THE DISTRIBUTION OF THE UNEMPLOYED BY OCCUPATIONAL GROUPS: A THEORETICAL AND EMPIRICAL ANALYSIS

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ABSTRACT

THE DISTRIBUTION OF THE UNEMPLOYED BY OCCUPATIONAL GROUPS: A THEORETICAL AND EMPIRICAL ANALYSIS

By

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This dissertation is an application of the tools of economic theory to the problem of constructing a short-run model which determines the distribution of unemployment by occupational groups through time. The level of unemployment in a particular occupation is defined to be the difference between the number of workers supplied and the number demanded at a given wage rate. This difference is, in general, positive because unemployed workers cannot obtain information on job opportunities instantaneously or at zero cost.

The short-run demand for the members of an occupation is specified to depend on the expected wage in the occupation and on an index of industry product demand. The short-run supply of workers to the occupation is a function of expected wage rates, the probability of employment in this occupation and in other occupations, and the level of expected nonwage earnings. The probability of employment

in an occupation is hypothesized to depend on the expected unemployment rate in the occupation.

The model was tested using time-series data for six major occupational groups and six major industries during the 1958-66 period. A system of six demand and six supply equations was estimated. Each equation was first estimated by single-equation least squares for alternative values of the parameter in a first-order autoregressive process. The value which minimizes the sum of squares of residuals and the corresponding coefficient estimates are maximum likelihood estimates of the parameters of the equation. The entire system of equations was also estimated by a two-step Aitken procedure. This procedure is intended to take account of possible correlation in contemporaneous disturbances across equations in addition to autocorrelation in individual disturbances.

The most significant variables in the demand equations were the indices of product demand. This result is expected from the theory of derived demand. However, a given increase in aggregate demand does not improve employment opportunities in all occupations equally. The evidence indicates that the low skill (high unemployment) occupations benefit less than do the higher skill occupations. A policy implication is that expansionary monetary and fiscal policies are effective policy instruments for reducing unemployment only if they are coupled with retraining programs designed to increase the occupational mobility of low skilled workers.

The results for the wage variables in the supply equations are consistent with several long-run studies which show that individuals respond to differentials in present values of expected earnings in choosing among occupations. In addition, significant coefficient estimates were obtained for the unemployment rate variables. With the exception of the unemployment rates for laborers, the sign of these estimates verifies the use in the model of "probabilistic" supply functions. The results for laborers can be rationalized by consideration of the probable effect of "hidden unemployment" concentrated among the low skilled.

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Finally, I gratefully acknowledge the invaluable assistance and support of Professor Thomas R. Saving who served as chairman of the committee. Professor Saving initially suggested the topic, and as the study progressed, he was an unfailing source of additional ideas and much needed encouragement.

Of course, the author is solely responsible for any errors, logical or otherwise, which appear in this dissertation.

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CHAPTER I

INTRODUCTION

This dissertation is an application of the tools of economic theory to the problem of explaining the short-run distribution of occupational unemployment. At neither the micro nor the macro level is the present state of economic analysis entirely satisfactory with respect to the labor market. At the microeconomic level of analysis, the traditional theory of competitive equilibrium essentially precludes the unemployment problem because the attainment of general equilibrium implies that all the marginal conditions are met including those for full employment. Thus, unemployment functions as a signal that the system is out of equilibrium; but it is not clearly explained how the unemployment comes about, nor is the mechanism specified by which full employment is regained as the system approaches equilibrium. Arrow neatly sums up the problem in the following passage:

> Neoclassical microeconomic equilibrium with fully flexible prices presents a beautiful picture of the mutual articulations of a complex structure, full employment being one of its major elements.

> [But] What is the relation between this world . . . and the real world with its recurrent tendencies to unemployment of labor . . .?[1]

At the aggregate level of analysis, excess supply in the labor market is a stable solution to the general class of macroeconomic models in which all markets but the labor market are simultaneously cleared. But here the inadequacy of the micro foundation is reflected in the seemingly ad hoc assumptions which are employed to arrive at the unemployment solution. Well-known examples are the cases of rigid money wages, money illusion on the part of labor suppliers, and the liquidity trap. Clearly, the descriptive power of the standard Keynesian model would be increased if the existence of unemployment could be demonstrated on the basis of assumptions consistent with economic theory.[2]

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[1]Kenneth J. Arrow, "Samuelson Collected," Journal of Political Economy, LXXV (October, 1967), p. 734.

[2]Axel Leijonhufvud argues persuasively that Keynes' theory, as distinct from the Keynesian model, is consistent with economic theory. In his theory, Keynes discusses wage rigidity as a policy recommendation rather than as a behavioral assumption. Hence, to move from general equilibrium theory to Keynes' world, it is sufficient only to give up the assumption of instantaneous price adjustments. Leijonhufvud notes that "The removal of the [Walrasian] auctioneer simply means that the generation of the information needed to coordinate economic activities in a large system where decision making is decentralized will take time and will involve economic costs. No other 'classical' assumptions need be relinquished." "Keynes and the Keynesians: A Suggested Interpretation," Proceedings of the American Economic Association, LVII (May, 1967), p. 404. As will be seen in the following paragraphs in the text, this is very much the general approach taken here.

The purpose of this dissertation is to construct and empirically test a model constructed from economic theory which determines the occupational structure of unemployment through time. The model is a short-run model because it is primarily short-run fluctuations in the unemployment vector in which we are interested. The level of unemployment in an occupation is defined to be the number of members of the occupation who are unemployed. Hence, the level of unemployment is the difference between the number of workers willing to supply their labor in the occupation at a given wage and the number of workers demanded by firms at this wage. The plan of attack is to develop market demand and supply functions for each occupational group. Then at the market wage rate, the quantity of labor supplied and demanded, and hence the level of unemployment, is determined at any particular moment.

Each occupational supply and demand function is constructed assuming rational decision making on the parts of individual firms and labor suppliers. But because product demand fluctuates unexpectedly and information and mobility are not costless, wage offers by firms and reservation prices of individuals will not in general adjust with sufficient speed to assure that the number of workers who desire to work will be equated to the number of workers demanded by firms in the short run.

Therefore, a positive level of unemployment can exist in the model without the assumption that labor unions or other institutions enforce rigid wages. Rather than serving as an indicator of disequilibrium, as in the traditional theory of competitive equilibrium, a positive level of unemployment is inherent in the system because of the costs involved in supply adjustments.

The labor economics literature related to the topic of this dissertation is voluminous. Of the studies examining unemployment as the dependent variable in the analysis, a large number are concerned with determining which of two contending hypotheses provides the better explanation of observed unemployment in the past ten to fifteen years. The two hypotheses are the inadequate-aggregate demand hypothesis and the structural unemployment hypothesis.[3] It is widely recognized that empirical information on the relative importance of the two hypotheses is critical, particularly from the policy point of view.[4] The present model is not explicitly constructed

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[3]The former hypothesis expresses the macro viewpoint that unemployment rates throughout the labor force rise and fall with changes in the total demand for goods and services. The latter hypothesis is based on micro considerations. It states that "structural" changes have occurred in the economy which have resulted in substantial changes in the composition of labor demand. Since workers are not instaneously mobile, unemployment has become concentrated in particular segments of the labor force while other segments enjoy a surplus of job opportunities.

[4]A widely quoted monograph supporting the inadequate-demand hypothesis is that by James W. Knowles and

to distinguish between the hypotheses; however, the demand side of the model does provide evidence as to the impact of changes in product demand on the occupational structure of labor demand.

In developing the supply side of the model, extensive use is made of two well-developed bodies of literature. These are the studies examining investment in human capital and the studies analyzing labor force participation rates. In the human capital literature, an individual's effort to increase his earning capacity is treated as an investment to raise the level of human capital he possesses.[5] As in the case of investment in

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Edward Kalachek, Higher Unemployment Rates, 1957-1960: Structural Transformation or Inadequate Demand, Subcommittee on Economic Statistics of Joint Economic Committee, U. S. Congress (Washington: U. S. Government Printing Office, 1961). Two brief statements of the views of Charles C. Killingsworth, the chief proponent of the structural hypothesis, are found in Jack Stieber (ed.) "Structural Unemployment in the United States," Employment Problems of Automation and Advanced Technology: A International Perspective (London: Macmillan and Company, Ltd., 1966), pp. 128-156 and Garth L. Mangum (ed.) "Automation, Jobs, and Manpower: The Case for Structural Unemployment," The Manpower Revolution: Its Policy Consequences (Garden City, New York: Doubleday & Company, 1965), pp. 97-117.

[5]Gary S. Becker was instrumental in laying out the theoretical framework upon which this literature developed. See his Human Capital (New York: National Bureau of Economic Research, 1964) and "Investment in Human Capital: A Theoretical Analysis," Journal of Policital Economy, LXX, Part 2 (Supplement: October, 1962), pp. 9-49. In this Supplement, the contributions of Jacob Mincer, Larry A. Sjaastad, and George J. Stigler should also be noted. An additional fruitful application of capital theory to individual investment decisions is Yoram Ben-Porath, "The Production of Human Capital and the Life Cycle of Earnings," Journal of Political Economy, LXXV, Part I (August, 1967), pp. 352-365.

physical capital, investing in oneself yields a return, but only at a cost. Therefore, it is postulated than an individual will invest in himself up to the point at which the present value of additional earnings equals the additional costs.

The studies of labor force participation attempt to isolate the variables which determine whether or not individuals will offer their services in the labor market.[6] Of special relevance to this dissertation is Mincer's fundamental contribution examining the supply behavior of married women.[7]

In the past few years, a literature has begun to grow delving into the response of both employers and workers to changes in product and labor demand.[8] Because

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[6]Two fine surveys of this literature are: Jacob Mincer, "Labor-Force Participation and Unemployment: A Review of Recent Evidence," in R. A. Gordon and M. S. Gordon (eds.) Prosperity and Unemployment (New York: John Wiley & Sons, Inc., 1966), pp. 73-112 and Anthony Fisher, "Poverty and Labor-Force Participation," Research Paper P-273, Economic and Political Studies Division, Institute for Defense Analyses, February, 1966.

[7]Jacob Mincer, "Labor Force Participation of Married Women: A Study of Labor Supply," Aspects of Labor Economics, Conference of the Universities-National Bureau Committee for Economic Research (Princeton: Princeton University Press, 1962), pp. 63-97.

[8]A survey of this literature is found in Charles C. Holt, "Job Search, Phillips' Wage Relation and Union Influence, Theory and Evidence," Firm and Market Workshop Paper 6705, Social Systems Research Institute, University of Wisconsin, December 14, 1967. (Mimeographed.) Of particular use in this dissertation is the approach to analyzing the costs and returns to information search

information cannot be obtained instantaneously or at zero cost, some lag in response almost always exists for both parties. In the development of the present model, the lag in labor supply is utilized to demonstrate the plausibility of an unemployment equilibrium situation. The hypothesis proposed is that individuals view a positive level of unemployment as the normal case rather than as a transitory phenomenon which can safely be ignored in making supply decisions. Consequently, they consider the relevant set of unemployment rates in evaluating alternative occupations against each other. The import of this hypothesis is that the past levels and distributions of unemployment become crucial variables determining workers' supply decisions in the current period, so that past unemployment is an important determinant of the characteristics of the present structure of unemployment.

The dissertation is organized in the following manner. In Chapter II the model is constructed. The labor demand function for members of an occupation by a firm is derived from the firm's production function, the

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developed by Armen A. Alchian in his yet unpublished paper "Information Costs and Unemployment" (Mimeographed) and in University Economics (co-authored with William R. Allen) (2d ed.; Belmont, California: Wadsworth Publishing Company, Inc., 1967), Chapter 25. Special reference should also be given the interesting application of Markov processes by Martin David and Toshiyuki Otsuki to the problem of predicting short-term movements between the states of employment, unemployment, and nonparticipation. See their "Forecasting Short-Run Variation in Labor Market Activity," Review of Economics and Statistics, XLX (February, 1968), pp. 68-77.

definition of the profit function, and the profit-maximizing constraints. Aggregation is performed first over all firms in an industry and then over all relevant industries to arrive at the total demand function for a particular occupation.

The supply function to an occupation is the outcome of a theory of short-run occupational choice. The theory is developed on the hypothesis that individuals behave as if they decide between occupations by comparing the present values of the time streams of adjusted expected wages in alternative occupations over a short-run earnings horizon. The adjusted expected wage in an occupation at any moment in time is the expected wage adjusted by the probability of employment at that moment. The expected unemployment rate enters the supply function as the determinant of the probability of employment in the occupation.

Chapter III is divided into two sections. The first is a description of the data chosen to test the model. In the second, the model is condensed for statistical estimation, and the statistical techniques used are considered. Finally, Chapter IV contains a report of the empirical results and suggests some conclusions that may be drawn from the study.

CHAPTER II

THE MODEL

I. Introduction

The model presented in this chapter is an attempt to explain short-run fluctuations in the occupational structure of unemployment. We proceed under the assumption that individuals and firms act so as to maximize utility and profits, respectively. However, supply and demand decisions in occupational markets must be made in an uncertain and rapidly changing environment. The effects of external events and shifts in consumer tastes result in changes in the level and composition of product demand. These changes are reflected in the demand for labor, and, after a lag, in the vector of wage offers. However, information on wage rates in alternative occupations is not available to workers instantaneously or at zero cost. Nor is mobility costless after information is obtained. As information is collected, the market works toward equating supply and demand, but, in general, this process is not completed in a short-run period. Consequently, a positive level of unemployment can exist in every occupational group. There is no need to place institutional or other constraints on wage flexibility to demonstrate the existence of unemployment.

Suppose we describe the occupational structure of unemployment at a particular moment in time by the following m-dimensional vector:

$$(2.1) \qquad (U_{1t}, U_{2t}, \ldots, U_{mt}),$$

where U_{qt} $(q=1,\ldots,m)$ is the number of unemployed workers in the qth occupational group at time t. Each component of this vector is defined to be the difference between the quantity of labor supplied and the quantity demanded at a given wage rate. We denote the number of workers who are willing to supply their services in occupation q by $\tilde{\ell}^s_{qt}$ and the number of members of occupation q demanded by firms by $\tilde{\ell}^d_{qt}$. At a given wage w_{qt}, the qth component of the unemployment vector at time t may be written:

$$(2.2) \qquad U_{qt} = \tilde{\ell}^s_{qt} - \tilde{\ell}^d_{qt} \qquad (q=1,\ldots,m).$$

Our approach is to construct supply and demand functions for the qth occupation at time t. Using (2.2) we are then able to solve for the level of unemployment in the occupation at a given wage.

This chapter is divided into three sections. In Section II, static general equilibrium theory is utilized to construct a short-run demand function for workers in the qth occupation. Section III is devoted to the development of the corresponding short-run supply function. These functions are expressed in terms of the vectors of expected wage and unemployment rates and the endogenous vector of industry output.

Section IV contains hypotheses specifying how expectations are formulated and how the other endogenous variables are determined. To complete the system, a set of relationships is introduced to determine the vector of current wage rates.

II. The Demand for Labor

We begin the construction of the demand side of the model by deriving the short-run labor demand function for an individual firm. Then aggregation is performed over all firms in the industry and over all industries to obtain the total short-run demand function facing the members of the qth occupation. Each multi-product firm is viewed as a combination of two or more single-product firms. Furthermore, each single-product firm is assumed (1) to be perfectly competitive on both the product and the factor markets, and (2) to employ the same factors of production as the other firms producing the same product. An implication of these assumptions for the multi-product firm is that the level of output of any single product does not affect the output of its other products. We define an industry to be the number of single-product firms producing a distinct product. The model is constructed for a short-run situation in which there are m variable inputs (types of labor) and one fixed input (the stock of capital) in the economy.

Consider the ith firm in the jth industry, $i=1,\ldots,n_j$ and $j=1,\ldots,M$. The firm's demand for the qth labor input is derived from its production function, the definition of profit, and the profit-maximizing constraint. The following general production function is employed:[1]

$$(2.3)\qquad y_{ij} = f_{ij}(\ell_1,\ldots,\ell_m,k_j) \qquad (i=1,\ldots,n_j;j=1,\ldots,M),$$

where y_{ij} denotes the level of output, $\ell_1,\ldots,\ell_m$ denote levels of the m variable (labor) inputs, and k_j denotes the quantity of the fixed input capital in the jth industry. The definition of expected total profit for the firm is

$$(2.4)\qquad \pi^*_{ij} = p^*_j y_{ij} - (w^*_1\ell_1 + \ldots + w^*_m\ell_m + w^*_k k_j),$$

where p^*_j is the expected market price of the jth product and $(w^*_1,\ldots,w^*_m,w^*_k)$ is the (m+1)-dimensional expected input price vector facing the firm. Differentiating (2.4)

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[1]Since the analysis in this and the following section is static, the time subscript on all variables is omitted to simplify the notation.

partially with respect to each variable input, setting the resulting equations equal to zero, and introducing a random disturbance term yields the following m profit-maximizing conditions:

$$(2.5) \qquad p_j^* \frac{\partial y_{ij}}{\partial l_q} = w_q^* + \varepsilon_{qij} \qquad (q=1,\ldots,m).$$

A rationale for the disturbance term (ε_{qij}) is that entrepreneurs modify their profit-maximizing input decisions in response to essentially random disturbances occurring outside the system which are not reflected in the expected wage and price parameters. With the m+2 equations of (2.3), (2.4), and (2.5) in the unknowns $y_{ij}, \pi_{ij}^*, \ell_1, \ldots, \ell_m$, we can solve for the levels of profit, output, and labor inputs in terms of the expected parameters given to the firm. The profit-maximizing level of the qth labor input is

$$(2.6) \qquad \tilde{\ell}_{qij} = h_{qij}(p_j^*, w_1^*, \ldots, w_m^*, \varepsilon_{qij}),$$

where $\tilde{\ell}_{qij}$ is the number of members of occupation q which the firm desires to employ.

