Philippine Review of Economics and Business
Volume XXXI, No. 2, December 1994

A REVIEW AND APPRAISAL OF TECHNICAL MANPOWER FORECASTING TECHNIQUES

By Casimiro V. Miranda, Jr.*

Various articles on technical manpower forecasting techniques are reviewed for the purpose of critically evaluating their contributions and the usefulness of the forecasting technique itself. Some factors are suggested to be taken into account to improve the forecasting methods especially in the course of economic development when the composition of technical manpower requirement changes with structural change.

1. Introduction

The development of human resources has become a major policy issue in most countries. Development plans of almost all developing countries have placed more emphasis on the need for qualified manpower as required by the goal of achieving accelerated economic growth. Education and training as forms of investment in human capital have been shown to be important factors contributing to labor productivity growth. Thus, the need for substantial expansion of educational facilities becomes quite evident. Development through material capital formation was replaced by investment in human capital. However, the scarcity of resources serves as a limiting factor in the realization of the above-mentioned goal. Economic growth requires an effective development plan that balances the allocation of resources among alternative uses. The use of modern technology in a more industrialized society is useless if there were no available manpower that possess the required skills to operate

* Professor of Economics, University of the Philippines. The author would like to acknowledge the assistance of Ms. Maria Teresa Sanchez on the seminal version of this paper.

them. Moreover, the supply of qualified manpower will not be utilized effectively without the appropriate technology that matches them. Changing technology along with a rising capital-intensity that accompanies growth requires adjustment of manpower patterns to maximize production. Thus, the development of technical manpower becomes an important component of manpower planning.

Manpower planners of different countries have utilized various methods of forecasting demand and supply of workers of specific categories as part of their manpower development plans. While these forecasting methods were criticized for their limited applications and shortcomings, they were redefined and extended to suit a particular country's needs. In the midst of these developments, the debate as to what method is appropriate and best continues while the more prominent methods are still being used in manpower development planning.

The paper explores and evaluates the scope and methods of manpower forecasting. The structure of the paper is as follows. First, it basically discusses the various forecasting techniques involved in manpower planning and their uses. Second, it presents the critical evaluation of each forecasting technique. Examination of each technique also includes discussion of its applicability to countries in the Asia-Pacific region taking into account the diverse economic conditions, levels of development, economic structure, technological development and factor endowments. Lastly, it deals with the modifications that would make the techniques applicable and more relevant to developing countries in the Asia-Pacific region.

2. Methods of Manpower Forecasting

The techniques of manpower forecasting cover multiple diverse activities ranging from the more simple methods involving inquiry and extrapolation of historical trends to the more complicated statistical techniques. The two most prominent manpower forecasting methods are the manpower requirements aproach (MRA) and the human capital or rate of return approach (RRA). A number of other techniques were developed to make up for the shortcomings of the two techniques. Moreover, the combination of the MRA and the

RRA approaches is suggested to be more appropriate in the sense that the two work to complement each other. Recently, the diagnostic approach or manpower analysis was considered to be the better alternative method for manpower planning.

This section discusses in detail the MRA and the RRA approaches as well as the other alternative approaches. With the use of some indicators, their applicability to the Asia and the Pacific countries is critically appraised.

2.1. *An Overview of the Forecasting Techniques*

2.1.1 *The Manpower Requirements Approach (MRA)*

Before discussing in detail the manpower requirements approach, it is neccesary to differentiate manpower requirements from demand for labor. The concept of labor demand for a category of worker requires information about possible wage rates for coresponding quantities of employed labor. On the other hand, manpower requirements refer to the amount of manpower needed to achieve certain economic growth targets. Parnes (1962) defines manpower requirements as the functional/occupational composition of employment that will be neccesary if certain social and/or economic targets are to be achieved. The concept is more of a technological rather than an economic one.

Godfrey and Stavenuiter (1986) define the manpower requirements approach as a method of forecasting demand for manpower by education and skill category for comparison with supply forecasts. The approach sets labor demand as a function of sectoral output with the use of fixed coefficients. From the output projections, the labor requirements forecasts are derived. These forecasts are made in such a way that they fit the established ouput growth targets. The method applies the fixed coefficient methods to manpower planning. The MRA includes a number of procedures outlined as follows.

In the first phase, the labor requirement for different categories of workers, i.e., by occupation or skill is projected for each economic sector. The labor requirement projection requires

projection of economic output, sectoral output growth rates assumptions (growth targets), productivity assumptions for each skill in each sector, employment projections, and projections of occupational structure. The MRA implicitly assumes that the output which is determined by final demand for goods and services in turn determines employment levels. It also assumes that there can be no substitution between labor and other factors, between occupations/skills, and between different levels of education within a given occupation. Relative wages are not considered and occupational mix is determined only by existing technology. The labor productivity assumptions are based on estimates that can be obtained through any of the following techniques: (a) extrapolation of historical trend; (b) use of values obtained for an identical sector in another economy (international comparison); (c) survey on employer's estimates of future changes in productivity and corresponding manpower requirements.

The simplest model of employment projection used to forecast manpower requirement is presented as

$$(1) \qquad L_j = \sum_i l_{ij} Y_i \quad i = 1,2,\ldots,n; \quad j = 1,2,\ldots,m$$

where L_j = labor requirement of occupation or skill category j

l_{ij} = labor requirement of occupation or skill category j per unit of gross output in sector i

Y_i = gross output in sector i

The second phase translates the occupational requirements into educational needs. Using an occupation/education matrix, the demand for labor by occupational category is converted to demand for educational level. Using the simple model above, the conversion of labor occupational requirements into educational needs is presented as:

$$(2) \qquad L_k = \sum_i l_{ki} L_j \quad k = 1,2,\ldots,p$$

where k represents educational level (e.g., in terms of years of schooling). Thus L_k represents the quantity of labor with k educational level.

