pp. 19-31.

The article summarizes methods used to estimate the cost of replacing drafted personnel with an all-volunteer force. Factors affecting the level of enlistments are analyzed, including civilian unemployment and draft pressure. The effect of increased pay on volunteer accessions to the Armed Forces is analyzed for enlistees and officers. Elasticities are computed and used to estimate payroll costs of a volunteer force.

263. Alchain, A. A., K. J. Arrow, and W. M. Capron. *An Economic Analysis of the Market for Scientists and Engineers*. Chicago: Rand McNally, 1958.

The authors review various concepts of shortages and present an extensive analysis of the market for scientists and engineers, including such issues as R&D contracting practices, government employment policies, and "stocking" of high-skill personnel by firms. Long- and short-term supply problems are discussed in relation to salary and noneconomic factors influencing students' enrollments and completion of training.

264. American Council on Education. "A New Look at the Supply of College Teachers," *Educational Record*, Summer 1965.

265. Arrow, Kenneth J., and William M. Capron. "Dynamic Shortages and Price Rises: the Engineer Scientist Case," *Quarterly Journal of Economics*, May 1959, pp. 292-308.

Persistent shortages of engineers and scientists in the 1950's in spite of increasing salaries were often interpreted as a failure of the price mechanism. Arrow and Capron argue that the price mechanism did not fail, but simply did not adjust quickly enough to meet the continually expanding demand for scientists and engineers. They present a model of dynamic shortages to explain the market phenomena of the 1950's—simultaneous rising salaries and "shortage" conditions. Much of the paper is taken from Alchain, Arrow, and Capron, 1958.

266. Bayer, Alan E. "Nurse Supply: It's Better than We Thought," *The Modern Hospital*, July 1967.

Bayer contends that the elasticity of labor force participation for inactive R. N.'s could be increased by providing more flexible hours and improved working conditions.

267. Benham, Lee. "The Labor Market for Registered Nurses: A Three-Equation Model," *Review of Economics and Statistics*, August 1971, pp. 246-52.

Benham explores the factors influencing the numbers of employed registered nurses and their earnings across states. The simple model includes one structural equation for demand, one for labor force participation, and one for geographic location. Results are of limited usefulness because of poor data.

268. Bishop, Christine E. "Manpower Policy and the Supply of Nurses," *Industrial Relations*, February 1973, pp. 86-94.

Bishop explores the potential for short-run expansion of the supply of nurses. A model is constructed which estimates the elasticity of the labor force participation of nurses with respect to salary, and is tested on a large cross-section sample of married nurses in Massachusetts. Regression analysis produces positive but small estimates of elasticity. Bishop applies familiar techniques of labor force participation analysis, such as comparing salaries to "wages" earned from housework in the area of occupational labor force participation.

269. Blank, David, and George Stigler. *The Demand and Supply of Scientific and Technical Personnel*. New York: National Bureau of Economic Research, 1957.

Blank and Stigler conclude that no significant shortage of engineers and scientists occurred during the postwar period. A shortage is said to occur when the supply of workers increases less rapidly than the number demanded at salaries paid in the recent past. The authors rely primarily on comparisons of earnings of engineers with earnings of other professional groups.

270. Bognanno, Mario F., Mahmood A. Zaidi, and Jesse S. Hixon. *The Married Women's Supply of Labor: A Microstudy of the Professional Nurse*. Minneapolis: Industrial Relations Center, University of Minnesota, February 1972.

Estimates the elasticities of labor supply of married nurses with respect to wages and husband's income. Based on a limited sample of nurses in Iowa in 1968.

271. Bumás, Lester O. "Engineering Occupational Choice, 1950-1965," *Industrial Relations*, February 1970, pp. 231-42.

Bumas challenges the conventional economic interpretation of relative earnings as a major determinant of occupational choice. He contends that employment opportunity is the primary explanatory variable and illustrates the hypothesis with regression analysis of engineering students for 1950-65.

272. Cain, Glen, and W. Lee Hansen. *Occupations of Engineers: Economic Aspects*. Madison: University of Wisconsin, Social Systems Research Institute, January 1967 (unpublished).