To derive the labor demand function for the industry, we cannot simply sum the demand functions of the individual firms for the reason that the product price is not fixed to the industry. The industry product demand function is based on the results of individual consumer utility maximization aggregated to the industry level. For our purposes, it is specified that the desired level of output of an industry is a function of the own expected price and the expected prices of all other products. Hence, the demand function for the jth product may be written

$$\tilde{y}_j = g_j(p_1^*, \ldots, p_M^*) \qquad (j=1,\ldots,M), \tag{2.7}$$

where $\tilde{y}_j$ is the desired level of output of industry j. We assume that the Jacobian of the system of functions designated in (2.7) exists and is nonsingular for the relevant intervals on the p_j's, that is,

$$\begin{vmatrix} \frac{\partial g_1}{\partial p_1^*} & \frac{\partial g_1}{\partial p_2^*} & \cdots & \frac{\partial g_1}{\partial p_M^*} \\ \frac{\partial g_2}{\partial p_1^*} & \frac{\partial g_2}{\partial p_2^*} & \cdots & \frac{\partial g_2}{\partial p_M^*} \\ \cdots & \cdots & \cdots & \cdots \\ \frac{\partial g_M}{\partial p_1^*} & \frac{\partial g_M}{\partial p_2^*} & \cdots & \frac{\partial g_M}{\partial p_M^*} \end{vmatrix} \neq 0. \tag{2.8}$$

Appeal to the Inverse Function Theorem allows us to rewrite (2.7) as

$$p_j^* = h_j(\tilde{y}_1, \ldots, \tilde{y}_M) \qquad (j=1,\ldots,M). \tag{2.9}$$

Substituting, the labor demand function of the jth industry is

$$(2.10) \qquad \tilde{\ell}_{qj} = k_{qj}[h_j(\tilde{y}_1,\ldots,\tilde{y}_M),w_1^*,\ldots,w_m^*\varepsilon_{qj}]$$

$$= n_{qj}(w_1^*,\ldots,w_m^*,\tilde{y}_1,\ldots,\tilde{y}_M,\varepsilon_{qj}),$$

where $\tilde{\ell}_{qj}$ is the number of members of the qth occupation which the firms in industry j desire to employ, and ε_{qj} is the sum of the disturbances for the individual firms.

The total demand function for the members of the qth occupation is obtained by summing over all the industries employing members of this occupation. The total demand function is

$$(2.11) \qquad \tilde{\ell}_q^d = \sum_{j=1}^{M} n_{qj}$$

$$= G_q(w_1^*,\ldots,w_m^*,\tilde{y}_1,\ldots,\tilde{y}_M,\varepsilon_q) \qquad (q=1,\ldots,m),$$

with the partial derivatives[2]

$$(2.12) \qquad \frac{\partial G_q}{\partial w_q^*} < 0, \ \frac{\partial G_q}{\partial w_r^*} > 0 \ (r \neq q), \ \frac{\partial G_q}{\partial \tilde{y}_j} > 0 \ (j=1,\ldots,M).$$

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[2]The sign of the partial derivative of G_q with respect to y_j is due to the assumption that

$$\frac{\partial G_q}{\partial \tilde{y}_j} > \sum_{\substack{i=1 \\ i \neq j}}^{M} \left| \frac{\partial G_q}{\partial \tilde{y}_i} \frac{\partial \tilde{y}_i}{\partial p_i^*} \frac{\partial p_i^*}{\partial \tilde{y}_j} \right| .$$

That is, the direct effect of a change in the quantity

III. The Supply of Labor

In this section, the supply side of the model is developed from a theory of short-run occupational choice. Since it is a short-run model, we consider only the behavior of individuals who are in a position to move between occupations or between market and nonmarket activity within a short period of time. That is, we are interested in those individuals whose supply decisions have a short-run impact on the occupational distribution of the labor force. Here, the labor force is defined as the total number of workers either employed or unemployed in an occupation. Unemployment in the short run comes about because the time period selected for analysis is frequently too short to allow an individual to both choose an occupation and choose a job within the occupation.

In the first part of this section, the individuals whose supply behavior is relevant to a short-run model are identified, and then we supply a rationale for the inclusion of current expected wages in the supply functions of these individuals.

A. Expected Wage Rates as Arguments in the Labor Supply Function

It is first assumed that occupational groups may be ranked by the stock of human capital that must be

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demanded of product j on the demand for workers of the qth type exceeds the indirect effect appearing via substitute and complement relationships in the product markets of all other goods, even in the most extreme case.

possessed by a worker in order to enter the occupation. Secondly, it is assumed that an individual possessing a given stock of capital may enter any of the occupations (if such occupations exist) requiring a lower stock. Upward mobility, however, requires that he first invest in himself in order to increase his level of skills. Examples of pertinent investment in human capital are information gathering, education, migration, and on-the-job training.

The costs of the investments described above may be separated into two components: (1) the direct costs of purchased goods and services, e.g., tools, tuition, moving costs, etc., and (2) the earnings foregone, that is, the present value of productive services withdrawn from another occupational group. The individual will invest in himself up to the point at which the present value of additional earnings from investing equals the present value of the additional costs.

To acquire a higher level of skills for upward occupational mobility, an individual must normally undertake an investment over a long-run period. The direct and opportunity costs of this type of investment are large enough that in order to justify such investments the present value of prospective earnings over a long-run horizon (perhaps a lifetime horizon) must normally be considered. Because of the length of time required to complete the necessary investment, we ignore upward mobility as a possible short-run supply adjustment. Therefore, the short-run sources of additional members to an occupation, say occupation q, are: (1) members of occupations which require higher levels of skills than does the qth occupation, and (2) workers currently outside the labor force (i.e., workers not currently members of any occupation) who possess at least the minimum level of skills to enter occupation q. For these individuals, the costs of investing in occupation q involve only the costs of collecting job information and moving costs. Since their investment costs are relatively minor, they are in a position to enter occupation q in response to favorable job conditions which may prove to be only "temporary." That is, these individuals may make their supply decision with respect to the qth occupation on the basis of the present value of expected returns in the occupation for a short-run earnings horizon. Over a short-run horizon, it is reasonable to assume that the current expected wage is a reliable measure of future expected wages. The work-leisure analysis of traditional wage theory provides a useful point of departure for developing a theory of short-run occupational choice.

Suppose that the decision to work in the short-run is an all-or-nothing decision, meaning that an individual anticipates either working full time, say, eight hours per day, or specializing in leisure, where leisure refers to all forms of nonmarket activity. Further, assume that an individual may be a member of only one occupation at any moment in time. In Figure 1, we depict an individual's indifference map with income per unit of time on the vertical axis and leisure per unit of time on the horizontal axis. The distance OL_m represents twenty-four hours per day of leisure and OL_0 represents sixteen hours per day of leisure. The level of income OY_0 is the income received other than that earned from supplying labor on the market, and Y_0Y_T is wage income. Points A and B are assumed to be the only alternatives available to the individual.

Conceptually, it is possible to distinguish between the following two decisions for an individual: (1) whether to choose the qth occupation over all other relevant occupations; and if occupation q is selected, (2) the choice between this occupation and full-time leisure. He makes the first decision by picking out the set of occupations for which he is qualified, and from the corresponding set of expected wage rates selecting the highest. Suppose that the expected wage in the qth occupation is the highest. This expected wage is represented in Figure 1 by the slope of the line segment BC. Any lower wage is represented by a line segment, such as BD, of slope less than BC in absolute value.

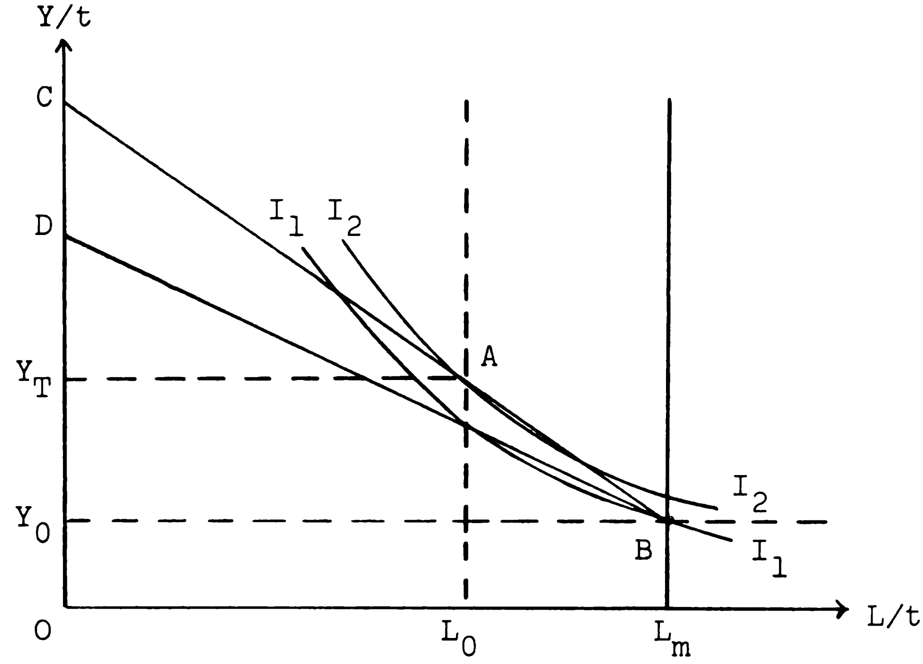

Figure 1.--The orthodox theory of work-leisure choice.

The individual's second decision depends on whether the indifference curve passing through point A is higher than the indifference curve passing through point B. In Figure 1, I_2I_2 exceeds I_1I_1 so that the individual will supply his labor to the qth occupation. However, if the expected wage in occupation q should fall to a level lower than the wage rate represented by the slope of BD and still remain the highest of the set of available expected wage rates, the individual will choose to specialize in leisure.

The analysis depicted in Figure 1 is deficient in that attention to expected wage rates may not be sufficient to evaluate expected earnings in alternative occupations if conditions of less than full employment prevail. In the next part of this section it is argued that short-run unemployment arises because of the time involved in the adjustment process required to move from one occupation to another or to move into or out of the labor force. The essence of the argument is that the adjustment process may be carried out most efficiently while a worker is unemployed. Differences in demand conditions across occupations give rise to the occupational distribution of unemployment. The discussion is carried out in a framework of individuals' reservation prices.

B. Incorporation of Short-Run Unemployment Into the Model[3]

The reservation price represents a worker's evaluation of his market alternatives. Consider an individual employed in an industry which suffers a decrease in product demand. Given that the labor supply function is

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[3]Many of the important concepts in this discussion of reservation prices are developed in Alchian, "Information Costs and Unemployment" and in Alchian and Allen, *University Economics*, pp. 494-509. Other papers dealing with the topic of job search are George J. Stigler, "Information in the Labor Market," *Journal of Political Economy*, LXX, Part 2 (Supplement: October, 1962), pp. 94-105; Albert Rees, "Information Networks in Labor Markets," *Proceedings of the American Economic Association*, LVI (May, 1966), pp. 559-566; and Holt, *op. cit.*, pp. 59-65.

not perfectly elastic, he can be employed in this industry only at a lower wage. Suppose, however, he feels that he has alternative employment opportunities in his occupation (or in occupations requiring a lower level of skills) at a higher wage than that now offered him. That is, his reservation price exceeds the wage his employer is offering. Rather than lowering his reservation price, we expect that he will make an effort to obtain information on job vacancies in other industries.[4] Since this information is not available instantaneously, time is consumed in the search process. As the worker continues to search out information, he will acquire an ever larger sample of the wage offers being made by employers. Finally, he will terminate the job search when the increment in earnings by which his best offer exceeds his next best offer suggests that the expected increment from further search is less than the cost of the additional search.[5] At this time he will adjust his reservation price if he concludes that an adjustment is necessary to secure employment. There is a limit to the length of the search process because the "law" of diminishing returns suggests that increments in earnings

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[4]The principles outlined here also apply to the case of a worker who revises his reservation price upward and quits his job even though he could continue to work at his previous wage rate.

[5]Alchian, <u>op. cit</u>., p. 12.

will begin to decline after some positive level of investment in search. The costs to be considered are the earnings foregone during the period of search, the direct costs of search (e.g., the costs of using the services of employment agencies and of traveling to job interviews), and the costs of moving.

The individual in the above situation has the following short-run alternatives open to him: (1) continue working at the reduced wage and engage in job search during leisure hours, (2) begin working in the highest-wage job immediately available and engage in job search during leisure hours, or (3) devote himself full time to searching for a job. Except in the unlikely situation that an immediately available job is a global optimum, the second alternative is more costly than the first because it involves two moves, whereas the other alternatives involve only one. The first move is to the immediately available job, while the second is to the job chosen at the end of the search period. Consequently, the second alternative will never be selected over the first unless the increment in earnings exceeds the additional cost of an extra move.

The third alternative would seem to be the highest cost in terms of foregone earnings, but because the unemployed worker specializes in job search, he can, in general, accumulate more information about wage offers in a given period of time than an employed worker is able to acquire. Consider two workers who possess equivalent levels of skills. If the above proposition holds, the unemployed worker is able to make his choice from a set of alternatives and begin work some time before the employed worker is in a position to choose among a comparable set of job offers. For this reason, it is likely to be the employed worker who is at a net disadvantage with respect to foregone earnings. If so, it would be completely rational for a worker to select unemployment as the best alternative state during his adjustment period.[6] The fact that information is not available instantaneously or at zero cost implies, in this case, that a positive level of unemployment is consistent with optimal individual behavior. Thus, unemployment may be said to exist in short-run equilibrium where supply adjustments are a part of the unconstrained functioning of labor markets. However, unemployment is not consistent with long-run equilibrium which occurs only when all adjustments have been carried out.

Returning to Figure 1, if a worker determines that his highest expected wage is less than the expected wage rate represented by the slope of line segment BD after his period of search is completed, he will leave the

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[6]The result that it is rational does not imply that unemployment is painless to the worker and his family. Indeed, every effort should be made to increase the flow of job information and hence shorten the period of adjustment.

labor force and specialize in leisure, either investing in himself to upgrade his level of skills or devoting full time to home work. This expected wage may therefore be defined to be the worker's reservation price for remaining in the labor force.

The above analysis implies that except in the case where changes in product demand are always positive, there will exist a positive level of unemployment consistent with short-run equilibrium in any occupational market. The level of unemployment depends on the nature of fluctuations in product demand faced by the industries which employ the members of the occupation.[7] The greater are the frequencies and magnitudes of the fluctuations, the larger is the number of workers placed in a position where they may choose to be unemployed during their adjustment period rather than to accept a lower wage. Consequently, the level of unemployment in the occupation increases, even in the case in which the fluctuations average out to zero across industries.

In the case of a downward shift in the entire vector of industry product demand, workers do not, in general, immediately recognize that the distribution of wage ovvers has shifted downward. This realization occurs only after they have collected a sufficiently large

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[7]This discussion abstracts from the unemployment impact of changes in supply due to long-run forces such as changes in the demographic composition of the population.

sample to infer that the reason wage offers are lower than anticipated is a decrease in demand rather than simple bad luck. Hence, while the market eventually forces workers to adjust their reservation prices downward, the length of the average adjustment period increases so that the level of short-run unemployment is higher in each occupational group.

To conclude the discussion of short-run unemployment, the special cases of fixed proportions in production and downward rigid wages are incorporated into our theory. These are the two cases usually pointed out as the causes of unemployment.

In a full-employment situation with fixed proportions, a shift in the composition of product demand results in an excess supply of the members of some occupations. The marginal product of these workers falls to zero so that there is no positive wage at which employers find it profitable to retain them on the payroll. Similarly, effective minimum wages remove the option for some workers of working at reduced wages in the face of a decrease in demand.

In periods of a general decrease in demand, effective minimum wages and/or fixed proportions reduce the total number of positive wage offers that employers can make. Thus, an individual finds that he must increase his investment in search in order to obtain a given sample of wage offers. To the extent that these constraints on firm behavior are more significant in some occupational markets than in others, they serve to accentuate inter-occupational differences in unemployment rates. Indeed, the least-skilled unemployed workers may find employment opportunities entirely closed off, with a consequent rise in hard-core unemployment.

C. Expected Unemployment Rates as Arguments in the Labor Supply Function

The analysis presented in Figure 1 does not take into account the existence of unemployment. The inclusion of unemployment in the system means that occupational choice must be made under conditions of uncertainty. A particular job does not guarantee a certain time path of earnings, even over a short-run horizon. Consequently, the vector of expected wages is not the only factor involved in short-run decision making. The rational individual will also take into consideration the possibility that unforeseen changes in demand may occur which result in his unemployment. At each moment in time he will compare his current position (whether employed or not) with the information he has on the conditions existing in the occupations he is qualified to enter. Consider his evaluation at time $t=t_0$ on the assumption that if he selects a particular occupation he expects that he will be a member of this occupation for at least the duration of his short-run earnings horizon, which we suppose to end at t=T. In what follows, a theory is developed in which the individual first chooses among occupations, taking into account the possibility that he may be unemployed for a period of time in any one of the occupations. Then he decides whether to enter or to remain in the occupation judged to be the best among those considered.

An individual belonging to a particular occupational group is either employed or unemployed in that group; hence, at any time t, his employment position in the occupation may be described by a binomial probability distribution. Moreover, it is expected that the probability of employment in occupation q at a future moment in time for a worker currently employed in the occupation is not the same as the probability of employment for a worker currently unemployed in the occupation.

