

## CLASSIFICATION OF OCCUPATIONS: SOME PROBLEMS OF ECONOMIC INTERPRETATION\*

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Introduction

A well-conceived system of occupational classification can be a valuable tool for facilitating empirical work in economics on topics concerned with labor markets, manpower supplies and requirements, wage structures, and the like. This paper considers the nature of such a "well-conceived" system.

Despite the potential importance of occupational data and the interest of government in them, little effort has been given by academic economists to examining the conceptual basis of the occupational classification system or to suggesting modification in it in the light of their own objectives.<sup>1</sup> Now that we are confronted with a new occupational classification system (set forth in the third edition of the Dictionary of Occupational Titles), and now that the Bureau of the Budget has established a committee to re-examine occupational classifications, it is past time for economists, along with others, to indicate their own needs and to assess the usefulness of the existing and alternative classification systems.

The fundamental position of this paper is that occupational classifications can serve economists as part of a larger information system, a system designed to reveal more about the current and prospective labor-resource flexibility of the economy. This concern about labor-resource flexibility is the essential theme of this paper. And we suggest that occupational classifications need to be defined and developed with this objective in mind to be useful to economists. We are aware that other disciplines may view the objectives differently.

Labor-resource flexibility is, of course, only part of a larger class of resource substitution issues with which economists are concerned--substitutions between capital and labor, in particular, receive and deserve considerable attention. For this reason, the emphasis on

flexibility among types of labor that is implicit in the emphasis on occupational data may be too narrow for certain problems, as is noted later in the paper.

The following remarks are organized in two parts. The first focuses on the meaning of the term, "occupational data classification," and also on the uses to which such a classification system can be put. The second discusses the attributes of an "ideal" system of occupational data classification. We concern ourselves for the most part with conceptual issues rather than with the empirical implementation of any particular occupational classification and data system.

The Meaning and Uses of Occupational Classifications

By a "system of occupational data classification" we mean two things: First, one or more sets of categories that provide (1) job-skill descriptions and (2) worker-skill descriptions; and second, sets of data relevant to those categories--that is, for a given period of time, data on (a) number of jobs available at specified levels of skill and at specified levels of wages and (b) numbers of workers possessing specified levels of skills and willing to supply those skills, at specified levels of wages.<sup>2</sup> In short, a system of occupational data consists of useful sets of boxes filled with corresponding series of quantity measures.

As economists our interest in such a system falls into two major categories: (1) We are interested in the process by which employers choose among the alternative types of labor that are capable of producing given goods and services. (2) We are interested in the process by which individuals choose amongst alternative job and career opportunities. To understand and predict the outcomes of these processes, economists need three types of information: (a) information about current and expected factor prices, (b) information about the factor substitution possibilities that are technologically feasible, and (c) information about the preference patterns that determine the willingness of people to take one job or another. Without such information, we can say little or nothing about the choices employers and workers will make in response to changes in technology or relative factor prices. The lack of this information, moreover, is the principal reason why manpower projections and occupational forecasts are so often empty of economic content.<sup>3</sup>

<sup>2</sup>The fixing of the point in time controls for the state of technology, price structure, and other variables that need to be given to permit an economically meaningful count of jobs and workers.

<sup>3</sup>For further discussion of this point see W. Lee Hansen, "Labor and Force and Occupational Projections," Processing of the Industrial Relations Research Association, 1965, pp. 10-20.

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<sup>1</sup>The following two articles have recently examined the problem from the standpoint of economic analysis: John Dunlop, "Job Vacancy Measures and Economic Analysis," The Measurement and Interpretation of Job Vacancies, A Conference Report of the National Bureau of Economic Research, Columbia University Press, New York, 1966, pp. 27-47; and James Scoville, "The Development and Relevance of U.S. Occupational Data," Industrial and Labor Relations Review, October, 1965, pp. 70-79. An earlier article that discussed the concepts of occupational classifications in the course of analyzing the distribution of income is, Jan Tinbergen, "Some Remarks on the Distribution of Labor Incomes," International Economic Papers, Vol. 1, 1951, pp. 195-207.

Occupational data, as defined above, can be helpful in providing information about (b) and (c)--that is, about substitutions that employers and workers are willing and able to make. But in any case that information must be supplemented with data on current and anticipated factor prices.

Existing data on occupations do provide some information relevant to substitution possibilities, since workers within occupational classes--as those classes are currently defined--tend to be better substitutes for each other than are workers in different occupational classes. But the extent to which this is the case is worthy of further study.

As we have noted, occupational data can be part of an information system which facilitates decision-making regarding (a) production planning (short-run and long-run), and (b) job and career selection (short-run and long-run). We now consider each of these.