273. \_\_\_\_\_, \_\_\_\_\_, and Richard B. Freeman. *Labor Market Analysis of Engineers and Technical Workers*. Baltimore: Johns Hopkins University Press, 1973.

Analysis of supply, demand, and utilization of engineers and technicians, including reviews of several types of supply models and use of cost-benefit analysis and projections in policy decisionmaking.

274. Cartter, Alan. "The Supply of and Demand for College Teachers," *Journal of Human Resources*, Summer 1966, pp. 22-38.

Cartter takes issue with those who feared a crisis in higher education because of shortages of Ph.D. level personnel and deteriorating quality of faculty. He argues that the quality of faculty actually improved during 1955-65, and that the "shortages" or sellers' market among Ph.D.'s would

disappear shortly after 1966. The article summarizes the events of the previous 10 years, and presents a growth model for projecting supply and demand to 1985. The model includes independent projections of enrollments, development of replacement needs estimates and faculty-student ratios, estimates of production of doctorates, and doctorates entering college teaching.

275. Committee on the National Science Foundation Report on the Economics Profession. *The Structure of Economists' Employment and Salaries, 1964*. *American Economic Review*, Supplement, December 1965.

This analysis of the economics profession based on NSF Register data gives particular attention to the problems of occupational definition and the relationship between education and salary. Rates of return are not calculated.

276. Deane, R. T. *Simulating an Econometric Model of the Market for Nurses*. Unpublished Ph.D. dissertation, University of California at Los Angeles, 1971.

277. Fein, Rashi. *The Doctor Shortage: An Economic Diagnosis*. Washington: The Brookings Institution, 1967.

Fein analyzes the demand for physicians' services and the supply of physicians, emphasizing the problems of defining a shortage and measuring and pricing medical services. He examines difficulties of applying economic analysis where profit maximization is not the only or the primary goal of the physician or patient.

278. Folger, John, Helen S. Astin, and Alan E. Bayer. *Human Resources and Higher Education*, Staff Report of the Commission on Human Resources and Advanced Education. New York: Russell Sage Foundation, 1970.

This volume reviews the supply and demand situation for many degree fields, concentrating on degrees conferred and deaths and retirements. Includes discussion of difficulties in planning and implementing effective manpower and educational policy.

279. Folk, Hugh. "Another Look at the Shortage of Engineers and Scientists," unpublished Working Paper No. 6512 for the Department of Economics. St. Louis: University of Missouri, September 1964.

280. \_\_\_\_\_. *The Shortage of Scientists and Engineers*. Lexington, Mass.: D.C. Heath and Co., 1970.

281. Franke, Walter, and Irvin Sobel. *The Shortage of Skilled and Technical Workers*. Lexington, Mass.: Heath Lexington Books, 1970.

The authors discuss conflicting views on the concept of shortages and present supply analysis for six craft and technical occupations in St. Louis and Chicago.

282. Freeman, Richard B. "Engineers and Scientists in the Industrial Economy." Cambridge, Mass.: Harvard University, 1971, mimeo.

Freeman examines three aspects of change in industrial economies: 1) the contribution of scientific manpower to the rate and nature of change, 2) the impact of change on the labor market, and 3) the determination of the number of persons devoted to scientific-technical change. He presents factual and theoretical structures for analysis including models of research and development activity and the operation of the labor market under conditions of change.

283. \_\_\_\_\_. *The Market for College-Trained Manpower, A Study in the Economics of Career Choice*. Cambridge, Mass.: Harvard University Press, 1971.

Freeman uses traditional price theory to develop econometric models of the postwar market for college-trained manpower, and tests the models for accounting, business administration, mathematics, chemistry, and engineering. He concludes that 1) career decisions are substantially

influenced by economic incentives, 2) salaries are determined by the intersection of supply and demand curves with time lags, 3) changes in the market are explained by two adjustment or feedback models, and 4) the university system responds to market incentives by creating the necessary training opportunities.

284. Friedman, Milton, and Simon Kuznets. *Income from Professional Practice*. New York: National Bureau of Economic Research, Publication No. 45, 1945.