Suppose that an individual is employed in occupation q at time t_0. Viewed at t_0, the conditional probability of being employed at the expected market wage in the qth occupation at time t ($t_0 < t \leq T$) may be written as

$$P(E_t | E_{t_0}) = g(t, u_q^*), \tag{2.13}$$

where u_q^* is the expected unemployment rate in the occupation at t_0. It is assumed that the worker anticipates that the wage rate and the unemployment rate in occupation q expected to exist at time t_0 will continue unchanged over his short-run horizon. In the same manner, the probability of being employed at time t ($t_0 < t \leq T$) in occupation q given that the individual is unemployed in occupation q at t_0 is

$$(2.14) \qquad P(E_t | U_{t_0}) = h(t, u_q^*).$$

The signs of the partial derivatives of (2.13) and (2.14) are postulated to be

$$(2.15) \qquad \frac{\partial g(t, u_q^*)}{\partial u_q^*} < 0 \quad \text{and} \quad \frac{\partial g(t, u_q^*)}{\partial t} < 0,$$

and

$$(2.16) \qquad \frac{\partial h(t, u_q^*)}{\partial u_q^*} < 0 \quad \text{and} \quad \frac{\partial h(t, u_q^*)}{\partial t} > 0.$$

The negative sign of the second of the two partial derivatives in (2.15) is rationalized as follows: the further in the future is t, the less certain is the individual that he will continue to be employed. On the other hand, the sign of the second of the partial derivatives in (2.16) is positive because the individual may be more certain of finding a job the longer the period in which he engages in search.

At any time t, it is hypothesized that a worker adjusts the expected wage rate in occupation q, denoted by x_q^*, by the conditional probability of employment at t--either (2.13) or (2.14) depending on the worker's current employment state. We define the adjusted expected wage in occupation q at time t to be x_q^* times the conditional probability of employment in occupation q at t. Thus, if a worker is employed in the qth occupation at time t_0, the present value of the time path of adjusted expected wages in occupation q is given by

$$(2.17) \qquad PV_q = \int_{t_0}^{T} [g(t,u_q^*)\cdot x_q^*]e^{-i(t-t_0)}dt,$$

where the expression in brackets is the adjusted expected wage of an employed worker at time t, and i is the rate of interest. The interest rate is assumed constant during the short-run horizon.

Conversely, the present value of adjusted expected earnings in occupation q as viewed by a worker currently unemployed in the occupation is

$$(2.18) \qquad PV_q = \int_{t_0}^{T} [h(t,u_q^*)\cdot x_q^*]e^{-i(t-t_0)}dt.$$

Finally, the present value of adjusted expected earnings in occupation q evaluated by an unemployed individual outside the qth occupation is

$$(2.19)\quad PV_q = \int_{t_0}^{T} [h(t,u_q^*)\cdot x_q^*]e^{-i(t-t_0)}dt - \frac{c}{i}[1-e^{-i(t_1-t_0)}],$$

where c is the direct cost of investment in occupation q at time t ($t_0 \leq t \leq t_1$), and t_1 is the end of the investment period. The individual's choice among the set of occupations available to him depends upon which one offers the highest present value of adjusted expected earnings net of any direct investment costs.

Figure 2 presents two time paths of adjusted expected earnings drawn for $\bar{x}_r^*$ and $\bar{u}_r^*$ which are assumed to be the current values of the expected wage and the expected unemployment rate, respectively, in occupation r, an alternative to occupation q. The function AA represents the time path of adjusted expected earnings for a member of occupation r employed at time t_0, while BB represents the time path for the same worker should he currently happen to be unemployed in the occupation. The vertical axis measures adjusted expected wages, denoted by $A(x_r^*)$, and time is measured on the horizontal axis. The second partial derivatives with respect to t of the conditional probabilities of employment (2.13) and (2.14) are not specified so that the time paths AA and BB could be re-drawn in several alternative ways consistent with $\bar{x}_r^*$ and $\bar{u}_r^*$ so long as the slopes of the functions are negative and positive, respectively, in the interval

$(t_0,T]$.[8] However, the partial derivatives with respect to u_q^* in (2.15) and (2.16) imply that for any $\hat{u}_r^* > \bar{u}_r^*$, each time path would shift such that every point on the new function is lower than the corresponding point on the old function for any t $(t_0 < t \leq T)$.

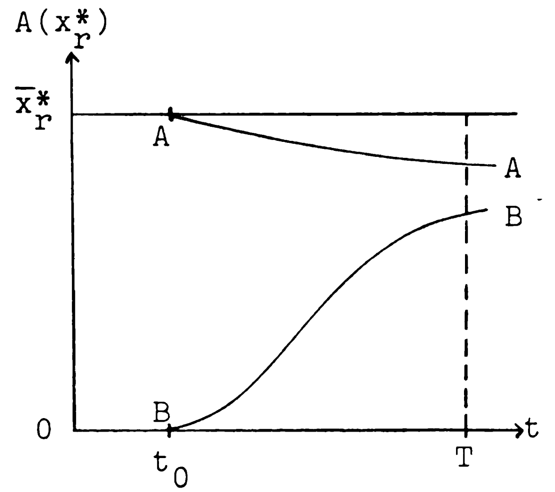

Figure 2.--Time paths of adjusted expected wages of an employed and an unemployed worker in the rth occupation.

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[8] The particular time paths depicted in Figure 2 are drawn on the assumption that at any time t, a currently employed worker never evaluates the probability of retaining his job to be less than the probability he would assign to obtaining employment were he currently unemployed. A further assumption that might be made is that in either case the worker views his probability of employment to be asymptotic to $(1-\bar{u}_r^*)$. On this assumption, the time paths AA and BB would be drawn asymptotic to $(1-\bar{u}_r^*)\cdot\bar{x}_r^*$.

As mentioned previously, the sources of short-run change in the relative quantities of labor supplied to occupations are (1) members of higher occupational groups who switch to lower occupations, and (2) individuals who move into and out of the labor force. We examine first the considerations relevant to a worker deciding between occupations.

Figure 3 illustrates the position of a member of occupation r, either employed or unemployed, who is

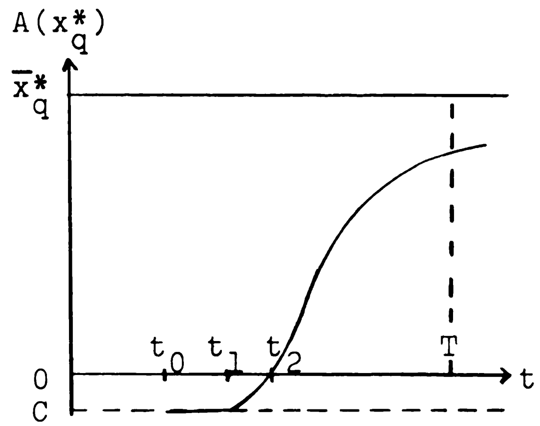

Figure 3.--Time path of adjusted expected wages in occupation q as viewed by a member of occupation r.

considering the possibility of entering occupation q. For this worker, one may conceptually distinguish the process of selecting an occupation on the basis of general information on wage and employment conditions from the process of selecting a particular job within the chosen occupation. In the figure, it is assumed that the time required to complete investments in information and/or geographical mobility in selecting occupation q is the interval $[t_0,t_1]$. The direct cost of these investments charged against expected earnings in the occupation is shown by the rectangle $(Oc \times t_0 t_1)$. In addition, further investment in job search may be necessary to sample the industry wage offers being made to members of the occupation. If this investment has a direct cost, the net expected wage in occupation q is negative for an additional time period, say (t_1,t_2). For $t \geq t_2$, however, the individual can anticipate a positive adjusted expected wage. A portion of total short-run unemployment in an occupation therefore arises because the time interval considered is long enough to allow a worker to select an occupation, but it is too short for him to search out the best available job.

The opportunity cost of investing to enter occupation q is the present value of the time path of adjusted expected earnings in occupation r--either AA or BB in Figure 2. But it is unlikely that a worker who is dissatisfied with his present job in occupation r can obtain the information necessary to locate the best job in an alternative occupation with instant search or while working at the old job to avoid unemployment. Hence, the time path AA in Figure 2, the present value of which is calculated by (2.17), does not represent the relevant opportunity cost of investment in occupation q for most individuals. In what follows, we consider explicitly only the case of workers who are unemployed for some positive period of time. The decision between any two occupations is therefore made by comparing present values calculated by (2.18) and (2.19).

It is reasonable to assume that an individual's utility function includes the following arguments: the rate of consumption of goods and services, the rate of consumption of leisure, and tastes for particular occupations. Define the total present value of expected earnings in an occupation (TPV) to be the sum of the present value of expected nonwage earnings (PV_0), which is assumed to be invarient between occupations, and the present value of adjusted expected earnings from working in the occupation (PV). Then in the two-occupation case, the utility function may be rewritten in the arguments TPV_q, TPV_r, and leisure, since tastes for occupations exist. Each argument may be measured on one axis of a three-dimensional diagram. Assume, as in Figure 1, that an individual anticipates working either eight hours per day or not at all during his short-run horizon, and that he works in either occupation but not in both. To choose between the occupations, he will select the one which puts him on the higher indifference curve at a level of leisure equal to sixteen hours per day. This will necessarily be a corner solution.

Suppose that occupation q is preferred to occupation r. The indifference curves presented in Figure 4 are slices of the three-dimensional indifference map at $TPV_r = PV_0$. As in Figure 1, the distance OL_m represents twenty-four hours per day of leisure and OL_0 represents sixteen hours per day of leisure. The vertical axis measures TPV_q; the distance OPV_0 is the present value of expected nonwage earnings, while OPV_q-OPV_0 is the present value of adjusted expected earnings in occupation q. Given the assumptions stated above, points E and H

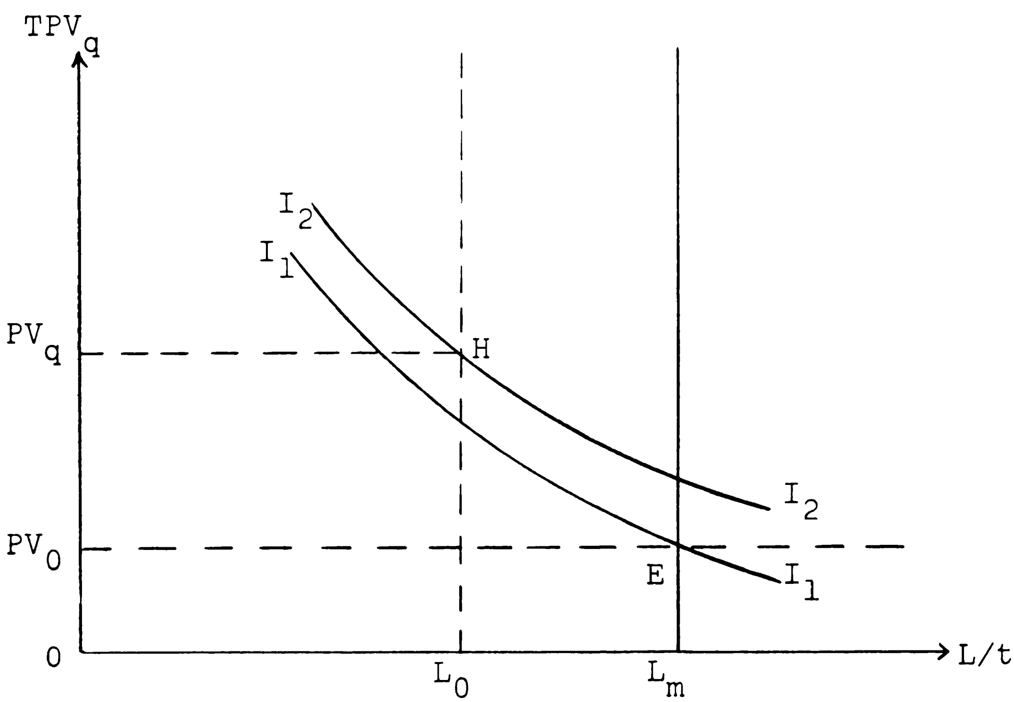

Figure 4.--Work-leisure choice incorporating the possibility of unemployment in an occupation.

are the only possible solutions. Since point H lies on a higher indifference curve than does point E, market labor in occupation q is preferred to specialization in leisure. The higher is PV_q, in general, the more likely an individual is to enter the qth occupation rather than to devote full-time to leisure. In this way, the level of PV_q enters an individual's supply of labor function to occupation q by determining the choice between this occupation and others, and, if occupation q is selected, it also determines the choice between the occupation and full-time leisure.

Now suppose that the ith individual obtains wage and unemployment information for m_i alternative occupations ($m_i \leq m$), including the qth occupation. Then the following m_i-dimensional vector is included as an argument in his supply function to the qth occupation:

$$(PV_1, \ldots, PV_{m_i}). \tag{2.20}$$

To simplify further, the following assumptions are made: (1) the direct costs of investment are a minor consideration in inter-occupational mobility; (2) the discount rate applied to the time streams of adjusted expected earnings is the same for all occupations; and (3) an unemployed worker assigns the same conditional probability distribution to all occupations, so that if $u_q^* = u_r^*$, the worker views the probability of being employed in occupation q at time t to be the same as in occupation r. Under this set of assumptions, (2.20) may be rewritten as

$$(2.21) \qquad (x_1^*, \ldots, x_{m_i}^*, u_1^*, \ldots, u_{m_i}^*).$$

It is mathematically equivalent to express this vector in the following manner:

$$(2.22) \qquad \left(\frac{x_q^*}{x_1^*}, \ldots, \frac{x_q^*}{x_{m_i}^*}, x_q^*, \frac{u_q^*}{u_1^*}, \ldots, \frac{u_q^*}{u_{m_i}^*}, u_q^*\right).$$

Up till now, no attention has been given to how the level of nonwage earnings is determined. Clearly, a number of variables are involved including the level of nonhuman wealth an individual possesses. In what follows, we continue to ignore the effect of fluctuations in nonwage income except for the important special case of "secondary workers," i.e., males younger than 25 years and older than 54 years of age and all females. Exactly the same principles of occupational choice outlined above apply in this case, except that one additional feature--the level of nonwage earnings--is given explicit consideration.

Most secondary workers are assured of a positive level of nonmarket income simply by virtue of being a family member and supplying their services within the family.[9] This is true except during periods in which the "primary" wage earner is unemployed. Therefore, the present value of expected nonwage earnings of a secondary worker over his short-run horizon depends on the expected employment position of the primary wage earner during this interval. It is assumed that the expected employment position is an inverse function of the current unemployment rate of married males, u_p. In terms of Figure 4, an increase in u_p is shown by a decrease in the distance OPV_0, and, hence, a downward movement of point E on the vertical line drawn perpendicular to the leisure axis at OL_m. The higher is u_p, the more likely it is that there will exist a wage offer which has a present value that exceeds the secondary worker's reservation price for market labor.[10]

The ith individual's supply function to the qth occupation may now be written as

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[9]The inclusion of family income in the labor supply functions of married women, the major component of total secondary workers, is theoretically and empirically treated in Mincer, "Labor Force Participation of Married Women: A Study of Labor Supply," pp. 63-97.

[10]This type of supply behavior is referred to in the literature as the "additional worker" hypothesis. According to this hypothesis, as the level of economic activity falls, labor force participation increases as secondary workers enter the market in an attempt to offset the loss of income by primary wage earners.

$$(2.23) \qquad \ell_{qi} = f_{qi}\left(\frac{x_q^*}{x_1^*},\ldots,\frac{x_q^*}{x_{mi}^*},x_q^*,\frac{u_q^*}{u_1^*},\ldots,\frac{u_q^*}{u_{m_i}^*},u_q^*,u_p,\eta_{qi}\right),$$

where η_{qi} is a random disturbance term reflecting the short-run impact of random nonmarket variables on the individual's labor market behavior.

Equation (2.23) is not an individual supply function in the usual sense of a worker supplying his services in a particular occupation if the expected wage rate exceeds his reservation price for entering the occupation. Instead, joint consideration is given the expected unemployment rate in the occupation. Viewed in this manner, the equation is correctly labeled a "probabilistic" supply function since it is the expected wage rate adjusted by the probability of employment through time in each occupation that is the crucial variable to the individual.

A worker either supplies his services to the qth occupation or he does not. Hence, equation (2.23) may be regarded as a step function where $\ell_{qi}=1$ if the worker enters occupation q, and $\ell_{qi}=0$ if he does not. Aggregating across individuals, the probabilistic supply function to the qth occupation takes the following form:

$$(2.24) \qquad \tilde{\ell}_q^s = H_q\left(\frac{x_q^*}{x_1^*},\ldots,\frac{x_q^*}{x_m^*},x_q^*,\frac{u_q^*}{u_1^*},\ldots,\frac{u_q^*}{u_m^*},u_q^*,u_p,\eta_q\right) \quad (q=1,\ldots,m),$$

where $\tilde{\ell}_q^s$ is the number of workers who are willing to supply their services in the qth occupation, and η_q is the sum of the individual disturbances.[11] If we assume that equation (2.24) is a continuously differentiable function, the partial derivatives are assumed to have the following signs:

$$(2.25) \qquad \frac{\partial H_q}{\partial \left[\frac{x_q^*}{x_i^*}\right]} > 0 \; (i \neq q); \; \frac{\partial H_q}{\partial x_q^*} > 0; \; \frac{\partial H_q}{\partial \left[\frac{u_q^*}{u_i^*}\right]} < 0;$$

$$\frac{\partial H_q}{\partial u_q^*} < 0; \; \frac{\partial H_q}{\partial u_p} > 0.$$

The vector of expected wage rates and the variable u_p are representative of arguments similar to those frequently found in ordinary supply functions. The test of the probabilistic supply function specified here is whether or not the vector of expected unemployment rate variables is significant in the empirical analysis of the model.

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[11]The aggregation process used to obtain (2.24) involves the assumption that all individuals' short-run time horizons are approximately the same length. In addition, the aggregation assumes that each individual calculates the present value of adjusted expected earnings using the same discount rate. This would be the case if all individuals could borrow and lend in the capital market at the same rate of interest.