(a) Production Planning. For given conditions of product demand, production plans will be made by cost-minimizing decision-makers on the basis of information concerning the availability of various skills or occupational groups--information which is given by an occupational data system--and on the basis of schedules of prices at which these skills are offered--which is not normally given by such a system. This knowledge is then translated into "lowest-cost" production techniques by employers. These adaptations of production plans to resource availability and prices are a principal cause of substitutions in the mix of labor inputs demanded.<sup>4</sup> The substitution possibilities are, of course, a principal determinant of the elasticities of demand for various types of labor.

Actually, the process of determining "lowest cost" production techniques is more complex than just suggested. Decision-makers in fact are not confronted solely by choices among various types of labor, but also by choices among various types of capital and, probably even more important, substitution between various types of labor and capital, particularly in the long-run. For this reason, any occupational data system ideally should be meshed with a broader information system which takes into account these other substitution possibilities--the full range of which is encompassed by the concept of the production function.

In this context we might note that discussion of "needs" and "requirements" for workers with various skills are likely to be seriously deficient because they imply that substitutions among types of labor and between labor and capital cannot be made. The empir-

<sup>4</sup>These demand patterns will sometimes produce their own supply responses as employers adjust their level and composition of training activities.

ical estimates that have been made of production functions have concentrated on substitutability between capital and a single undifferentiated labor input.<sup>5</sup> There is reason to expect and to hope, however, that future work will disaggregate labor into various occupational subtypes, which will provide estimates of elasticities of substitution among such subtypes of labor. A significant degree of detail involving many occupational classes, however, will probably not be incorporated in the statistical models of production functions for some time.

(b) Job and Career Choice. These choices are made by individuals largely on the basis of information about the relative attractiveness and remuneration associated with various kinds of work, the costs of securing the education and training necessary for entry into various occupations, and the ease of shifting from one type of work to another. The third type of information might well be provided by an occupational data system, while the first two are unlikely to be provided. Again, we see that an occupational data system must be regarded as part of a larger information system, in this instance one producing indicators of long-run elasticities of supply for various types of labor.

The two uses of occupational data just noted included the possibility of adopting new production techniques and of acquiring new skills and both of these require time. But even in the very short run when these possibilities may be limited, occupation data can improve the functioning of the labor market through reducing the costs of search to both employers and workers. If jobs and workers' skills were identified and described more precisely, the process of employers finding workers and workers finding jobs would be facilitated. And it is interesting to note that the resulting reduction in the costs of search could come about because of a standardized classification alone, i.e., even in the absence of data on the number of jobs and workers available at various prices.

#### Attributes of an Effective Occupational Classification and Data System

To serve effectively the purposes of economists, an occupational classification and data system should possess a variety of attributes that would contribute to the likelihood that the system would be useful for the purposes indicated above.

1. The first attribute we suggest stems directly from our insistence that the basic purpose of occupational classifications for the economist is the provision of information about factor substitution possibilities. On this basis occupational classes should be relatively homogeneous, in the sense that a high degree of

<sup>5</sup>For a useful review of the extensive literature on this subject, see Marc Nerlove, "Statistical Production Functions: A Selective Review," to be published in the volume in the series, *Conferences on Income and Wealth*, the National Bureau of Economic Research.

substitutability should exist within each class. Specifically, for any given level of aggregation of occupational classifications:

(a) Each "class" of jobs should be such that the elasticity of substitution among jobs in that class (or, rather, among various workers who can perform those jobs) will on average be higher than the elasticity of substitution between jobs in different classes. We use the term, "elasticity of substitution," in its conventional sense--as a measure of the technical ease with which one input may be substituted for another to obtain a given output. The higher the elasticity, the greater are the substitution possibilities.

(b) Each "class" of workers should be such that cross-elasticities of supply among workers will on average be high than the cross-elasticities between workers in that class and those in other classes. (Here, too, the higher the cross-elasticities, the easier it is to substitute one worker for another).