This volume is an early study of career choice and labor markets. The authors present empirical analyses of the medical professions, with special concern for the potential for monopolistically induced shortages because of restricted medical school enrollments.

285. Hansen, W. Lee. "The Economics of Scientific and Engineering Manpower," *Journal of Human Resources*, Spring 1967, pp. 191-220.

For annotation, see entry 250.

286. \_\_\_\_\_. "Educational Plans and Teacher Supply," *Comparative Education Review*, October 1962, pp. 136-41.

Hansen discusses why American and British teacher forecasts have gone wrong and reviews the factors influencing changes in the demand and supply of teachers.

287. \_\_\_\_\_. "The Shortage of Engineers," *Review of Economics and Statistics*, August 1961, pp. 251-56.

288. \_\_\_\_\_. "Shortages and Investment in Health Manpower," in *The Economics of Health and Medical Care*, Proceedings of a Conference on the Economics of Health and Medical Care. May 1962, Ann Arbor, Mich.: The University of Michigan, 1965.

Hansen's article is one of the first to use rate-of-return evidence to analyze shortages of qualified manpower, in this case physicians and dentists. He compares rates of return between 1939 and 1956, showing that the shortage of doctors and dentists has declined since 1949.

289. Harris, Seymour. *The Market for College Graduates*. Cambridge, Mass.: Harvard University Press, 1949.

Harris argues that the United States would face an excess of college trained manpower during the 1950's resulting from the tremendous increase in college enrollments after the war. Includes extensive documentation and supporting statistics.

290. Hurd, Richard W. "Equilibrium Vacancies in a Labor Market Dominated by Non-Profit Firms: The Shortage of Nurses," *Review of Economics and Statistics*, May 1973, pp. 234-40.

Hurd's statistical tests of the oligopsony explanation of the shortage of nurses find supportive results from three data sources: the 1960 Census and the 1960 and 1966 BLS Hospital surveys. Equations are presented and policy implications discussed.

291. Kehrer, Barbara H. *The Nursing Shortage and Public Policy—An Economic Analysis of the Demand of Hospital Nurses in Connecticut*. Unpublished Ph.D. dissertation, Yale University, 1970.

292. Kershaw, Joseph A., and Roland N. McKean. *Teacher Shortages and Salary Schedules*. New York: McGraw Hill Inc., 1962.

293. Klarman, Herbert E. *The Economics of Health*. New York: Columbia University Press, 1965.

This volume is a thorough introduction to the field of health economics. Chapters are included on



the supply of health personnel and on issues related to the economics of education, as well as a comprehensive bibliography.

294. Klarman, Herbert E., ed. *Empirical Studies in Health Economics*. Baltimore: Johns Hopkins Press, 1970.

This volume includes Stuart Altman's "The Structure of Nursing Education and its Impact on Supply," Donald Yett's "The Chronic Shortage of Nurses: A Public Policy Dilemma," and other studies.

295. Lewin, David. "Wage Parity and the Supply of Policemen and Firemen," *Industrial Relations*, February 1973, pp. 77-85.

Lewin presents a nonstatistical comparison of the duties and costs of hiring policemen and firemen in Los Angeles County. He recommends removal of the parity policy, i.e., equal starting salaries, in order to increase flexibility in hiring policemen.

296. Mack, Donald R. *A Model of the Supply and Demand for Engineers*. Schenectady, New York: General Electric Company, 1973.

Presents a feedback model of demand, enrollment/attrition, and unemployment of graduate engineers, using a system of algebraic and first-order differential equations.

297. Matilla, J. Peter. *The Impact of Extending Minimum Wages to Private Household Workers*. RF Project 3270, Final Report. Columbus: The Ohio State University, Research Foundation, October 1971.

In a study for the Manpower Administration, Matilla estimates the elasticity of demand for private household workers with respect to wages and family income, and of supply in respect to wages and alternative job opportunities. Estimates are then used to measure the impact of alternative minimum wage levels. Analysis is based on a cross-section of metropolitan areas, using data from the National Longitudinal Surveys.