IV. The Complete Model

In this section, the model is formulated in terms of distinct time periods so that it is readily amenable to empirical testing using discrete data. The variables in the model are now defined as follows:

$\tilde{\ell}^d_{qt}$ = number of members of occupation q which firms desire to employ at the beginning of period t;

ℓ^d_{qt} = number of positions filled by individual members of occupation q in period t;

$\tilde{\ell}^s_{qt}$ = number of workers who desire to provide their services in occupation q at the beginning of period t;

ℓ^s_{qt} = number of members of the qth occupation employed in period t;

U_{qt} = number of unemployed members of occupation q in period t;

w^*_{qt} = wage which firms expect to pay members of occupation q at the beginning of period t;

x^*_{qt} = wage expected in occupation q by labor suppliers at the beginning of period t;

w_{qt} = market wage in the qth occupation in period t;

u^*_{qt} = expected unemployment rate in occupation q at the beginning of period t;

u_{pt} = unemployment rate of married males in period t; and

$\tilde{y}_{jt}$ = desired level of output of industry j at the beginning of period t.

The model developed thus far for the qth occupational group consists of the following system of equations for period t:

$$(2.26)\qquad \tilde{\ell}^d_{qt} = G_q(w^*_{1t},\ldots,w^*_{mt},\tilde{y}_{1t},\ldots,\tilde{y}_{Mt},\varepsilon_{qt})$$

$$(2.27)\qquad \tilde{\ell}^s_{qt} = H_q\left(\frac{x^*_{qt}}{x^*_{1t}},\ldots,\frac{x^*_{qt}}{x^*_{mt}},x^*_{qt},\frac{u^*_{qt}}{u^*_{1t}},\ldots,\frac{u^*_{qt}}{u^*_{mt}},u^*_{qt},u_{pt},\eta_{qt}\right)$$

$$(2.28)\qquad U_{qt} \equiv \tilde{\ell}^s_{qt} - \tilde{\ell}^d_{qt} \qquad (q=1,\ldots,m),$$

where $u_{qt} = U_{qt}/\tilde{\ell}^s_{qt}$. Equation (2.26) is the market demand function, equation (2.27) is the market supply function, and (2.28) is a definitional equation. The relationships between $\tilde{\ell}^d_{qt}$ and ℓ^d_{qt} and between $\tilde{\ell}^s_{qt}$ and ℓ^s_{qt} are the following:

(i) If $\tilde{\ell}^s_{qt} > \tilde{\ell}^d_{qt}$ (i.e., $U_{qt}>0$), then

$$\tilde{\ell}^d_{qt} = \ell^d_{qt} \text{ and } \tilde{\ell}^s_{qt} - \ell^s_{qt} = U_{qt}.$$

(ii) If $\tilde{\ell}^s_{qt} < \tilde{\ell}^d_{qt}$ (i.e., $U_{qt}<0$), then

$$\tilde{\ell}^s_{qt} = \ell^s_{qt} \text{ and } \tilde{\ell}^d_{qt} - \ell^d_{qt} = U_{qt}.$$

It is clear that $\ell^d_{qt} \equiv \ell^s_{qt}$.

In Part A of this section, a set of equations determining the desired vector of industry output is specified. Then in Parts B and C, expectations mechanisms are formulated for the vectors of expected wage and unemployment rates. A set of equations determining the current wage vector is described in Part D. In the final part of the section, Part E, the complete model is drawn together.

A. Determination of the Desired Vector of Industry Output

The firm simultaneously determines its desired rate of output and its desired level of employment; therefore, a set of equations determining the desired output vector must be developed. For our purposes, a very simple output determination model is specified. However, it is recognized that a more detailed treatment of this problem might be desirable.

Because the firm must operate under conditions of uncertainty, we assume that it utilizes a bit of information it does possess, namely, last period's sales, to determine its desired output level. At the beginning of period t, this assumption may be written as

$$(2.29) \qquad \tilde{y}_{ijt} = f_{ij}(s_{ijt-1}) \qquad (i=1,\ldots,n_j;j=1,\ldots,M),$$

where s_{ijt-1} is the sales volume of the ith firm in the jth industry in period t-1. Assuming a fixed composition of the industry, the desired level of output for industry j at the beginning of period t is

$$\tilde{y}_{jt} = f_j(s_{jt-1}), \tag{2.30}$$

where s_{jt-1} is the sales of industry j in period t-1.

B. Determination of Firm and Worker Expectations of Wage Rates

Firm Expectations.--Given a change in the level or composition of product demand, there are two cases to be considered from the point of view of firms in the jth industry. First, suppose that the demand for the "own" product increases. Each firm in the industry now finds it desirable to increase output, and, consequently, expand its labor force in order to maximize profits. One alternative facing firms which find it necessary to attract additional workers is to increase their wage offers.[12] Hence, a change in the wages offered in industry j may be assumed to be a function of the change in the demand for the product produced by the industry.

Now suppose that the product demand facing the jth industry is constant or declining, but other industries

[12] Examples of nonwage alternatives are increasing expenditures on search, revising productivity standards downward, upgrading existing employees, and expanding on-the-job training programs.

are enjoying an increase in demand. It is likely that some of these industries employ members of the same occupations as are employed in industry j, or that some other "spill-over" relationship exists between the wages paid in these industries and in industry j. If so, the firms in industry j may find that they have to raise the wages paid to workers they desire to keep on their payrolls in order to match wage offers made by industries in more favorable demand situations. Consequently, the wages offered in industry j are not only a function of the "own" change in product demand, but they are also a function of the changes in product demand facing other industries.

An increase in demand for the product produced by an industry is observable in a decrease in inventories and/or an increase in product price. The volume of sales of an industry is measured in nominal terms. Thus, a positive change in sales may measure either the drawing down of inventories, i.e., an increase in the physical quantity of output sold, or an increase in the price at which each unit of the product is sold. Both situations indicate to the profit-maizimzing firm that a larger level of output, and, hence, a larger labor force, would be desirable. Using sales as a proxy for industry demand, we specify that the wage firms in industry j expect to pay the members of occupation q at the beginning of period t is

$$(2.31) \qquad w^*_{qjt} = w_{qjt-1} + g_{qj}(\Delta s_{1t-1},\ldots,\Delta s_{M_j t-1}),$$

where w_{qjt-1} = wage paid by firms in the jth industry to members of occupation q in period t-1;

M_j = number of industries whose sales affect the wage paid by firms in the jth industry to members of the qth occupation, $1 \leq j \leq M_j$;

s_{jt-1} = sales of industry j in period t-1; and

$\Delta s_{jt-1} = s_{jt-1} - s_{jt-2}$.

Assuming a given industry composition of the economy, aggregation across all industries yields:

$$(2.32) \qquad w^*_{qt} = w_{qt-1} + g_q(\Delta s_{1t-1},\ldots,\Delta s_{Mt-1}) \quad (q=1,\ldots,m).$$

In this equation, the variable w^*_{qt} may be interpreted as an average of the distribution of industry expected wage rates and w_{qt-1} as an average of industry wages paid in the last period.

Worker Expectations.--Turning to the supply side of the model, it is simply assumed that workers set their reservation prices equal to the wage they last earned in the occupation of their choice. They have every reason to believe that at this wage they were receiving the value of their marginal product. Hence, they believe that other employers will be willing to offer them the same wage. This expectation is justified except in a situation of a general decrease in demand. In this case, the worker perceives the necessity of reducing his reservation price only after he has invested the time to obtain information on his alternative employment opportunities.[13] As a short-run first approximation, it is assumed that workers expect the wage structure existing last period to carry over into the current period, that is, $x^*_{qt} = w_{qt-1}$ $(q=1,\ldots,m)$.

C. Determination of the Vector of Expected Unemployment Rates

It is hypothesized that at the beginning of period t, an individual adjusts his expectation of the unemployment rate in the qth occupation in proportion to the discrepancy in the previous period between the market determined unemployment rate (u_{qt-1}) and the rate he expected to exist at the beginning of the period (u^*_{qt-1}). In addition, we assume that the ratio of the expected unemployment rate in occupation q to each of the expected unemployment rates in the other m-1 occupations is

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[13] In his study of unemployed Minnesota workers, Hirschel Kasper found that for each month of unemployment, workers were willing to reduce their reservation prices by only 0.3 per cent. In fact, Kasper suggests that workers who have been unemployed less than six months often have reservation prices which exceed their former wages. "The Asking Price of Labor and the Duration of Unemployment," Review of Economics and Statistics, XLVIV (May, 1967), pp. 165-172. For a summary of this and other studies of the time path of reservation prices see Holt, op. cit., pp. 59-65.

determined in the same manner. This hypothesis may be written as

$$(2.33)\qquad u^*_{qt} - u^*_{qt-1} = (1 - \delta_q)(u_{qt-1} - u^*_{qt-1}),$$

and

$$(2.34)\qquad \left(\frac{u^*_{qt}}{u^*_{it}}\right) - \left(\frac{u^*_{qt-1}}{u^*_{it-1}}\right) = (1 - \delta_q)\left[\left(\frac{u_{qt-1}}{u_{it-1}}\right) - \left(\frac{u^*_{qt-1}}{u^*_{it-1}}\right)\right]$$

$$(i=1,\ldots,m; i\neq q),$$

where $0<\delta_q<1$. The coefficient $(1 - \delta_q)$ determines the speed at which the expected unemployment rate (ratio of unemployment rates) is adjusted to the difference between the actual and the expected rate (ratios) in the previous period. Equation (2.34) may be equivalently written as

$$(2.35)\qquad \left(\frac{u^*_{qt}}{u^*_{it}}\right) = (1 - \delta_q)\left[\left(\frac{u_{qt-1}}{u_{it-1}}\right) + \delta_q\left(\frac{u_{qt-2}}{u_{it-2}}\right) + \delta_q^{\,2}\left(\frac{u_{qt-3}}{u_{it-3}}\right) + \ldots + \delta_q^{\,n}\left(\frac{u_{q,t-n-1}}{u_{i,t-n-1}}\right) + \ldots\right].$$

The level of unemployment of married males (U_p) is an endogenous variable determined by the relation $U_{pt} = \sum_{q=1}^{m} c_{qt}U_{qt}$, where c_{qt} is the proportion of married males in occupation q in period t. Since we are not particularly interested in the time path of U_{pt}, some occupations are conveniently excluded from the empirical analysis in Chapter III so that $U_{qt} \neq U_t$, where U_t is total unemployment in period t. Therefore, the unemployment rate of married males (u_p) is assumed to be exogenously determined in Chapter III. To simplify the presentation of the model, u_p will also be assumed to be exogenous in this chapter.

D. Determination of the Vector of Current Wage Rates

To complete the model, all that remains to be done is to specify a set of relationships determining the vector of wage rates in period t. On the basis of the previous discussion, it is hypothesized that the rate of adjustment in the quantities of labor demanded in occupational labor markets exceeds the rate of adjustment in the corresponding wage rates. Hence, we assume that the change in a market wage rate is inversely proportional to the change in the level of unemployment in the occupation. That is, we specify the following relationship for occupation q in period t:

$$(2.36) \qquad \Delta w_{qt} = k_q(\Delta U_{qt}) \qquad (q=1,\ldots,m; k_q<0),$$

where $\Delta w_{qt} = w_{qt} - w_{qt-1}$,

$\Delta U_{qt} = U_{qt} - U_{qt-1}$, and

k_q is defined to have the appropriate dimension.

E. Consolidating the Model

Consider first the demand side of the model which consists of the following 2m+M equations:

$$(2.37) \qquad \tilde{\ell}^{d}_{qt} = G_q(w^*_{1t},\ldots,w^*_{mt},\tilde{y}_{1t},\ldots,\tilde{y}_{Mt},\varepsilon_{qt})$$

$$(2.38) \qquad \tilde{y}_{jt} = f_j(s_{jt-1}) \qquad (j=1,\ldots,M)$$

$$(2.39) \qquad w^*_{qt} = w_{qt-1} + g_q(\Delta s_{1t-1},\ldots,\Delta s_{Mt-1}) \qquad (q=1,\ldots,m).$$

Substituting equations (2.38) and (2.39) into (2.37) yields:

$$(2.40) \qquad \tilde{\ell}^{d}_{qt} = F_q(w_{1t-1},\ldots,w_{mt-1},s_{1t-1},\ldots,s_{Mt-1},$$

$$\Delta s_{1t-1},\ldots,\Delta s_{Mt-1},\varepsilon_{qt}).$$

After assuming a linear approximation of this set of equations, we have

$$(2.41) \qquad \tilde{\ell}^{d}_{qt} = a_{q0} + a_{q1}w_{1t-1} + \ldots + a_{qm}w_{mt-1} + b_{q1}s_{1t-1}$$

$$+ \ldots + b_{qM}s_{Mt-1} + f_{q1}\Delta s_{1t-1} + \ldots$$

$$+ f_{qM}\Delta s_{Mt-1} + \varepsilon_{qt}.$$

The supply side of the model is comprised by the following system of 3m equations:

$$(2.42)\qquad \tilde{\ell}^{s}_{qt} = H_q\left(\frac{x^*_{qt}}{x^*_{1t}},\ldots,\frac{x^*_{qt}}{x^*_{mt}},x^*_{qt},\frac{u^*_{qt}}{u^*_{1t}},\ldots,\frac{u^*_{qt}}{u^*_{mt}},u^*_{qt},u_{pt},\eta_{qt}\right)$$

$$(2.43)\qquad x^*_{qt} = w_{qt-1}$$

$$(2.44)\qquad u^*_{qt} - u^*_{qt-1} = (1-\delta_q)(u_{qt-1} - u^*_{qt-1})$$

$$(2.45)\qquad \left(\frac{u^*_{qt}}{u^*_{it}}\right) - \left(\frac{u^*_{qt-1}}{u^*_{it-1}}\right) = (1-\delta_q)\left[\left(\frac{u_{qt-1}}{u_{it-1}}\right) - \left(\frac{u^*_{qt-1}}{u^*_{it-1}}\right)\right]$$

$$(i=1,\ldots,m; i\neq q).$$

Linearizing equation (2.42) and then substituting equation (2.43), we obtain:

$$(2.46)\qquad \tilde{\ell}^{s}_{qt} = c_{q0} + c_{q1}\left(\frac{w_{qt-1}}{w_{1t-1}}\right) + \ldots + c_{qm}\left(\frac{w_{qt-1}}{w_{mt-1}}\right)$$

$$+ c_{qm+1}w_{qt-1} + d_{q1}\left(\frac{u^*_{qt}}{u^*_{q1}}\right) + \ldots + d_{qm}\left(\frac{u^*_{qt}}{u^*_{qm}}\right)$$

$$+ d_{qm+1}u^*_{qt} + e_q u_{pt} + \eta_{qt}.$$

Now substituting equations (2.44) and (2.45) into (2.46) and applying the Koyck transformation, the following equation is obtained:

$$(2.47) \qquad \tilde{\ell}^{s}_{qt} = (1 - \delta_q)c_{q0} + \delta_q \tilde{\ell}^{s}_{qt-1} + c_{q1}\left(\frac{w_{gt-1}}{w_{1t-1}}\right)$$

$$- \delta_q c_{q1}\left(\frac{w_{qt-2}}{w_{1t-2}}\right) + \ldots + c_{qm}\left(\frac{w_{qt-1}}{w_{mt-1}}\right)$$

$$- \delta_q c_{qm}\left(\frac{w_{gt-2}}{w_{mt-2}}\right) + c_{qm+1}w_{qt-1} - \delta_q c_{qm+1}w_{qt-2}$$

$$+ (1 - \delta_q)d_{q1}\left(\frac{u_{qt-1}}{u_{1t-1}}\right) + \ldots$$

$$+ (1 - \delta_q)d_{qm}\left(\frac{u_{qt-1}}{u_{mt-1}}\right) + (1 - \delta_q)d_{qm+1}u_{qt-1}$$

$$+ e_q u_{pt} - \delta_q u_{pt-1} + \eta_{qt} - \delta_q \eta_{qt-1}.$$

The complete model now consists of the following 3m equations and m definitional equations in the variables $\tilde{\ell}^{d}_{qt}$, $\tilde{\ell}^{s}_{qt}$, U_{qt}, and w_{qt}:

$$(2.48) \qquad \tilde{\ell}^{d}_{qt} = a_{q0} + a_{q1}w_{1t-1} + \ldots + a_{qm}w_{mt-1} + b_{q1}s_{1t-1}$$

$$+ \ldots + b_{qM}s_{Mt-1} + f_{q1}\Delta s_{1t-1} + \ldots$$

$$+ f_{qM}\Delta s_{Mt-1} + \varepsilon_{qt}$$

$$(2.49)\qquad \tilde{\ell}^{s}_{qt} = (1 - \delta_q)c_{q0} + \delta_q\tilde{\ell}^{s}_{qt-1} + c_{q1}\left(\frac{w_{qt-1}}{w_{1t-1}}\right)$$

$$- \delta_q c_{q1}\left(\frac{w_{qt-2}}{w_{1t-2}}\right) + \ldots + c_{qm}\left(\frac{w_{qt-1}}{w_{mt-1}}\right)$$

$$- \delta_q c_{qm}\left(\frac{w_{qt-2}}{w_{mt-2}}\right) + c_{qm+1}w_{qt-1} - \delta_q c_{qm+1}w_{qt-2}$$

$$+ (1 - \delta_q)d_{q1}\left(\frac{u_{qt-1}}{u_{1t-1}}\right) + \ldots$$

$$+ (1 - \delta_q)d_{qm}\left(\frac{u_{qt-1}}{u_{mt-1}}\right) + (1 - \delta_q)d_{qm+1}u_{qt-1}$$

$$+ e_q u_{pt} - \delta_q e_q u_{pt-1} + \eta_{qt} - \delta_q \eta_{qt-1}.$$

$$(2.50)\qquad w_{qt} - w_{qt-1} = k_q(U_{qt} - U_{qt-1})$$

$$(2.51)\qquad U_{qt} \equiv \ell^{s}_{qt} - \ell^{d}_{qt} \qquad (q=1,\ldots,m).$$