The first condition views the classification from the employers' standpoint and depends on the technical production function, which specifies the extent to which factor substitutions among types of labor are possible. The second condition views the classification from the workers' standpoint. On the workers' side, the substitutability of one job for another depends on workers' preferences along with their abilities to perform various tasks. In short, the elasticity of labor supply for any given type of work depends on both the ability and willingness to perform those tasks. The greater the change in remuneration required to cause workers to switch types of work (which may involve the acquisition of more education or training), the lower is the cross-elasticity of supply, and the more disparate are the two types of work.<sup>6</sup>

It may be noted that our emphasis on cross-elasticities as a criterion for defining classes of jobs and classes of workers follows the usual definition in economics of an "industry" as comprising those firms that produce goods for which the cross-elasticity of demand is high.<sup>7</sup> Similarly, a "commodity" is often thought of as a group of (not-necessarily identical) items for which the cross-elasticity of demand is high--

<sup>6</sup> John Dunlop has suggested an approach to categorizing occupations involving two dimensions: (1) "job families," that include the characteristic of a "common mobility pattern," and (2) "job content," that is related to the tasks performed. This approach is consistent with the emphasis we have given to workers' substitution decisions--which ties into Dunlop's first point--and to employers' substitution decisions--which relates to point (2).

<sup>7</sup> For example, "a commodity group with high cross-elasticities (of demand) within the group but with low cross-elasticities with respect to other commodities is often said to constitute an industry." Richard H. Leftwich, The Price System and Resource Allocation (New York: Holt, Rine-

hard and Winston, 1966), p. 43.

for example, automobiles. Our criterion for determining "job" classes also uses this cross-elasticity-of-demand concept, while our criterion for determining "worker" classes is that cross-elasticities of supply of workers should be high.

In principle, the elasticities between any and all pairs of occupation can be measured. Although it may be objected that this would be prohibitively expensive, given the paucity of current information on this subject and the potentially large number of occupational classes, the same objection could be made concerning economists' definitions of "commodities" and "industries." But this has not prevented us from devising useful--if less than ideal--groupings of commodities and industries that have widespread acceptance. For example, although all automobiles are not the same, it is nonetheless useful to discuss and to forecast the demand for a group of diverse vehicles that are defined, at least implicitly, in terms of substitutability criteria, and which we label "automobiles."

Our approach to the problem of classifications may be illustrated in the context of the policy-oriented debate over "shortages" of engineers. In preliminary work on another research project<sup>8</sup> we have found that occupational mobility (by several measures) appears greater between the occupational groups of surveyors and civil engineers than between the 9 groups civil engineers and aeronautical engineers. Assuming these findings hold up in the completed analysis, we would draw the following policy implications:

- (1) any projected shortage of civil engineers would be significantly lessened if large numbers of surveyors existed;
- (2) any projected shortage of aeronautical engineers would be lessened only slightly by the presence of large numbers of civil engineers;

hard and Winston, 1966), p. 43.

<sup>8</sup> The research, by Cain and Hansen, uses the 1962 Post-Censal Survey of scientists, engineers, and technicians, and is sponsored by the National Science Foundation. A first report will be available in early 1967.

<sup>9</sup> This finding actually refers to observed inter-"occupational" mobility. Strictly speaking, for the illustration to be valid evidence for our point it should be true that an equivalent percentage change in wage rates of surveyors and civil engineers, and of aeronautical and civil engineers (or better, "net remuneration") should bring about greater occupational mobility in the former case. The available data on occupational mobility, unfortunately, do not disclose the magnitude of changes in relative wage rates that led to the actual occupational shifts--even assuming that the only reason for the shifts was the change in wages.

- (3) the occupational category of "engineers" is either too broad or, if a gross level of aggregation is desired, the category should include surveyors.<sup>10</sup>

Furthermore, the implications of these findings for individuals making career choices in the field of engineering are apparent and significant. As one example, a "large" pool of surveyors would tend to moderate wage increases among civil engineers while a large pool of aeronautical engineers would not.

The new edition of the Dictionary of Occupational Titles provides another illustration to which our approach applies. We note that there are separate classifications of "salesman" and "salespersons," and within these classes there are 150 subtypes. By contrast, the occupation, "faculty-member college or university," contains no sub-types. By the cross-elasticity criterion we propose, the sales classifications have excessive detail while the faculty-member class has too little. The cross-elasticities for employers and workers between many of the sales sub-types appear to exceed greatly the cross-elasticities among, say, professors of physics, English, Latin, etc.--not to mention between labor economists and mathematical economists. Incidentally, this example shows that the numbers of individuals in an occupational class may be a poor indicator of the amount of within-class homogeneity. The number of people in a subtype of sales workers would surely be larger than the number in a subtype of professors.

2. As a second attribute, closely related to the cross-elasticity notion, the occupation classification system should be applicable to both types of substitutions--by employers and by workers. A set of categories useful for analyzing one type of substitution may not be useful for the other. For example, an employer may regard two technicians as equivalent to that of one engineer for the performance of certain tasks. Thus, from the employer's point of view, the system should be such that these two occupations can be combined, perhaps with some differential weighting scheme. From the workers' point of view, however, the different training required, the varied work activities performed, and the disparate salary levels paid may make the two occupations relatively poor substitutes. Thus, with respect to choices made by workers, the two should not be put into the same class.<sup>11</sup>

<sup>10</sup>We would not advocate obliterating the distinction between the classes, "civil engineers" and "surveyors"; rather we suggest that it will be useful to combine and rank these occupations in different ways than have been customary.