298. Meyers, Raymond, O.D. "Optometric Manpower: An Analysis of the Supply," *Journal of the American Optometric Association*, November 1971, pp. 1135-39.

Meyers projects requirements for optometrists until 1980 based on estimates of current supply, attrition, and projected annual graduates during the 1970's. An optimal ratio of optometrists to population is assumed.

299. National Education Association. "Teacher Supply and Demand in Degree-Granting Institutions," *NEA Research Bulletin*, December 1955.

300. \_\_\_\_\_. *Teacher Supply and Demand in Public Schools*. Annual reports by the NEA Research Division since 1947.

Reports analyze the supply and demand conditions for elementary and secondary teachers in public education, and include special analyses of topics such as varying teacher status by type of school, supply of beginning teachers, and the supply of qualified former teachers.

301. National Research Council, National Academy of Sciences. *The Life Sciences*. 1970.

Discusses the nature of the life sciences, research progress and applications, and the nature and materials of the life scientists' work. Examines the process of educating new scientists. Statistical information is based on a survey of over 12,000 research life scientists.

302. \_\_\_\_\_, \_\_\_\_\_. *Physics in Perspective*. 2 vols., 1973.

Reports on the status, opportunities, and problems of the physics profession in the United States.

Vol. I discusses the nature of physics and its subfields, research priorities and sources of support, and education; Chapter 12 presents an analysis of physics manpower supply and utilization. Vol. II, Part A, discusses the content of research topics; Part B discusses astrophysics and relativity, including a chapter on manpower; and Part C is a compendium of data used in the rest of the report.

303. National Science Foundation. *The Long-Range Demand for Scientific and Technical Personnel, A Methodological Study*. Prepared by the U.S. Department of Labor, Bureau of Labor Statistics, 1961.

This study presents quantitative projections of the demand for scientists and engineers, with special reference to the chemical and electrical industries. Methods for projecting supply are discussed and measures are proposed to close the gap between expected demand and supply.

304. \_\_\_\_\_ . *Scientists, Engineers, and Technicians in the 1960's: Requirements and Supply*. NSF-63-34, 1963.

Projections are updated, using methodology from an earlier NSF publication. Policies for improving utilization of manpower and for training are discussed as remedies for projected excess demand.

305. New York State Department of Labor, Division of Research and Statistics. *Manpower in Selected Metal Crafts in New York State*. Part I, The State-wide Picture, Part II, Area Data. Publication No. B-107, January 1959.

Survey of existing and future manpower supplies and requirements in metalworking occupations. Includes analysis of employment, personal characteristics, and training sources.

306. \_\_\_\_\_ , \_\_\_\_\_ . *Technical Manpower in New York State*. 2 vols. Special Bulletin 239, December 1964.

Results of a survey to ascertain personal and skill characteristics of science and engineering technicians, sources of workers, education and experience requirements, and employment. Vol. I presents summary information, with appendix tables and projections in supplements A and B respectively. Vol. II presents detailed data for each of 15 occupations.

307. Porter, R. C. "A Growth Model Forecast of Faculty Size and Salaries in U.S. Higher Education," *Review of Economics and Statistics*, May 1965, pp. 191-97.

Porter applies the Harrod growth model borrowed from economic development theory to explain the expansion of higher education. Faculties are treated as capital-input, and as an input produced by higher education itself. He concludes that the strain of faculty expansion during the 1960's will automatically reduce the strain during the 1970's, and possibly produce a slack thereafter. Salaries are also analyzed.

308. President's Science Advisory Committee. "Meeting Manpower Needs in Science and Technology," December 12, 1962.

This report points out shortages of engineering, mathematics, and physics personnel, and calls for Federal action. A grants policy is discussed as a means of channeling graduate students into areas of high national priority.

309. Schacter, G., B. Cohen, and H. Goldstein, "The Demand and Supply of College Teachers of Economics, 1969-1970," *American Economist*, Spring, 1972.

310. Sharp, Laure M. *Education and Employment*. Baltimore: Johns Hopkins Press, 1970.

Sharp analyzes the qualitative as well as quantitative effects of the expansion of higher education. Relying on National Science Foundation data, *Two Years After the College Degree*, she examines the relationship of occupation to field and type of degree. The data show reinforcement of basic trends such as early specialization and occupational choice, high level of occupational stability, and

the tendency of women to become teachers regardless of major. Separate analyses are presented for women and blacks.