Equations (2.48) and (2.49) are already in reduced form. Eliminating the identities, the system of equations may be written in matrix form as follows:

$$(2.52)\qquad \underline{B}_q\underline{Y} - \underline{\Gamma}_q\underline{X} = \underline{V} \qquad (q=1,\ldots,m),$$

where $\underline{B}_q = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ k_q & -k_q & 1 \end{bmatrix}$, $\underline{Y} = \begin{bmatrix} \tilde{\ell}^d_{qt} \\ \tilde{\ell}^s_{qt} \\ w_{qt} \end{bmatrix}$,

$$\underline{\Gamma}_q = \left[\begin{array}{ccc|cccccc|cc} A & B & F & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \delta_q & C & -\delta_q C & (1-\delta_q)D & e_q & -\delta_q e_q & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -k_q \end{array}\right],$$

$$\underline{X} = \left[W_{t-1} \; S_{t-1} \; \Delta S_{t-1} \,\middle|\, \tilde{\ell}^s_{qt-1} \; W^R_{t-1} \; W^R_{t-2} \; U^R_{t-1} \; u_{pt} \; u_{pt-1} \,\middle|\, w_{qt-1} \; U_{qt-1}\right]',$$

$$\underline{V} = \begin{bmatrix} \varepsilon_{qt} \\ \eta_{qt} - \delta_q \eta_{qt-1} \\ 0 \end{bmatrix},$$

and $A = (a_{q0}, a_{q1}, \ldots, a_{qm})$

$B = (b_{q1}, \ldots, b_{qM})$

$F = (f_{q1}, \ldots, f_{qM})$

$C = (c_{q0}, c_{q1}, \ldots, c_{qm}, c_{qm+1})$

$D = (d_{q1}, \ldots, d_{qm}, d_{qm+1})$

$W_{t-1} = (1, w_{1t-1}, \ldots, w_{mt-1})$

$S_{t-1} = (s_{1t-1}, \ldots, s_{Mt-1})$

$$\Delta S_{t-1} = (\Delta s_{1t-1},\ldots,\Delta s_{Mt-1})$$

$$W^R_{t-1} = (1,\frac{w_{qt-1}}{w_{1t-1}},\ldots,\frac{w_{qt-1}}{w_{mt-1}},w_{qt-1})$$

$$W^R_{t-2} = (1,\frac{w_{qt-2}}{w_{1t-2}},\ldots,\frac{w_{qt-2}}{w_{mt-2}},w_{qt-2})$$

$$U^R_{t-1} = (\frac{u_{qt-1}}{u_{1t-1}},\ldots,\frac{u_{qt-1}}{u_{mt-1}},u_{qt-1})$$

The inverse of the coefficient matrix of the current endogenous variables is

$$(2.53) \qquad \underline{B}^{-1} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ -k_q & k_q & 1 \end{bmatrix},$$

so that the parameter k_q does not enter either of the two stochastic equations, (2.48) or (2.49).

CHAPTER III

THE DATA AND THE ESTIMATION PROCEDURE

The purpose of this chapter is to construct an empirical test of the model developed in Chapter II. Our intent is to determine the extent to which the variables proposed in the theoretical analysis are able to account for variations through time in the structure of occupational unemployment. In Section I, we discuss the data used in representing the variables of the model. Then in Section II, the model is condensed to make it manageable for regression analysis, and the estimation techniques used in testing are discussed.

I. The Data

The variables included in the model constructed in the previous chapter are defined as follows:

$\tilde{\ell}^d_{qt}$ = number of members of occupation q desired by employers at the beginning of period t;

$\tilde{\ell}^s_{qt}$ = number of members of occupation q who desire to work at the beginning of period t;

U_{qt} = number of unemployed members of occupation q in period t;

w_{qt-1} = wage rate in occupation q in period t-1;

u_{qt-1} = unemployment rate in occupation q in period t-1;

s_{jt-1} = sales of industry j in period t-1; and

u_{pt} = unemployment rate of married males in period t.

United States time-series data for six major occupational groups and six industries are collected to measure these variables. The six occupational groups are clerical workers, sales workers, service workers, craftsmen and foremen, operatives, and laborers; and the six industries are contract construction, durable good manufacturing, nondurable good manufacturing, wholesale trade, retail trade, and services. The time period examined is from January, 1958 to December, 1966--a total of 108 monthly observations on each variable.

In 1959 the six industries listed above employed 59.4 per cent of employed clerical workers, 85.4 per cent of employed sales workers, 84.3 per cent of employed service workers, 73.8 per cent of employed craftsmen and foremen, 84.2 per cent of employed operatives, and 76.6 per cent of employed laborers.[1]

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[1]These percentages were calculated from U. S. Department of Commerce, Bureau of the Census, U. S. Census of Population: 1960, Subject Reports, Occupation by Industry, Table 1.

The Bureau of Labor Statistics (BLS) publishes monthly seasonally adjusted level of employment and unemployment rate data for the eleven major occupational groups going back to January, 1958.[2] It should be mentioned at the onset that there are at least two difficulties inherent in using these occupational data. First, the major occupational groups are composed of a large number of specific occupations so that in using these data, we are not examining supply and demand decisions in well defined labor markets. Second, in the collection of these data, the BLS places an unemployed worker in a particular occupation according to his last job. However, there are likely to be numerous cases in which in his last job the worker did not work as a member of the occupation for which he is trained and of which he considers himself a member. Consequently, these unemployment data may not accurately reflect the true distribution of the unemployed by their chosen occupations.

The BLS publication Employment and Earnings provides monthly seasonally adjusted data measuring the unemployment rate of married males.

In every time period, the unemployment rate in each occupation considered is observed to be positive.

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[2] U. S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings and Monthly Report on the Labor Force, Vol. 14 (July, 1967).

Therefore, we assume that the desired quantity of labor demanded at the beginning of period t is always satisfied during the period so the $\tilde{\ell}^d_{qt} = \ell_{qt}$, where ℓ_{qt} is the number of employed workers in occupation q in period t. It follows from our definition of unemployment that $\tilde{\ell}^s_{qt} = \ell_{qt} + U_{qt}$. Using BLS data on the level of unemployment and the unemployment rate in the qth occupation in period t, the desired labor supply in the occupation at the beginning of period t is calculated by

$$(3.1) \qquad \tilde{\ell}^s_{qt} = \frac{\ell_{qt}}{1-u_{qt}} \qquad (q=1,\ldots,6).$$

Data published by the Office of Business Economics (OBE) are collected to measure the sales of the six industries specified above.[3] Monthly seasonally adjusted estimates of sales are used for the durable and nondurable manufacturing sectors and for wholesale and retail stores. The final sales of services in the OBE estimate of GNP by major type are employed to measure the sales of the services sector. Since these data for the services sector are published only quarterly, it is assumed that the changes in the series between quarters are linear so that monthly estimates can be obtained.[4] The F. W.

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[3]The sales series are taken from U. S. Department of Commerce, Office of Business Economics, Business Statistics, 1967.

[4]The monthly estimates obtained on the basis of this assumption involve measurement errors so that

Dodge Company seasonally adjusted index of the value of construction contracts in 48 states is used as a proxy for the sales of the contract construction sector.

Published time-series data measuring wage rates in occupational groups are not available. Consequently, the wage rates specified in the model must be estimated from the earnings data that are available, namely, monthly estimates of gross average weekly earnings of production and related workers by industry[5] and median annual earnings of the experienced labor force who worked 50 to 52 weeks in 1959 by detailed occupation.[6] As noted previously, the 1960 Census of Population provides industry employment data cross-classified by occupational groups.[7]

A number of estimators of the wage rate in an occupation, say the qth occupation, may be constructed

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regression analysis applied to these data yields inconsistent parameter estimates. It is assumed that the inconsistency introduced by interpolating is small enough to be ignored.

[5]U. S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for the United States--1909-1967, Bulletin No. 1312-5.

[6]U. S. Department of Commerce, Bureau of the Census, U. S. Census of Population: 1960, Subject Reports, Occupational Characteristics, Table 30.

[7]U. S. Department of Commerce, Bureau of the Census, Occupation by Industry, Tables 1 and 2.

from these data. The estimator presented here seemed to require the least restrictive assumptions of those considered.

The following assumptions are employed in the construction of the estimator: (1) the wage paid to members of the qth occupation by firms in the jth industry changes in proportion to the average wage paid by the industry, and (2) the number of employed workers of the qth type per dollar of output (ℓ_{qj}/y_j) is constant for the jth industry. The assumption that ℓ_{qj}/y_j is constant over the 1958-66 period implies that the average product of the qth labor input is fixed for each industry. For all six variable inputs, this in turn implies that if the output of a particular industry doubles, its rate of use of all inputs must also double. But this can be true only if each firm produces according to a linearly homogeneous production function. Assuming linear homogeneity does not seem too unreasonable.

The output measures are constructed as follows for each industry. The measure employed for durable and nondurable manufacturing and wholesale and retail trade is current sales plus the change in inventories from the end of the previous period, this sum deflated by an appropriate price index.[8] The sale of services deflated by the

[8] The source of the inventory series and the price indices is U. S. Department of Commerce, Office of Business Economics, op. cit.

services component of the Consumer Price Index (CPI) is the output measure used for the services sector. Finally, the value of new construction put-in-place (seasonally adjusted) deflated by the Commerce Department's Composite Construction Cost Index is used to measure the output of the construction sector.

Based on the two assumptions listed above, the estimate of the wage in occupation q in period t is

$$(3.2) \qquad \hat{W}_{qt} = \frac{\sum_{j=1}^{6}\left[\left(\frac{l_{qjB}}{y_{jB}}\right)\left(\frac{W_{jt}}{W_{jB}}\right)W_{qjB}\right]}{\sum_{j=1}^{6}\left(\frac{l_{qjB}}{y_{jB}}\right)} \qquad (q=1,\ldots,6),$$

where

B = base year 1959;

ℓ_{qjB} = number of members of occupation q employed by industry j in the base year;

y_{jB} = output of the jth industry in the base year measured in dollar terms;

W_{jt} = average weekly wage paid by the jth industry in period t;

W_{jB} = average weekly wage paid by the jth industry in the base year; and

W_{qjB} = median annual wage paid to the male members of the qth occupation by the jth industry in the base year.

The 1960 Census of Population provides annual earnings data by detailed occupations; but a significant fraction of the workers in each major occupation group, with the exception of service workers, is defined to be "not elsewhere classified." Each of these n.e.c. categories is broken down to a greater or lesser degree by industry. Thus, for five of the six occupation groups, we can utilize the variable W_{qjB}. But for service workers, this variable must be replaced by W_{qB}. Here, the year 1959 may be interpreted as an equilibrium period so that the wage paid to service workers is the same across all industries which employ them.

Within the services sector, time-series earnings data are published for hotels, tourist courts, and motels; laundries and dry cleaning plants; and motion picture filming and distributing. Unfortunately, these three industries employ only a small percentage of the total number of workers employed in the services sector. As a proxy for the ratio W_{jt}/W_{jB}, we use employment in the services sector in period t relative to the total employment in the sector in the base period. The use of this proxy assumes that the elasticity of the aggregate supply function of all types of workers to the services sector is unitary over the relevant range.

The wage measure specified in (3.2) is in nominal terms. Since individual workers and firms make decisions on the basis of real variables, our wage measure should be adjusted for changes in prices during the 1958-66 period. The CPI is intended to measure changes in the prices of goods and services bought by urban wage earners and clerical workers. Hence, it is a particularly appropriate measure of the price changes facing the members of the six occupations we are considering. Deflating (3.2) by the CPI, our measure of the real wage in occupation q as seen by labor suppliers in period t is

$$\hat{w}^s_{qt} = \frac{\hat{W}_{qt}}{(CPI)_t} \qquad (q=1,\ldots,6), \tag{3.3}$$

where $(CPI)_{1959} = 100$.

For the wage variables appearing in the demand equations, the price deflators used are indices of product prices for the six industries examined. The specific indices are the Construction Cost Index (construction), the Wholesale Price Index--Manufacturers (durable and nondurable good manufacturing), the Wholesale Price Index--All Commodities (wholesale trade), and the CPI--Commodities (retail trade). The proxy used for the ratio W_{jt}/W_{jB} in the services sector makes it unnecessary to use a price deflator since we assume that employment in an industry adjusts to changes in real wages. The measure of the real wage in occupation q viewed by employers in period t is constructed as follows:

$$\hat{w}^d_{qt} = \frac{\sum_{j=1}^{6} \left\{ (\ell_{qjB}/y_{jB}) \left[\frac{\left(\frac{W_{jt}}{PI_{jt}/PI_{jB}} \right)}{W_{jB}} \right] W_{qjB} \right\}}{\sum_{j=1}^{6} (\ell_{qjB}/y_{jB})} \quad (q=1,\ldots,6),$$

where PI_{jt} is the relevant price deflator for industry j in period t.

II. The Estimation Procedure

In this section, *a priori* information is applied to the model for the purpose of reducing the number of parameters to be estimated to a more manageable number. In the process, we will hopefully remove some of the multicollinearity which is likely to be encountered in estimation. After the model has been condensed, the estimation techniques applied to the model are described.

From Chapter II, the system of equations to be estimated is writen as follows for m=M=6:[9]

$$(3.5) \quad \tilde{\ell}^d_{qt} = a_{q0} + a_{q1}\hat{w}_{1t-1} + \ldots + a_{q6}\hat{w}_{6t-1} + b_{q1}s_{1t-1} + \ldots + b_{q6}s_{6t-1} + f_{q1}\Delta s_{1t-1} + \ldots + f_{q6}\Delta s_{6t-1} + \varepsilon_{qt}.$$

[9]The d and s superscripts on the two vectors of real wage variables are omitted for convenience. However, it should be kept in mind that different real wage vectors appear in the supply and the demand equations.

$$(3.6)\quad \tilde{\ell}^s_{qt} = (1-\delta_q)c_{q0} + \delta_q\tilde{\ell}^s_{qt-1} + c_{q1}\left(\frac{\hat{w}_{qt-1}}{\hat{w}_{1t-1}}\right)$$

$$- \delta_q c_{q1}\left(\frac{\hat{w}_{qt-2}}{\hat{w}_{1t-2}}\right) + \ldots + c_{q6}\left(\frac{\hat{w}_{qt-1}}{\hat{w}_{6t-1}}\right)$$

$$- \delta_q c_{q6}\left(\frac{\hat{w}_{qt-2}}{\hat{w}_{6t-2}}\right) + c_{q7}\hat{w}_{qt-1} - \delta_q c_{q7}\hat{w}_{qt-2}$$

$$+ (1-\delta_q)d_{q1}\left(\frac{u_{qt-1}}{u_{1t-1}}\right) + \ldots$$

$$+ (1-\delta_q)d_{q6}\left(\frac{u_{qt-1}}{u_{6t-1}}\right) + (1-\delta_q)d_{q7}u_{qt-1}$$

$$+ e_q u_{pt} - \delta_q e_q u_{pt-1} + \eta_{qt} - \delta_q\eta_{qt-1}$$

$$(q=1,\ldots,6).$$

We expect that autocorrelation exists in both disturbance terms ε_{qt} and η_{qt} because it is likely that the effect of random shocks on the system spills over from one monthly time period into the next. In particular, we assume that ε_{qt} satisfies the first-order autoregressive process

$$(3.7)\quad \varepsilon_{qt} = \rho_q\varepsilon_{qt-1} + \partial_{qt},$$

where the ∂_{qt}'s are normally and independently distributed, each with zero mean and common variance σ^2_{qd}, that is, NID$(0,\sigma^2_{qd})$. Similarly, we assume that η_{qt} satisfies the first-order autoregressive process

$$(3.8) \qquad \eta_{qt} = \xi_q \eta_{qt-1} + \pi_{qt},$$

where the π_{qt}'s are NID$(0,\sigma^2_{qs})$.

One method of consolidating the wage vector in equation (3.5) is to retain the own wage and construct a weighted average of the other five wage rates. The optimal weighting scheme would employ as weights the marginal rates of technical substitution between the members of one occupation and the members of each of the other occupations. However, in the absence of information on the marginal rates of technical substitution between the broad occupational groups employed here, it is assumed that $\tilde{\ell}^d_q$ is a function only of the own wage rate in the wage vector, i.e., $a_{qi}=0$ $(i\neq q)$ in equation (3.5).

Suppose that the components of the sales vector are numbered in the following order: construction, 1; durable good manufacturing, 2; nondurable good manufacturing, 3; wholesale trade, 4; retail trade, 5; and services, 6. The number of arguments in the labor demand function can also be reduced by constructing summary measures of the sales and change in sales vectors. Note, however, that the sales variable for the construction sector is in different units than the sales variables for the other industries; hence, it cannot be included in a summary measure. Assume that

$$(3.9) \qquad b_{q2} = B_q\left(\frac{\ell_{q2B}}{y_{2B}}\right) \qquad f_{q2} = F_q\left(\frac{\ell_{q2B}}{y_{2B}}\right)$$

$$\vdots \qquad\qquad\qquad \vdots$$

$$b_{q6} = B_q\left(\frac{\ell_{q6B}}{y_{6B}}\right) \qquad f_{q6} = F_q\left(\frac{\ell_{q6B}}{y_{6B}}\right),$$

where (ℓ_{qjB}/y_{jB}) $(j=2,\ldots,6)$ is the number of workers of the qth type employed in the jth industry in the base period per dollar of output of the jth industry in the base period. This is much the same weighting scheme employed in the construction of the wage variables in (3.2), and the same assumptions apply. Now equation (3.5) may be rewritten as

$$(3.10) \qquad \tilde{\ell}^d_{qt} = a_{q0} + a_q\hat{w}_{qt-1} + B_q\bar{s}_{qt-1} + F_q(\bar{s}_{qt-1}-\bar{s}_{qt-2})$$

$$+ b_{q1}s_{1t-1} + f_{q1}(s_{1t-1}-s_{1t-2}) + \varepsilon_{qt},$$

where $\bar{s}_{qt-1} = \sum_{j=2}^{6}(\ell_{qjB}/y_{jB})s_{jt-1}$. The variable $\bar{s}_{qt-1}$ should be interpreted as an index of the product demand facing the industries which employ members of the qth occupation. The sales variables for the construction sector will be included only in the equations for craftsmen and foremen, operatives, and laborers since the industry is not a major employer of white-collar and service workers.