<sup>11</sup>This example may be compared with the case of certain types of engineers and physical scientists. They may be good substitutes for employers in production, and at the same time the two occupations could also provide alternative career paths--lateral occupational mobility--for people trained as one or the other, and thus they would be considered good substitutes to workers as well.

3. The informational function of occupational categories clearly requires that job descriptions be codified, in terms of skill requirements, and that worker-skill descriptions be codified, in terms of skill capabilities. In this way the process of staffing by employers, and job-finding by workers would be facilitated. Just as in commodity markets where standardization of size, quality, and so on has been used effectively, similar gains could be achieved by the standardization of skill descriptions.

The desirability of some degree of standardization can hardly be disputed, but the difficult question is exactly what features of jobs and characteristics of workers should be standardized. This issue is beyond our area of expertise, but we are intrigued by the possibility of using a set of quite basic or elemental skill attributes as the building blocks for classification. Thus, it would be desirable to know the level of attainment that a person has in such skills as manual dexterity of various types, the ability to get along with people, or the ability to do abstract reasoning, as well as various combinations of these skills. Occupational titles or categories would then correspond to various combinations and levels of such "elemental attributes."<sup>12</sup> The particular strength of this feature is the possibility of developing a continuum of gradations of job requirements and skill attainments, and of being able to recombine different groupings to suit the needs of various users. We are dubious that the present state of knowledge permits the speedy development and application of such a system, but we applaud the attempts along this line which appear in the new 1965 edition of the Dictionary of Occupational Titles.

4. The occupational classification system should be adaptable to changes that occur over time. Changes in technology and educational policy may bring about new types of jobs and different skill levels which, in turn, alter the range of substitution possibilities. An important advantage of classifications based on rather basic and elemental skills, is that they could be restructured without great loss in continuity.

5. Occupational categories should be presented at a level of detail that pays heed to the costs of obtaining it. In short, there is a level that balances the benefits of additional detail--information that would enable workers to pick jobs more suitable to their skills and preferences, and that would permit employers to select more easily workers with the desired skills--against the costs of obtaining the additional detail. In view of the heterogeneity of uses for labor market data, the optimal level of detail will vary among uses and among occupa-

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Such a system was proposed by Tinbergen, who wanted to analyze the supply and demand of these types of skills to determine the distribution of wages and salaries that would result. Tinbergen, op. cit.

tional groups. We could point, again to the new Dictionary of Occupational Titles and sales people and professors as specific examples of excessive and insufficient detail, respectively, in occupational classifications.

#### Conclusion

In attempting to sketch out the kind of occupational classification and data system that would be of interest to economists, we have tried to make clear the main uses to which such a system could be put. These uses--involving substitution possibilities among different types of labor--are not likely to be the same as those of sociologists or others. Moreover, a system useful to academic or government researchers, be they economists or sociologists, may not be of greatest value to employers, workers, and government officials responsible for action programs. In short, many goals and objectives must be taken into consideration before we can determine what is an optimal system of classification, and, in fact, we have suggested that no single system is likely to be optimal for all purposes.<sup>13</sup>

In developing and implementing a system it should be borne in mind that more-detailed standardization, added flexibility, and, for that matter, added precision in measurement, all come at increased costs. Thus, users of the data system--researchers as well as labor and employer groups--have a serious obligation to justify in

terms of real benefits to be produced, the demands they make on governmental agencies responsible for developing an occupational classification system. At the same time, government agencies responsible for these programs have an obligation to be responsive to the needs of users of the system.

Irrespective of the particular type of occupational classification system chosen, too much should not be expected of it. An occupational classification system and the data it generates serve at best as a proxy for one class of variables--labor and job substitutions--with which we as economists are concerned. Thus, we reiterate our hope that any system of occupational classification will be recognized as only one part, albeit a potentially important one, of a larger system of information for decision-makers.

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<sup>13</sup> James Scoville offers a useful discussion of the various purposes for which occupational classifications and data were collected as these purposes evolved over the years. He mentions briefly the economic, analytical purpose concerning the "characteristics of manpower and technological change, such as training and education requirement," and suggests that the present system has serious shortcomings for this purpose. James Scoville, op. cit. especially p. 78.