311. Sloan, Frank. "Lifetime Earnings and Physicians, Choice of Specialty," *Industrial and Labor Relations Review*, October 1970, pp. 47-56.

Sloan finds little relationship between earnings and physicians' choice of specialties over general practice.

312. Stewart, Charles T., Jr., and Corazon M. Siddayao. *Increasing the Supply of Medical Personnel: Needs and Alternatives*. Washington, D.C.: American Enterprise Institute for Public Policy Research, 1973.

This study considers medical personnel shortages and ways to relieve these shortages. Chapters include discussions of legislation intended to increase medical manpower supplies, causes of shortages, especially in relation to Medicare, Medicaid, and private insurance; questions of geographic distribution and utilization; and policy recommendations.

313. U.S. Department of Health, Education, and Welfare, Office of Education. *Library Manpower—Occupational Characteristics of Public and School Librarians*, OE-15061, 1966.

314. \_\_\_\_\_, Public Health Service. *Ophthalmology Manpower: A General Profile, United States, 1968*. Vital Statistics Series 14, No. 5, DHEW Publication No. (HSM) 73-1800, 1972.

315. \_\_\_\_\_, \_\_\_\_\_. *Opticians Employed in Health Services, United States, 1969*. Vital Health Statistics Series 14, No. 3, DHEW Publication No. (HSM)72-1051, 1972.

316. \_\_\_\_\_, \_\_\_\_\_. *Physicians for a Growing America*. Report of the Surgeon General's Consultant Group on Medical Education, Publication No. 709, October 1959.

317. U.S. Department of Labor. *1970 Manpower Report of the President*, "Manpower Demand and Supply in Professional Occupations," 1970.

Analyzes the effects of postwar birth rates and trends in education and labor force participation on the demand and supply of professionals in general, and scientists, teachers, and health manpower in particular.

318. \_\_\_\_\_, Bureau of Labor Statistics. *Library Manpower—A Study of Requirements and Supply*. Forthcoming 1974.

The primary objectives of this study were the identification and analysis of factors having the greatest bearing on determining manpower requirements, projections of requirements by employment setting, and analysis of supply.

319. \_\_\_\_\_, \_\_\_\_\_. *Technician Manpower: Requirements, Resources, and Training Needs*. Bulletin 1512, 1966.

This report presents the results of a comprehensive study of current and future technician manpower conducted by the Bureau of Labor Statistics with the support of the National Science Foundation. Emphasis is placed on the ways in which persons are trained for technician jobs, and on the projected supply and demand for these workers. Extensive information also is presented on the personal and educational characteristics of technicians and the nature of their work.

320. \_\_\_\_\_, \_\_\_\_\_. *Technician Manpower 1966-1980*. Bulletin 1639, 1970.

This report updates the earlier BLS study, and incorporates new data and methods. Data gaps and weaknesses and directions for future research are discussed.

321. Wool, Harold, and Bruce D. Phillips. *The Labor Supply for Lower Level Occupations: Interim Report*. Washington, D.C.: National Planning Association, October 1973.

Examines the hypothesis that a variety of demographic and social forces have contributed to a sharp reduction in the traditional sources of workers for lower level jobs. The study includes a system for ranking occupations, analysis of 1960-70 trends in occupational labor supply, and projections. The second stage of the report, forthcoming in 1974, will present analysis of individual occupations.

322. Yett, Donald E. "The Supply of Nurses: An Economist's View," *Hospital Progress*, February 1965, pp. 88-102.

323. Zerfoos, Evelyn, and Leo Shapiro. *The Supply and Demand of Teachers*. Lincoln, Neb.: Nebraska Curriculum Development Center, February 1973.

### C. Methods of analysis

324. Folk, Hugh, and Donald Yett. "Methods of Estimating Occupational Attrition," *Western Economic Journal*, Vol. 6, No. 4., September 1968, pp. 297-302.