On combining equation (3.10) with the first-order autoregressive process specified in (3.7), we have, after rearranging,

$$(3.11)\quad \tilde{\ell}^{d}_{qt}-\rho_q\tilde{\ell}^{d}_{qt-1} = a_{q0}(1-\rho_q) + a_q(\hat{w}_{qt-1}-\rho_q\hat{w}_{qt-2})$$

$$+ B_q(\bar{s}_{qt-1}-\rho_q\bar{s}_{qt-2})$$

$$+ F_q[(\bar{s}_{qt-1}-\bar{s}_{qt-2})-\rho_q(\bar{s}_{qt-2}-\bar{s}_{qt-3})]$$

$$+ b_{q1}(s_{1t-1}-\rho_q s_{1t-2})$$

$$+ f_{q1}[(s_{1t-1}-s_{1t-2})-\rho_q(s_{1t-2}-s_{1t-3})]$$

$$+ \varepsilon_{qt}-\rho_q\varepsilon_{qt-1}.$$

Turning to the supply side of the model, we can also reduce the number of variables appearing as arguments in equation (3.6). One way of doing this is to rank the occupations by the approximate skill level required to enter the major components of each occupational group. The three blue-collar occupations may be roughly ranked in the following order of descending skill requirements: (1) craftsmen and foremen, (2) operatives, and (3) laborers. Within the blue-collar group, we assume that a worker can move down in the skill hierarchy but not up. In addition, it is assumed that workers in the white-collar occupations and service workers can become laborers, and that both white-collar and blue-collar workers can become service workers. The alternatives relevant to a member of each occupation are shown in Table 1, where the occupational groups are numbered as follows: clerical workers, 1; sales workers, 2; service workers, 3; craftsmen and foremen, 4; operatives, 5; and laborers, 6.

TABLE 1.--Alternative occupations for members of each occupational group.

	Current Occupational Group					
	Clerical Workers	Sales Workers	Service Workers	Craftsmen & Foremen	Operatives	Laborers
Alternative	2	1	6	5	6	3
Occupations	3	3		6	3	
	6	6		3		

With respect to the supply equation for craftsmen and foremen, one further assumption will be made. The variable u_{pt} is included in the model because the supply decisions of secondary workers hinge on the employment state of the primary wage earner in the family. In view of the component occupations of craftsmen and foremen and the fact that most of these workers are males, it seems likely that the vast majority of the members of this occupation are primary wage earners. Hence, the variable u_{pt} will be excluded from this equation.

Consider now any one of the six supply equations, for example, the equation for laborers which is written as follows:

$$(3.12)\quad \tilde{\ell}^{s}_{6t} = (1-\delta_6)c_{60} + \delta_6\tilde{\ell}^{s}_{6t-1} + c_{63}\left(\frac{\hat{w}_{6t-1}}{\hat{w}_{3t-1}}\right) - \delta_6 c_{63}\left(\frac{\hat{w}_{6t-2}}{\hat{w}_{3t-2}}\right) + c_{67}\hat{w}_{6t-1} - \delta_6 c_{67}\hat{w}_{6t-2} + d_{63}\left[(1-\delta_6)\left(\frac{u_{6t-1}}{u_{3t-1}}\right)\right] + d_{67}[(1-\delta_6)u_{6t-1}] + e_6 u_{pt} - \delta_6 e_6 u_{pt-1} + \eta_{6t} - \delta_6\eta_{6t-1}.$$

Note that u_{6t-1} is a component of $\tilde{\ell}^{s}_{6t-1}$ by the construction of the latter variable (see (3.1)). Consequently, in what follows, the own lagged unemployment rate is omitted from each supply equation. The effect of this omission on the estimated coefficients of the unemployment rate of married males is discussed in Chapter IV.

As is usual in distributed lag models, equation (3.12) is overidentified with respect to certain parameters. For example, an estimate of δ_6 may be obtained from an estimate of the coefficient of $\tilde{\ell}^{s}_{6t-1}$; however, yet another estimate of δ_6 may be obtained from estimates of the coefficients of $\hat{w}_{6t-1}/\hat{w}_{3t-1}$ and $\hat{w}_{6t-2}/\hat{w}_{3t-2}$. These two estimates will not, in general, be the same. In particular, the coefficients of w_{6t-2}/w_{3t-2}, w_{6t-2}, u_{6t-1}/u_{3t-1}, and u_{pt-1} are nonlinear in the parameters of the model. To estimate the parameters of this equation, nonlinear restrictions must be placed on each of these four coefficients (d_{67}=0 by assumption). Following Zellner _et al_., a nonlinear estimation technique that could be applied is the Gaushaus method.[10]

An alternative nonlinear technique, which we shall employ, is described most easily by first rewriting (3.12) as

$$(3.13)\quad \tilde{\ell}^s_{6t} - \delta_6\tilde{\ell}^s_{6t-1} = (1-\delta_6)c_{60} + c_{63}\left[\left(\frac{\hat{w}_{6t-1}}{\hat{w}_{3t-1}}\right) - \delta_6\left(\frac{\hat{w}_{6t-2}}{\hat{w}_{3t-2}}\right)\right] + c_{67}(\hat{w}_{6t-1}-\delta_6\hat{w}_{6t-2}) + d_{63}\left[(1-\delta_6)\left(\frac{u_{6t-1}}{u_{3t-1}}\right)\right] + e_6(u_{pt}-\delta_6 u_{pt-1}) + \eta_{6t} - \delta_6\eta_{6t-1}.$$

[10]A. Zellner, D. S. Huang, and L. C. Chau, "Further Analysis of the Short-Run Consumption Function with Emphasis on the Role of Liquid Assets," _Econometrica_, Vol. 33 (July, 1965), pp. 571-581.

Equations (3.11) and (3.13) are now expressed in a form such that unique parameter estimates of both equations may be obtained by single-equation application of ordinary least squares (OLS) for selected values of the parameters ρ_q and δ_q, where $0<\rho_q,\delta_q<1$ and $q=6$ in (3.13). The criteria for selecting the estimates of ρ_q and δ_q and the corresponding sets of coefficient estimates is to choose ρ_q and δ_q for which the sum of squares of residuals is a minimum in each equation. The estimates obtained are maximum likelihood estimates and are thus consistent and asymptotically efficient.

Estimation of equations in the form of (3.13) involves the assumption that the expectations coefficient δ_q equals the parameter ξ_q in the first-order autoregressive process specified in (3.8). This assumption is commonly employed, but it must be noted that we have no knowledge from economic theory from which to infer that $\xi_q=\delta_q$.[11]

A random shock may affect the contemporaneous disturbances of the set of demand or supply equations, or it might simultaneously affect both sets of disturbances.

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[11]The sensitivity of the inferences made from a distributed lag consumption function model to this and various alternative specifications of the disturbance term is examined by Arnold Zellner and Martin S. Geisel in their yet unpublished paper "Analysis of Distributed Lag Models with Applications to Consumption Function Estimation." (Mimeographed.)

To handle this situation, Zellner has proposed a procedure which yields coefficient estimators at least asymptotically more efficient than single-equation least squares estimators.[12,13] In this procedure, regression coefficients are estimated simultaneously by applying Aitken's generalized least squares to the system of equations. To construct the Aitken estimators, Zellner employs estimates of the disturbance terms' variances and covariances based on the residuals derived from an equation-by-equation application of OLS.

However, Zellner's method for estimating seemingly unrelated regressions is constructed on the assumption that individual equation disturbances are not autocorrelated. To take into account both autocorrelation and contemporaneous correlation in a system of equations, the following two-step estimation procedure is proposed:[14]

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[12]Arnold Zellner, "An Efficient Method of Estimating Seemingly Unrelated Regressions and Test for Aggregation Bias," Journal of the American Statistical Association, Vol. 57 (June, 1962), pp. 343-368.

[13]Zellner, "Estimators for Seemingly Unrelated Regression Equations: Some Exact Finite Sample Results," Journal of the American Statistical Association, Vol. 58 (December, 1963), pp. 977-992.

[14]Richard W. Parks presents a similar asymptotically efficient technique for estimating the coefficients of a system of regression equations. The difference between his procedure and the one presented here is that he estimates the parameter ρ_i in a first-order autoregressive process as follows:

Step 1: Find the OLS estimates of the parameters δ_q and ρ_q which minimize the sum of squares of residuals for each equation in the system. Then use the associated estimates of the regression coefficients for each equations to estimate the contemporaneous variance-covariance matrix.

Step 2: Form the Aitken estimator using the estimated variance-covariance matrix. This step is equivalent to applying Zellner's technique to the regression equations after the estimates of δ_q and ρ_q have been obtained.

In the next chapter, the results obtained by OLS and the modified Aitken procedure are presented for the twelve-equation system.

$$\hat{\rho}_i = \frac{\sum_{t=2}^{n} u_{it}u_{it-1}}{\sum_{t=2}^{n} u_{it-1}^2},$$

where u_{it} is the OLS residual for the ith equation in period t, and n is the sample size. Parks proves that his estimator is consistent and asymptotically more efficient than the Zellner estimator when autocorrelation is present. "Efficient Estimation of a System of Regression Equations When Disturbances are Both Serially and Contemporaneously Correlated," Journal of the American Statistical Association, Vol. 62 (June, 1967), pp. 500-509.

Parks' estimate of ρ_i is the "first round" estimate in an iterative procedure discussed by J. Johnston, Econometric Methods (New York: McGraw-Hill Book Company, Inc., 1963), pp. 193-194. In general, the first round estimate of ρ_i will not be equivalent to the maximum likelihood estimate for finite samples.

CHAPTER IV

THE EMPIRICAL EVIDENCE AND CONCLUSIONS

This chapter is devoted to a discussion of the empirical results obtained for the model as specified in the previous chapter. In Section I, the parameter estimates for the sets of demand and supply equations are reported. Section II contains an economic analysis of the results. Finally, in Section III, we suggest some conclusions that may be drawn from the study.

I. The Results of the Estimation

The system of equations estimated is the following:

$$(4.1) \quad \tilde{\ell}^{d}_{qt} - \rho_q \tilde{\ell}^{d}_{qt-1} = a_{q0}(1-\rho_q) + a_q(\hat{w}_{qt-1} - \rho_q \hat{w}_{qt-2})$$

$$+ B_q(\bar{s}_{qt-1} - {}_q\bar{s}_{qt-2})$$

$$+ F_q[(\bar{s}_{qt-1} - \bar{s}_{qt-2}) - \rho_q(\bar{s}_{qt-2} - \bar{s}_{qt-3})]$$

$$+ b_{q1}(s_{1t-1} - \rho_q s_{1t-2})$$

$$+ f_{q1}[(s_{1t-1} - s_{1t-2}) - \rho_q(s_{1t-2} - s_{1t-3})]$$

$$+ \varepsilon_{qt} - \rho_q \varepsilon_{qt-1}$$

$$(4.2) \quad \tilde{\ell}^s_{qt} - \delta_q \tilde{\ell}^s_{qt-1} = c_{q0}(1-\delta_q) + c_{q1}\left[\left(\frac{\hat{w}_{qt-1}}{\hat{w}_{1t-1}}\right) - \delta_q\left(\frac{\hat{w}_{qt-2}}{\hat{w}_{1t-2}}\right)\right]$$

$$+ \ldots + c_{q6}\left[\left(\frac{\hat{w}_{qt-1}}{\hat{w}_{6t-1}}\right) - \delta_q\left(\frac{\hat{w}_{qt-2}}{\hat{w}_{6t-2}}\right)\right]$$

$$+ c_{q7}(\hat{w}_{qt-1} - \delta_q \hat{w}_{qt-2})$$

$$+ d_{q1}\left[(1-\delta_q)\left(\frac{u_{qt-1}}{u_{1t-1}}\right)\right] + \ldots$$

$$+ d_{q6}\left[(1-\delta_q)\left(\frac{u_{qt-1}}{u_{6t-1}}\right)\right] + e_q(u_{pt} - \delta_q u_{pt-1})$$

$$+ \eta_{qt} - \delta_q \eta_{qt-1} \qquad (q=1,\ldots,m),$$

where $\tilde{\ell}^d_{qt}$ = number of members of occupation q employed in period t;

$\tilde{\ell}^s_{qt}$ = number of members of occupation q in period t;

$\hat{w}_{qt-1}$ = estimate of the real wage in occupation q in period t-1;

$\bar{s}_{qt-1}$ = index of sales of the industries employing members of occupation q in period t-1;

s_{1t-1} = index of sales of the construction industry in period t-1;

u_{qt-1} = unemployment rate in the qth industry in period t-1; and

u_{pt} = unemployment rate of married males in period t.

A minimum of two and a maximum of four of the c_q and d_q coefficients in equation (4.2) are assumed a priori to equal zero in each supply equation.

A. The Demand Results

The parameters of the set of demand equations were first estimated by OLS. The coefficient estimates of the equations for craftsmen and foremen, operatives, and laborers suggested that the inclusion of the sales and change in sales variables for the construction industry adds very little to the explanatory power of the demand side of the model. The equations were again estimated excluding the construction sales variables, and the coefficient estimates and the corresponding standard errors of the six demand equations are reported in Table 2. The subscript q (q=1,...,6) refers to the equation in which the parameter occurs. The coefficients of multiple determination (R^2) are given in the last column of the table.

OLS estimates of each equation are obtained for ρ_q=0.1, ρ_q=0.2,...,ρ_q=0.9 (q=1,...,6). The maximum likelihood estimate of ρ_q ($\hat{\rho}_q$) is that which minimizes the sum of squares of residuals for each equation. The set of ρ_q's and the corresponding coefficient estimates are reported in the table.[1] The fact that ρ_q is 0.6 in two

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[1]The asymptotic variance of $\hat{\rho}_q$ is calculated by

TABLE 2.--OLS estimates of parameters appearing in the demand equations specified in (4.1).*

Occupation	Const.	$\hat{a}_q$ $(\times 10^{-5})$	$\hat{B}_q$ $(\times 10^{-7})$	$\hat{F}_q$ $(\times 10^{-7})$	$\hat{\rho}_q$	R^2
Clerical Workers	888[a] (158)	5,928 (25,990)	32,203[a] (4,683)	-9,156[c] (5,340)	0.8[a] (0.058)	0.7029
Sales Workers	716[a] (101)	-5,589 (11,874)	970[b] (400)	356 (453)	0.8[a] (0.058)	0.1603
Service Workers	453[a] (90)	37,748[c] (22,168)	6,466[a] (1,864)	-1,314 (1,752)	0.8[a] (0.058)	0.6278
Craftsmen & Foremen	2,550[a] (136)	492 (6,873)	1,989[a] (186)	-1,119[a] (324)	0.6[a] (0.077)	0.7599
Operatives	2,722[a] (335)	9,495 (29,003)	86,984[a] (13,596)	-10,049 (28,112)	0.6[a] (0.077)	0.7826
Laborers	784[a] (88)	-18,774 (11,955)	989 (760)	-467 (966)	0.8[a] (0.058)	0.0269

*Standard errors appear in parentheses below the coefficients and all tests are two-tailed t-tests.

[a]Significantly different from zero at the 1 per cent level.

[b]Significantly different from zero at the 5 per cent level.

[c]Significantly different from zero at the 10 per cent level.

equations and 0.8 in the other four indicates that positive autocorrelation exists in the ε_{qt}'s (q=1,...,6). In addition, each estimate of ρ_q is significant. The Durbin-Watson statistics for the disturbances $\varepsilon_{qt}-\rho_q\varepsilon_{qt-1}$ (q=1,...,6) range from 1.91 to 2.50. This range is well above the tabulated upper bound for the sample size and number of explanatory variables. Hence, we do not reject the hypothesis of random disturbances when a first-order autoregressive process is assumed.[2]

For the set of OLS estimates of ρ_q and δ_q, the Zellner procedure described in Chapter III was then applied to the twelve equation system.[3] These Aitken

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$$s^2_{\hat{\rho}q} = \frac{1-\hat{\rho}_q^{\,2}}{n} ,$$

where n is the sample size. This formula was derived by Professor J. Kmenta.

[2]The Durbin-Watson test is derived for the case of nonstochastic regressors; consequently, if the lagged dependent variable $\ell\tilde{d}_{qt-1}$ were considered a predetermined variable whose coefficient is to be estimated, the conditions required for use of the Durbin-Watson test would not be met. However, all the regressors in (4.1) are nonstochastic so that the Durbin-Watson test is appropriate.

[3]The OLS estimates of δ_q(q=1,...,6) are obtained in exactly the same way as the estimates of ρ_q. They are discussed in Part B of this section.

estimates of the demand equations are reported in Table 3. The coefficients of multiple determination were not calculated for this procedure.

The coefficient estimates obtained by OLS and the Aitken procedure differ because the data in the sample are given identical weights equal to unity in the OLS estimator; whereas, the elements of the inverse of the variance-covariance matrix are utilized as weights in the Aitken estimator.