On the other hand, the supply side requires a projection of the size of the total labor force by education and occupation. By comparing the demand and supply forecasts, imbalances as to shortages and surpluses are then established. Educational and training requirements of the economy are determined by translating manpower shortages into such needs.

The procedures/methods outlined generally describe the techniques of the approach. However, it is noteworthy to discuss the various methods underlying the manpower requirements approach. The variations in the techniques of translating occupational requirements to educational needs are as follows.

a. *The Inquiry method.* This method allows individual employers to project the quantity and the quality of manpower that they expect to hire in the future. The aggregate projection is constructed by interviewing the employers and summing up the individual employer's projections.

b. *The Labor-output ratio.* The method involves extrapolation from historical trends of the ratio between growth of manpower skills and growth of output. The method requires long time-series data on output per worker and labor force by skill.

c. *The Density ratio.* This method is a variation of the labor-output ratio. The method forecasts the manpower input per member of the total labor force, together with the total labor force derived from projections of total output and labor productivity.

d. *The International comparisons technique.* The method uses data from a similar economy at a point in time when its stage of development was comparable to the current stage of the country under study. The notion that most economies tend to undergo a well-defined development path explains the applicability of this method.

With the basic framework of the MRA, several extensions were formulated. The extensions of the method include:

a. Sectoral output and employment projections which are embedded into a consistent forecasting framework. This makes use of input-output coefficients and bases the output projections on the Leontief inverse matrix.

b. Linear programming framework with employment solves for shadow wages with the fixed coefficient assumption.

c. Simple employment projections model formulated in incremental terms in the following form:

(3) $$\Delta L_j = \sum_i l^*_{ij} \Delta Y_i$$

where ΔL_j = change in labor requirement of occupational/ skill category j induced by a change in gross output.

ΔY_i = change in gross output in sector i over some known base value, $\overline{Y}_i$

l^*_{ij} = change/increase in labor requirement of occupation/ skill category j associated with a unit increase in gross output of sector i

Combining the simple projection model with the formulation in incremental terms yields:

(4) $$L_j = \sum_i l^*_{ij} Y_i + \sum_i l_{ij} \Delta Y_i$$

The equation represents the linear nonhomogeneous function of L_j in terms of the planned-for increases in gross output.

2.1.2 *Human Capital or Rate of Return Approach (RRA)*

The rate of return approach treats investment in human capital in the same way as investment in physical capital. Investment in man may be in the form of education and training, job search and migration. The emphasis of most studies utilizing the RRA is on investment in education and training, and on planning for educational needs. The method estimates the costs of

educational or training investment and the resulting benefits over the worker's lifetime in the labor force using an appropriate discount rate. Educational investments or projects that yield positive returns (i.e., the difference between benefits and costs) should be undertaken or expanded. In the process, the costs and benefits are converted in terms of their present values from which the rates of return to investment are estimated. Thus, the criteron for investment decision is that the present value of the benefits should be greater than the present value of the costs, i.e., positive rate of return. With the assumption that wages are given for each occupation, the rate of return approach determines the supply of each occupational category that maximizes the return. In some cases, however, where certain occupations yield quasi-rent, it is necessary to distinguish private from social rate of return.

With the decision to invest being determined by the costs and benefits from such undertaking, a discussion on how they are estimated is considered important.

The benefits from educational investment are determined using any of the following two methods. One is to relate benefits to the person's potential contribution to total output. Information on the person's income over his lifetime in the labor force is necessary. Such information, however, is difficult to obtain. In this view, one can make the assumption that the future incomes of the workers will be similar to the figures from cross-section estimates of age-education profiles which can be obtained from population censuses and income surveys. Uthoff and Pernia (1986) explains,

> ...The technique assumes that the income received at the time of the census or survey covering persons of different ages with secondary education represents the income of youngsters throughout their lifetime.

The other method is called the cohort method. This method utilizes the appropriate time-series data that serve as basis in the determination of expected income for a given age and educational level. The method calls for at least six decennial censuses applying similar techniques in measuring income and educational level for

developing countries. On the other hand, the costs of investment in human capital do not only include the direct costs but also the foreign earnings (opportunity costs, i.e., income one could have earned if one worked instead of investing in education and training). Statistical data representing direct costs are easily obtained from various institutions. Indirect costs, on the other hand, can be estimated from alternative activities' opportunity costs.

2.2 *Critical Evaluation of the Techniques*

The first part of this section reviews the various criticisms of the manpower forecasting techniques. Most of the criticisms attack the assumptions that create difficulties with regard to the application of the methods to developing countries. The second part critically evaluates the applicability of the methods to Asia-Pacific countries. The usual approach with regard to this line of analysis is to compare the projections with the actual figures for the different countries, the so-called performance evaluation. This type of analysis tests the accuracy of the forecast but requires extensive data-gathering and actual application of the methods. Moreover, the performance evaluation of forecasting techniques with accuracy as criterion should take into account the purposes for which the forecasts are made. Are the forecasts sufficiently accurate for the present purpose? To avoid lengthy discussion, this paper limits itself to the critical evaluation of the methods' applicability with the use of rough indicators representing the factors that affect manpower development and the characteristics which are peculiar to a particular country concerned. Performance evaluation undertaken by existing studies will be briefly reviewed.

2.2.1. Criticisms of the Manpower Forecasting Techniques

a. Manpower Requirement Approach (MRA)

The approach, despite its shortcomings, is widely used in making medium and long-term forecasts of occupational requirements, and is generally applicable to developing countries. According to Amjad (1986), manpower planners prefer quantitative estimates as basis for determining the appropriate investment levels that meet expected demand. Cohen (1986), on the other