Comparison of several methods for estimating nonwage-related types of attrition, including age-specific occupational employment rates. Comparison of computations for nurses and engineers.

325. Goldstein, Harold. "Methods of Projecting Supply and Demand in High-Level Occupations," paper presented to Panel on Human Resources and Advanced Education, American Statistical Association, September 1965. Bureau of Labor Statistics (mimeo).

A brief review of methods, and statement of data uses and research needs. Bibliography.

326. \_\_\_\_\_. *Methods of Forecasting Demand for and Supply of Scientists and Engineers: Final Report*. Paris: Organization for European Economic Cooperation, 1958.

327. \_\_\_\_\_. "Projections of Manpower Requirements and Supply," in "A Symposium: Manpower Projections," *Industrial Relations*, May 1966.

Reviews BLS projections procedures, and points out areas needing research, including mobility, base-year supply measurement, wage elasticity, and information on specific training.

328. Gramm, Wendy Lee. "The Labor Force Decision of Married Female Teachers: A Discriminant Analysis Approach," *Review of Economics and Statistics*, August 1973, pp. 341-48.

This study uses the discriminant analysis technique, i.e., classification of individuals into mutually exclusive and exhaustive groups, to study the supply of women for full- and part-time teaching positions.

329. Jaffe, A. J., and R. O. Carleton. *Occupational Mobility in the United States, 1930-1960*. New York: King's Crown Press, Columbia University, 1954.

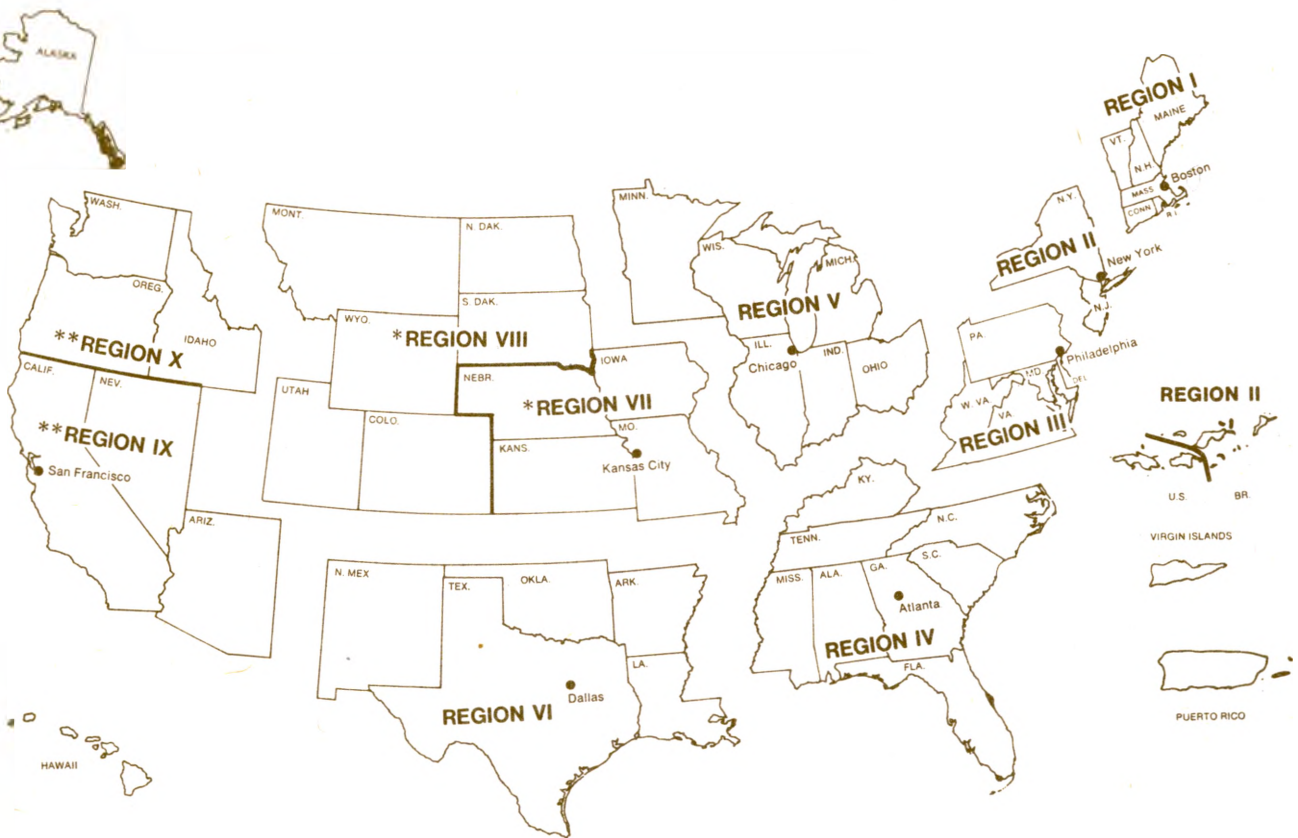
This study uses age-cohort analysis and a residual methodology to estimate net occupational mobility of adult civilian males 1930-50 and to project mobility to 1960.