As anticipated, the standard errors reported for the Aitken procedure in Table 3 are uniformly lower than the corresponding standard errors reported in Table 2. This is also the case for the standard errors estimated for the coefficients of the supply equations (see Tables 4 and 5).

In general, the gain in efficiency obtained by using Zellner's technique is a maximum for a given level of correlation between contemporaneous disturbances if the explanatory variables in different equations are uncorrelated. This is clearly not the case in the system of equations presented here, particularly in that five of the six supply equations contain the variable u_p. However, it is also clear that we obtain a significant gain in efficiency by using the Aitken estimator.

Turning to the coefficient estimates, the estimates of the constant terms obtained by both estimation

TABLE 3.--Aitken estimates of coefficients appearing in the demand equations specified in (4.1).*

Occupation	Const.	$\hat{a}_q$ ($\times 10^{-5}$)	$\hat{B}_q$ ($\times 10^{-7}$)	$\hat{F}_q$ ($\times 10^{-7}$)	$\hat{\rho}_q$
Clerical Workers	993[a] (115)	27,430 (17,876)	22,478[a] (3,304)	-10,458[a] (3,425)	0.8[a] (0.069)
Sales Workers	708[a] (50)	-871 (5,006)	709[a] (184)	-101 (188)	0.8[a] (0.069)
Service Workers	602[a] (59)	36,837[a] (12,510)	4,664[a] (1,089)	-1,758[c] (951)	0.8[a] (0.069)
Craftsmen & Foremen	2,595[a] (98)	1,040 (4,747)	1,866[a] (132)	-894[a] (190)	0.6[a] (0.077)
Operatives	3,074[a] (220)	-13,215 (17,973)	92,439[a] (8,496)	-11,198 (17,019)	0.6[a] (0.077)
Laborers	640[a] (65)	-5,036 (7,928)	1,319[a] (460)	-487 (423)	0.8[a] (0.069)

*Standard errors appear in parentheses below the coefficients and all tests are two-tailed t-tests.

[a]Significantly different from zero at the 1 per cent level.

[b]Significantly different from zero at the 5 per cent level.

[c]Significantly different from zero at the 10 per cent level.

techniques are uniformly positive and highly significant. The lagged indices of industry sales ($\bar{s}_{qt-1}$) also performed very strongly. Each of the estimated coefficients of $\bar{s}_{qt-1}$ is positive as expected, and five of the six OLS estimates and all of the Aitken estimates are significantly different from zero.

The lagged change in sales index ($\Delta\bar{s}_{qt-1}$) was introduced into the model as part of the hypothesis determining the wage rates expected by employers. The hypothesis states that the greater is $\Delta\bar{s}_{qt-1}$, the higher is the wage expected to exist in occupation q in period t. Thus, it is anticipated that the coefficients attached to the change in sales indices will be negative because the number of workers desired by firms is specified to be inversely related to the expected wage rate. This is the case for five of the six OLS estimates and for each Aitken estimate. Two of the OLS estimates and three of the Aitken estimates are significantly different from zero. More of the estimated coefficients might be expected to be significant except that variation in $\Delta\bar{s}_{qt-1}$ very likely has a direct impact on the demand for labor which partially offsets the indirect effect appearing via the expected wage.

The performance of the lagged real wage variables is somewhat disappointing in that only two of the OLS coefficient estimates and three of the Aitken estimates have the anticipated sign. Both the OLS and Aitken estimates of a_3 are positive and significant, while the only negative estimate approaching significance is the OLS estimate of a_6.

Part of the lack of significance of the lagged wage variables may be traced to the high correlation between the wage and sales indices. The existence of multicollinearity suggests that reliable estimates of the effect of changes in wage rates are not obtainable without utilizing some prior information about the relationship between the wage and sales variables.

B. The Supply Results

The OLS estimates of the parameters of the six supply equations, along with the corresponding standard errors and R^2's, are reported in Table 4. Table 5 contains the coefficient estimates calculated using the two-step Aitken procedure.

In all six supply equations, we assume that the expectations coefficient δ_q equals the parameter ξ_q in a first-order autoregressive process. The parameter ξ_q is successively assigned the values 0.1,0.2,...,0.9 in each equation; the estimates reported in Table 4 minimize the sum of squares of OLS residuals. Again, there is significant positive autocorrelation among the η_{qt}'s with $\hat{\xi}_q$ ($=\hat{\delta}_q$) equaling 0.9 in four equations and 0.8 and 0.6 in the remaining two equations. Each of these estimates

TABLE 4.--OLS estimates of parameters appearing in the supply equations specified in (4.2).*

Occupation	Const.	$\hat{c}_{q1}$	$\hat{c}_{q2}$	$\hat{c}_{q3}$	$\hat{c}_{q5}$	$\hat{c}_{q6}$	$\hat{c}_{q7}$ ($\times 10^{-4}$)	$\hat{d}_{q1}$	$\hat{d}_{q2}$	$\hat{d}_{q3}$	$\hat{d}_{q5}$	$\hat{d}_{q6}$	$\hat{e}_q$	$\hat{\delta}_q$	R^2
Clerical Workers	1,691[b]		-3,527	-3,719[c]		-1,691	-492		207	-1,566		13,972[a]	-9,540[c]	0.9[a]	0.3046
	(719)		(6,593)	(2,063)		(1,099)	(1,666)		(1,103)	(2,436)		(3,227)	(5,499)	(0.042)	
Sales Workers	618	1,181		439		-478	468	-168		-1,497[b]		2,289[b]	-2,203	0.8[a]	0.1749
	(579)	(3,114)		(880)		(484)	(688)	(438)		(666)		(998)	(2,838)	(0.058)	
Service Workers	410[a]					1,147[c]	1,661					2,238	-5,760	0.9[a]	0.1214
	(121)					(671)	(1,511)					(1,414)	(4,349)	(0.042)	
Craftsmen & Foremen	-5,278			572	197	36,536	258			-2,069[b]	1,812	-1,066		0.9[a]	0.1122
	(6,923)			(839)	(1,828)	(39,731)	(975)			(960)	(2,127)	(2,942)		(0.042)	
Operatives	1,253[a]			4,013[c]		-1,469	-224			-3,666[a]		4,299	-7,399	0.9[a]	0.1736
	(330)			(2,127)		(1,184)	(2,442)			(1,228)		(3,534)	(8,156)	(0.042)	
Laborers	1,988[a]			974			-3,583[a]			-259[b]			1,883	0.6[a]	0.1469
	(335)			(932)			(1,126)			(131)			(3,395)	(0.077)	

*Standard errors appear in parentheses below the coefficients and all tests are two-tailed t-tests.

[a]Significantly different from zero at the 1 per cent level.

[b]Significantly different from zero at the 5 per cent level.

[c]Significantly different from zero at the 10 per cent level.

TABLE 5.--Aitken estimates of coefficients appearing in the supply equations specified in (4.2).*

Occupation	Const.	$\hat{c}_{q1}$	$\hat{c}_{q2}$	$\hat{c}_{q3}$	$\hat{c}_{q5}$	$\hat{c}_{q6}$	$\hat{c}_{q7}$ ($\times 10^{-4}$)	$\hat{d}_{q1}$	$\hat{d}_{q2}$	$\hat{d}_{q3}$	$\hat{d}_{q5}$	$\hat{d}_{q6}$	$\hat{e}_q$	$\hat{\delta}_q$
Clerical Workers	1,163[a] (402)		1,222 (3,639)	-728 (1,219)		-429 (630)	1,202 (1,069)		-346 (587)	-4,341[a] (1,441)		7,688[a] (2,319)	-7,351[b] (3,272)	0.9[a] (0.042)
Sales Workers	861[a] (218)	481 (1,191)		-89 (362)		-93 (187)	237 (304)	-151 (162)		-979[a] (260)		1,360[a] (434)	-1,716 (1,155)	0.8[a] (0.058)
Service Workers	546[a] (81)					135 (379)	1,579[c] (916)					1,722[c] (939)	-3,225 (2,224)	0.9[a] (0.042)
Craftsmen & Foremen	-1,861 (3,556)			65 (466)	407 (934)	16,882 (20,403)	194 (536)			-2,015[a] (655)	80 (1,079)	505 (1,545)		0.9[a] (0.042)
Operatives	1,240[a] (193)			998 (1,328)		-475 (726)	979 (1,552)			-2,684[a] (904)		4,495[b] (2,102)	5,701 (4,921)	0.9[a] (0.042)
Laborers	1,818[a] (208)			730 (470)			-2,190[a] (523)			-242[a] (52)			6,845[a] (1,730)	0.6[a] (0.077)

*Standard errors appear in parentheses below the coefficients and all tests are two-tailed t-tests.

[a]Significantly different from zero at the 1 per cent level.

[b]Significantly different from zero at the 5 per cent level.

[c]Significantly different from zero at the 10 per cent level.

is significant. The Durbin-Watson statistics for the disturbances $\eta_{qt}-\delta_q\eta_{qt-1}$ (q=1,...,6) all exceed the tabulated upper bound.

Consider now the parameter estimates of the supply equations. Five of the six OLS estimates of the constant terms in the supply equations are positive, and of these five, four are significantly different from zero. All five positive Aitken estimates are significant.

Turning to the coefficient estimates for relative wage rates, eight of the thirteen OLS estimates have the expected positive sign, and two of the eight are signficant. It is interesting to note that all three relative wage coefficients in the equations for clerical workers are negative, and the only significant negative coefficient ($\hat{c}_{13}$) also appears here. Omitting this equation, the OLS estimates for the other five equations are much more consistent with the sign of the partial derivatives specified in the theoretical model. However, the Aitken coefficient estimates for relative wage rates in the equation for clerical workers show just two "incorrect" signs which is also the case in the equation for sales workers.

Three of the six absolute wage variables have positive OLS estimates of their coefficients. The only OLS estimate which is significant ($\hat{c}_{67}$) is also negative. The Aitken estimates are much more consistent with the theoretical model with five of the six coefficients having the expected positive sign. One of the positive estimates is significant, while the estimate of c_{67} is significant but negative.

Only seven of the thirteen coefficients of relative unemployment rates are estimated to be negative by OLS. Of the six significant coefficients, however, four have the expected negative sign. Again the OLS results are more consistent with the theoretical model if the equation for clerical workers is omitted. In this equation, two of the three coefficients of relative unemployment rates are positive, and one of these ($\hat{d}_{16}$) is also significant.

The Aitken coefficient estimates for relative unemployment rates are arranged in an interesting but not easily explicable pattern according to sign. The coefficients of the own unemployment rates relative to the unemployment rates for white-collar and service workers are negative, as expected, and each of the coefficients in the column headed by $\hat{d}_{q3}$ is highly significant. On the other hand, the own unemployment rates relative to the unemployment rates for operatives and laborers have positive coefficients, and four of these six coefficients are significant. The pattern of these coefficients will be considered further in the next section of this chapter.

Four of the OLS coefficient estimates for the unemployment rate of married males are negative, only one coefficient having the positive sign specified in the model. Two of the Aitken estimates are positive, and one of the positive estimates and one of the negative estimates are significant. These rather ambiguous results can be rationalized once it is pointed out that the reformulation of the model for empirical estimation leaves room for forces other than that specified in the model to be reflected in the coefficient estimates calculated for u_p.

The elements of the unemployment rate vector tend to fluctuate together in response to forces which shift the entire structure of unemployment. The impact of such forces affects both numerator and denominator of the unemployment rate ratios and thus washes out, but the impact is caught by the own unemployment rate in the supply equations specified in Chapter II. However, as noted in the previous chapter, the own unemployment rate is omitted from each equation because it enters the construction of the dependent variable. This means that the impact of forces affecting the structure of unemployment is reflected in the variable u_p since the level of unemployment among married males in any time period is a linear combination of the level of unemployment in each occupation. Thus, a rise in the unemployment rate of married males increases the incentive for secondary workers to supply their labor in the market, as specified in the model. But since the own unemployment rate is omitted from each equation, a rise in u_p also reduces the incentive for workers to enter or to remain in any particular occupation because of the lower present values of adjusted expected earnings from market labor. The estimated coefficients of u_p are considered in more detail in the next section.

II. The Interpretation of the Results

A. Interpreting the Demand Results

The sign of the constant terms in the six demand equations is expected since a firm must employ a positive number of workers if it is to operate. The fact that each of the six constant terms is significant indicates that some positive level of employment in each occupational group is assured in the short run, at least for the range of the product demand and wage variables observed in the 1958-66 period.

The magnitudes of the constants give an indication of the elasticity of demand for the members of the occupations: the smaller the constant, the more elastic the demand function in the observed interval. Perhaps the most clear-cut case among the six occupational groups involves the blue-collar occupations where the OLS and

Aitken estimates of the constant term in the equations for laborers are much smaller than the estimated constant terms in the equations for craftsmen and foremen and operatives. The explanation for the differences in elasticities in this case probably lies in the relatively greater hiring and training costs embodied in the more highly skilled workers.

It was noted in the previous section that there is a significant positive relationship between the indices of industry sales ($\bar{s}_q$) and the occupational demand for labor. To the extent that changes in these indices are adequate proxies for changes in product demand, this result is expected from the theory of derived demand. Note that the sales index in a particular demand equation is constructed to reflect both changes in the composition of the industry sales vector and shifts in the entire vector. Therefore, a change in the structure of product demand, as well as a change in the level of total demand, is reflected in the set of sales indices.

Examination of the R^2's for the demand equations indicates that the explanatory power of the demand side of the model is considerably less for two of the occupations than for the remaining four occupations. In particular, the R^2 for the equation for laborers is barely positive. To assist in evaluating the relative importance of the explanatory variables in each equation, beta coefficients were estimated, and the coefficients and their standard errors are reported in Table 6. The coefficient $\hat{B}^*_3$, for example, is the beta coefficient of the sales index in the equation for service workers.

The beta coefficients reported in Table 6 are single equation estimates of the coefficients of the independent variables standardized by their standard deviations. Within each equation, the beta coefficients provide a measure of the individual contribution of every regressor in explaining variation in the demand for labor. Since the coefficients are pure numbers, they also allow comparisons of individual regressors across equations.

The relative magnitudes of the beta coefficients of the sales indices are important because they indicate the employment response in each occupation to changes in the vector of industry product demand. Only in the equation for laborers is the beta coefficient of the sales index exceeded by the coefficient of one of the other variables in the equation. And while $\hat{B}^*_6$ is the lowest of the six coefficients of the sales indices, there is also a significant difference between the coefficients $\hat{B}^*_1$, $\hat{B}^*_4$, and $\hat{B}^*_5$ and the two coefficients $\hat{B}^*_2$ and $\hat{B}^*_3$.

As summarized in Table 1, the blue-collar occupations were ranked in the following order of descending skill requirements: craftsmen and foremen, operatives,

TABLE 6.--OLS estimates of the beta coefficients of the standardized variables appearing in (4.1).*

Occupation	a_q^*	B_q^*	F_q^*
Clerical Workers	0.0270 (0.1182)	0.8281 (0.1204)	-0.0983 (0.0573)
Sales Workers	-0.0838 (0.1781)	0.4429 (0.1826)	0.0756 (0.0962)
Service Workers	0.2643 (0.1552)	0.5536 (0.1596)	-0.0530 (0.0706)
Craftsmen & Foremen	0.0058 (0.0813)	0.8816 (0.0826)	-0.1749 (0.0506)
Operatives	0.0432 (0.1319)	0.8460 (0.1322)	-0.0167 (0.0468)
Laborers	-0.1804 (0.1149)	0.1585 (0.1216)	-0.0510 (0.1054)

*Standard errors appear in parentheses below the coefficients.

and laborers. There was no attempt to rank the two white-collar occupations, and it was assumed that both blue-collar and white-collar workers could enter the service occupations in the short run. This ordering is consistent with the BLS ordering of the same occupations, except that the BLS places clerical workers above sales workers in the white-collar skill hierarchy.

Suppose that fiscal and/or monetary policy were applied such that every element in the vector of industry product demand were increased by a given percentage. The estimated beta coefficients of the product demand indices reveal that craftsmen and foremen would benefit most from such a policy in terms of expanded job opportunities and laborers would benefit least. It is interesting to note, moreover, that within both the white- and blue-collar occupations the beta coefficients of the product demand indices rank the occupations in exactly the same order as they are ranked by skill requirements, assuming that clerical workers, in general, invest more in acquiring skills than do sales workers. Therefore, the relative magnitudes of the appropriate beta coefficients indicate that the higher skill occupations in both the white- and blue-collar groups would benefit more from a policy induced shift in aggregate demand than would the lower skill occupations.

It is also instructive to examine the structure of unemployment rates during the 1958-66 period. Among the blue-collar occupations, the levels of the time profiles of unemployment rates are inversely related to the ranking of the occupations by skill, with the time profile for craftsmen and foremen situated at approximately the same level as the time profiles for clerical and sales workers. The time profile of unemployment rates for service workers lies below those for clerical and sales workers but above the profile for laborers.

Consider now how these results compare with the conclusions reached by Charles C. Killingsworth in his study of the structure of unemployment. In a well-known statement of his position, Killingsworth examines the relationship between unemployment and the level of education during the period from 1950 to 1962.[4] He argues that during the period a "twist" in the demand for labor occurred such that there has been a long-run decline in the demand for low skilled, poorly educated workers and a long-run rise in the demand for high skilled, well educated workers. The implication for policy is that attempts to reduce the level of unemployment by increasing aggregate demand will increase job vacancies for well educated workers but will have relatively little effect in providing additional job opportunities for poorly educated workers.

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[4]Killingsworth, "Structural Unemployment in the United States."

In a recent article, Killingsworth examines the structure of the unemployed classified by educational levels between March, 1962 and March, 1967.[5] Although unemployment rates fell uniformly during the period, the decline for the lower educational levels arose only because labor force participation fell at a faster rate than employment decreased. Killingsworth makes a convincing case for the hypothesis that "discouragement" among the least educated groups due to insufficient job opportunities led to the decline in their labor force participation, even during this period of rapidly expanding aggregate demand.