330. Laslett, R. E. *A Survey of Mathematical Methods of Estimating Supply and Demand for Manpower*. Occasional Paper No. 1. London: Engineering Training Board, 1972.

Reviews types of mathematical models, including input/output, regression, and others. Bibliography.

331. McKinlay, Bruce, and Lowell E. Johnson. *Forecasting Occupational Supply: A Methodological Handbook*. Eugene: Oregon Department of Employment, Research and Statistics Division, Manpower Research Project. February 1969.
- Discusses the various components of supply, and develops methods for quantifying these components. Includes a systematic procedure for assessing the adequacy and changing personal characteristics of the total labor supply, and methods for estimating supply from "general education" programs, high school and college dropouts, military returnees, and geographic migrants.
332. Morton, J. E. *Handbook for Community Manpower Surveys*. Methods for Manpower Analysis, No. 5. Kalamazoo: W. E. Upjohn Institute for Employment Research, 1972.
- A step-by-step guide for conducting local manpower surveys.
333. Norton, John Herbert. *Accuracy Analysis for Projections of Manpower in Metropolitan Areas*. Washington, D.C.: George Washington University, 1967.
- Discusses forecasting accuracy, with illustrations of forecasts for 12 metropolitan areas. Bibliography.
334. O'Connell, John F. "The Labor Market for Engineers: An Alternative Methodology," *Journal of Human Resources*, Winter 1972, pp. 71-86.
- Separate supply and demand equations indicate that relative wage elasticity of demand is not a significant determinant of engineering employment though, with minor exceptions, research and development expenditures are. The supply of engineers tends to be responsive to absolute wage differences. Equations are ordinary and two-stage least squares regressions with relative employment as the dependent variable.
335. Parnes, Herbert S. *Research on Labor Mobility: An Appraisal of Research Findings in the United States*. New York: Social Science Research Council, Bulletin 65, 1954.
- Discusses conceptual and methodological problems in classifying and measuring labor mobility.
336. Podesta, Edward A. *Supply and Demand Factors Affecting Vocational Education Planning, A Methodological Study in Santa Clara County, California*. Menlo Park: Stanford Research Institute, October 1966.
- Discusses methods for inventorying the supply of vocational education teachers, and estimates the influence of instructional and personnel policies on the size and quality of teacher manpower resources.
337. Rosenthal, Neal. "Projections of Manpower Supply in a Specific Occupation," *Monthly Labor Review*, November 1966, pp. 1262-66.
- Discusses methods of calculating supply projections, including illustrative projections of scientists and engineers.
338. Shyrock, Henry S., and Jacob S. Siegel. *The Methods and Materials of Demography*. 2 vols., U.S. Department of Commerce, 1971.
- An exposition of the methods of collecting, classifying, and handling demographic data. Volume 1 deals with sources of data on population, size, distribution, and composition; Volume 2 discusses population dynamics (births, deaths, marriages, migration/mobility), and estimation and projection techniques.
339. Wolfe, Dael. "Forecasting Surpluses and Shortages in Key Occupations," American Academy of Political and Social Science, *Annals*, September 1959, pp. 29-37.

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