The results presented here for the 1958-66 period using data for occupational groups rather than educational groups strongly support Killingsworth's conclusion that increasing aggregate demand does little to improve the employment situation for low skilled workers. This is especially true for workers who classify themselves as laborers, the occupational group which had by far the worst unemployment record during the period studied. Indeed, expansionary monetary and fiscal policy may have the effect of increasing inflationary pressures by creating excess demands in the markets for more highly skilled

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[5]Killingsworth, "The Continuing Labor Market Twist," Monthly Labor Review, Vol. 91 (September, 1968), pp. 12-17.

workers. Probably the more effective way to deal with hard core unemployment is through retraining and education programs designed to assist workers to acquire the skills necessary to enable them to move from the low-skill occupations. At the very least, it is clear that an optimal strategy to combat unemployment must include programs of this type in addition to the policy instruments which expand aggregate demand.

B. Interpreting the Supply Results

Now turn to the results for the six supply equations. The R^2's for the six equations range from 0.11 to 0.30. Thus, the wage and unemployment variables in the model presented here account for some 11 to 30 per cent of the monthly variation in occupational labor supply. In view of the empirical results obtained in other short-run studies, these R^2's are not unexpectedly low. A case in point is the study by Peter S. Barth examining the quarterly labor force participation rates for 21 age-sex classes of the population over the period 1948-64.[6] Barth included a trend term in each equation to catch long-run changes occurring during the period. In most of his equations, the estimated coefficients for the trend terms were

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[6] Peter S. Barth, "Unemployment and Labor Force Participation," Southern Economic Journal, XXXIV (January, 1968), pp. 375-382.

highly significant. In the summary equations for all males and all females, Barth reports extremely high t-test statistics for the trend terms; indeed, he notes that the partial coefficient of correlation of the trend term for all males is 0.857.[7] Since the model presented here simply classifies the members of the labor force into alternative occupational groups, Barth's results imply that the equations of our purely short-run model will not have high associated R^2's.

As reported in Section I, five of the constant terms in the supply equations are positive and significant. This indicates that these supply functions are elastic in the range of the wage variables observed in the 1958-66 period. The constant term in the equation for craftsmen and foremen is negative, but the fact that this estimate is exceeded by its standard error does not allow the inference that the supply of craftsmen and foremen is inelastic.

The literature pertinent to the supply side of the model may be divided into two parts. The first part is composed of studies of the labor force participation rates of alternative age and sex categories of the population. These studies show quite clearly that labor

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[7] *Ibid.*, p. 379.

force participation is positively affected by increases in the levels of the relevant wage rates.[8]

In addition, there is a scattered literature examining the relationship between occupational choice and the time paths of long-run earnings in alternative occupations. Frequently, the relevant earnings horizon is taken to be individuals' entire working lives. The general conclusion drawn from the empirical evidence is that there is a long-run occupational supply response to differentials in the present values of expected earnings, even though the response may occur only after a significant lag because of the time involved in training.[9]

With the exception of the OLS estimates for the equation for clerical workers, the results presented in Tables 4 and 5 provide support for the hypothesis that

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[8]See Fisher, op. cit. for a summary of the empirical evidence presented in some of the best known of these studies.

[9]See the results reported in Bruce W. Wilkinson, "Present Values of Lifetime Earnings for Different Occupations," Journal of Political Economy, LXXIV (December, 1966), pp. 556-572 and the references cited therein. Jacob Mincer provides an additional indirect piece of evidence supporting this conclusion. He establishes that the distribution of personal income in the economy can be explained as the result of the market equalizing the present values of lifetime earnings in alternative occupations. "Investment in Human Capital and Personal Income Distribution," Journal of Political Economy, LXVI (August, 1958), pp. 281-302.

short-run occupational supply adjustments, just as long-run adjustments, depend on expected wage rates in alternative occupations. Although the signs of the estimated coefficients are quite consistent with the model, the general lack of significance of the estimates is probably due to violations of the fairly restrictive assumptions required to construct the wage estimates.

The sharp division in the results for relative unemployment rates may perhaps be rationalized by interpreting the coefficient estimates in light of the "hidden unemployment" in the United States economy. The hidden unemployed are those workers who have dropped out of the labor force due to lack of job opportunities. Because the level of hidden unemployment is positive, there is a discrepancy for some occupations between the BLS estimates of occupational unemployment rates and the "real" unemployment rates. This discrepancy arises because the former measures include only workers in the labor force, while the latter also include discouraged drop-outs from the labor force. Killingsworth's calculation of the real as opposed to the "official" unemployment rates for alternative educational groups in 1957 and 1962 indicates that the discrepancy is serious only for the lower educational groups.[10] In a subsequent paper reported on earlier,

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[10]Killingsworth, "Structural Unemployment in the United States," p. 44.

Killingsworth finds that this same discrepancy persisted into the period from 1962 to 1967.[11] In this connection, it was noted earlier that the unemployment rates for the lower educational groups declined between 1962 and 1967, but this decline occurred only because labor force participation fell faster than employment decreased.

Among the six occupational groups examined here, laborers are, in general, the least skilled and the most poorly educated, and there seems to be an important parallel between the employment conditions encountered by the poorly educated and by laborers. During the entire 1958-66 period, the employment of laborers remained fairly constant. In contrast, the employment of service workers increased sharply. However, from early 1961 to the end of 1966 the unemployment rate among laborers declined steadily. As in the case of the poorly educated, the explanation for this decline in the unemployment rate must lie in an important fall in labor force participation. And as with the poorly educated, a significant proportion of the laborers who leave the labor force probably do so because of discouragement. Hence, they are included among the hidden unemployed.

To see how the level of hidden unemployment relates to the interpretation of the positive coefficient estimates, consider the estimate of d_{16}. During the period

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[11]Killingsworth, "The Continuing Labor Market Twist."

from 1961 to 1966, the estimate of d_{16} reflects the positive correlation between the supply of clerical workers and the steady rise in the ratio u_{1t-1}/u_{6t-1} caused by the relatively greater rate of decline in the unemployment rate of laborers. A rational supplier evaluating unemployment conditions in the two occupations will take account not only of the number of unemployed laborers, but he will also take into consideration the number of discouraged laborers who have left the labor force. Since the official unemployment rate for laborers declined during this period while employment remained relatively constant, it is reasonable to assume that the hidden unemployment associated with a fall in participation increased among laborers. If this hypothesis is correct, the increase in the supply of clerical workers is not a positive response to the rise in the ratio u_{1t-1}/u_{6t-1}, but it is rather a negative response to the increase in the level of hidden unemployment among laborers. This interpretation is of course, consistent with the theoretical model if the relevant unemployment rate for laborers is taken to be the real rather than the official rate. For the five other occupational groups considered here, it seems reasonable to assume that the discrepancy between the two rates is of a second order of magnitude.

At this point, it might be worthwhile to repeat that the data utilized in the empirical analysis are collected for major occupational groups. Very probably, however, a significant proportion of short-run inter-occupational mobility is between specific occupations within particular major occupations. If this is the case, the fact that the relationships postulated in the model seem to exist for major occupational groups lends additional credence to the model.

To the extent that the unemployment rate ratios in the supply equations tend to verify the use of probabilistic labor supply functions, they also imply that the structure of unemployment in past periods affects the current structure by partially determining the current supply of workers to alternative occupations. Using the estimates of δ_q $(q=1,\ldots,6)$, we can calculate the weights assigned to the unemployment rate ratios in each period from equation (2.35). For $\hat{\delta}_q = 0.9$, the weights associated with u_{qt-1}/u_{it-1}, u_{qt-2}/u_{it-2}, u_{qt-3}/u_{it-3}, and u_{qt-4}/u_{it-4} $(i \neq q)$ are 0.10, 0.09, 0.08, and 0.07, respectively. The average lag is nine months.[12] For $\hat{\delta}_q = 0.8$, the weights are 0.20, 0.16, 0.13, and 0.10, respectively. The average lag is four months. Finally, for $\hat{\delta}_q = 0.6$, the weights are 0.40, 0.24, 0.14, and 0.09, respectively; and the average lag is one and one-half months. Hence, there is considerable variation in the weighting patterns in different occupations. In four of the occupations,

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[12]This is computed from $(1-\hat{\delta}_q)(\hat{\delta}_q+2\hat{\delta}_q^{\,2}+3\hat{\delta}_q^{\,3}+\ldots) = \hat{\delta}_q/(1-\hat{\delta}_q)$.

individuals appear to consider the time paths of relative unemployment rates for a year or more in arriving at expected relative unemployment rates. This is consistent with the finding in studies of the short-run consumption function that the weights applied to past levels of disposable income fall off rather gradually in the calculation of expected income.[13] For laborers and sales workers, however, the weights assigned to unemployment rates in past periods fall off rather more sharply.

One further implication may be drawn from the estimates for the relative unemployment rates. These results indicate that concentration of private of governmental efforts to ease an unemployment problem in a particular occupation is likely to be at least partly offset by short-run movements of workers into the occupation from related occupations and from outside the labor force. Consequently, programs designed to reduce unemployment by upgrading workers in all or most of the lower skill occupations are to be preferred to programs concentrated in any single occupation. The probable effect of the latter type of program is to shift the unemployed between occupations rather than to reduce the total level of unemployment.

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[13]Zellner, Huang, and Chau, op. cit., p. 579.

The final variable in the supply equations to be considered is the unemployment rate of married males. As pointed out in Section I, an increase in the level of u_p generates two opposing pressures on the flow of labor into an occupation. The flow of labor is increased in accordance with the additional worker hypothesis, described earlier. On the other hand, the flow is decreased due to the general reduction in present values of adjusted expected earnings implied by an increase in u_p. The latter effect of an increase in unemployment is referred to as the "discouraged worker" hypothesis. There have been a number of attempts to measure the relative impact of these two hypotheses on labor supply behavior. W. Lee Hansen found that the effects of the two hypotheses are roughly offsetting,[14] while Kenneth Strand and Thomas Dernburg concluded that the net effect is in favor of the discouraged worker theory.[15]

In a study referred to earlier, Peter S. Barth found an inverse and significant relationship between participation rates and the overall unemployment rate

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[14]W. Lee Hansen, "The Cyclical Sensitivity of the Labor Supply," American Economic Review, LI (June, 1961), pp. 299-309.

[15]Kenneth Strand and Thomas Dernburg, "Cyclical Variations in Civilian Labor Force Participation," Review of Economics and Statistics, XLVI (November, 1964), pp. 378-391.

for all groups of male workers classified by age, except for the age groups 35-44, 55-64, and 65 and over. For females, he found no consistent relationship for most of the female age groups considered.[16] Thus, Barth's results seem to indicate that within a number of the age groups included in the category secondary workers the discouraged worker hypothesis is roughly offset by the additional worker effect. However, among prime-age males, the discouraged worker effect clearly dominates.

The OLS coefficient estimates for u_p presented in Table 4 support the hypothesis that an increase in the general level of unemployment rates (and thus in u_p) leads to a decrease in the vector of present values of adjusted expected earnings which reduces the incentive for workers to offer their services in the market. However, the discouraging effect of the shift in this vector is offset by the entrance into the labor force by secondary workers motivated to attempt to maintain family income. Except in the equation for clerical workers, the offsetting impact of the additional worker hypothesis is sufficient to render the coefficients of u_p statistically insignificant for the relatively low-skill occupations remaining.

The Aitken estimates indicate that the discouragement effect dominates in the white-collar and the service

[16] Barth, op. cit., pp. 379-380.

occupations and is statistically dominant for clerical workers. However, these results also reveal the additional worker hypothesis to be statistically dominant for laborers.

III. Summary and Conclusion

On the theoretical level, we have utilized the tools of economic theory to construct a model which determines each component of the occupational vector of unemployment as the difference between the number of workers supplied and the number demanded at a particular wage rate. The supply and demand functions are developed on the assumptions of utility- and profit-maximizing behavior on the parts of individual workers and firms, respectively. From the level of the individual worker and firm, aggregation is performed to obtain the market demand and supply functions.

On the demand side of the model, the demand for the members of the qth occupation depends on the desired vector of industry output and on the vector of expected wage rates. The supply to the qth occupation depends on the vector of expected wage rates, the probability of employment in q and in alternative occupations, and expected nonwage earnings. The probability of employment in occupation q, in turn, depends on the expected unemployment rate in the occupation. For secondary workers, the unemployment rate of married males also enters the supply function as the determinant of the level of non-wage expected earnings. To complete the model, equations hypothesizing the formulation of expected wages and unemployment rates are introduced, and sets of equations determining the vector of desired output and the vector of current wages are specified.

On the empirical level, time-series data for six major occupational groups and six major industries were collected for use in testing the model. The time period examined is from 1958 to 1966. As part of the hypothesis, the six demand and six supply equations estimated were formulated in such a manner as to incorporate a first-order autoregressive process in the individual disturbance terms. Single equation OLS was then applied to obtain maximum likelihood estimates for each equation of the parameter in the first-order autoregressive process and the coefficients in the equation. In addition, a two-step Aitken estimation procedure was applied to the system of equations. This procedure allows the relaxation of the assumption that contemporaneous disturbance terms in different equations are independent.

The results for the demand equations indicate that the sales index representing the level and composition of industry product demand is a significant determinant of labor demand in every occupational market. In addition, there is some evidence to support the expected wage hypothesis proposed in the theoretical model. The large positive constant terms in the demand equations imply that a significant number of the members of each occupation are regarded by employers as fixed factors of production in the short-run for observed fluctuations in wage rates and product demand.

The estimates of the beta coefficients for the demand equations reveal that a given percentage increase in each component of the vector of industry product demand results in larger increases in employment opportunities in the high skill occupations than in the occupations requiring a low level of skills. This result for occupational groups strongly supports Killingsworth's finding for educational groups that the demand for labor has twisted such that the long-run employment opportunities for the poorly educated have worsened while those for the well educated have improved. An implication is that expansionary monetary and fiscal policy is a relatively ineffective instrument for increasing employment in the occupational markets which have the greatest unemployment problem. A more effective policy would be programs designed to increase the upward mobility of low skilled workers. Such programs would necessarily be coupled with expansionary policies intended to maintain a high level of aggregate demand so that the demand for more highly skilled workers is sufficient to allow for the employment of retrained workers.

The supply results provide some evidence that workers respond to differentials in the present values of expected earnings in alternative occupations in making their short-run labor supply decisions. In this respect, the results obtained here are consistent with the conclusions drawn in studies examing long-run occupational choice. In addition, these results show that not only expected wage rates but also expected unemployment rates are significant in short-run supply functions to occupational groups. Among the estimated coefficients of lagged relative unemployment rates an interesting pattern emerged. The signs of the coefficient estimates for unemployment rates relative to the unemployment rate for laborers were positive and significant, while the signs for the other relative unemployment rates were nearly all in accordance with the negative sign specified in the model. The rationale advanced to explain this important perverse result focuses on the existence of "hidden unemployment" in the economy. There is reason to expect that hidden unemployment among laborers is particularly severe relative to the other occupations examined. Moreover, there is likely an inverse relationship between the unemployment rate of laborers and the level of hidden unemployment among laborers for at least a significant part of the time period examined. Therefore, the significant positive coefficients may be interpreted as an adjustment in labor supply to changes in the relevant, but unreported, level of "real" unemployment. If this interpretation is accepted, the complete set of estimates for the unemployment rate variables verify the use of the probabilistic supply function rather than an ordinary supply function in the model. Because the expected unemployment rate in an occupation is calculated using a distributed lag model, the past distribution of unemployment helps to determine the current structure of unemployment by affecting relative labor supply.

The signs and significance of the coefficient estimates for the unemployment rate of married males were mixed indicating that neither the additional worker effect nor the discouraged worker effect dominates the other in the occupational groups considered here.

To summarize, the results at both the theoretical and the empirical level lead to the conclusion that short-run fluctuations in the vector of occupational unemployment can be explained to a significant extent by a purely economic model of supply and demand. Some of the policy implications of these results are the following.

A necessary condition for reducing short-run unemployment is the direction of additional effort toward shortening the supply adjustment periods of unemployed workers who do not require additional training to locate new employment. In particular, a good deal of short-run unemployment could be eliminated by simply increasing the flow of public and private information on job opportunities so as to reduce the direct and opportunity costs of investment for these workers.

Beyond this, the results for the demand equations show that policy measures designed to raise the level of aggregate demand do not increase labor demand to the same extent in all occupations. Members of low skill occupations appear to benefit less in terms of expanded job opportunities than do members of higher skill occupations. Since the low skill occupations are primarily those with the highest unemployment rates, measures intended to maintain a high level of aggregate demand will be successful in reducing the level of long-term unemployment only if low skilled workers are assisted in receiving the additional training necessary to qualify for membership in higher skill occupations. The results for relative unemployment rates in the supply equations indicate, moreover, that retraining programs spread across the low skill-high unemployment occupations will be more successful than programs concentrating on easing unemployment in particular low skill occupations. This difference between programs arises because a reduction in unemployment in particular occupations encourages workers in related occupations and outside the labor force to enter the now more attractive occupations. Consequently, the supply of workers to these occupations would increase so that the previous level of unemployment persists.

APPENDIX

AVERAGE LABOR SUPPLIED BY OCCUPATION (000)

Occupation 1 LS1	Occupation 2 LS2	Occupation 3 LS3	Occupation 4 LS4	Occupation 5 LS5	Occupation 6 LS6
4061.983	9461.059	5857.449	9177.778	13212.088	4218.037
4105.649	9399.374	5946.294	9375.133	13073.497	4039.720
4035.454	9462.905	5924.731	9289.079	13001.125	4053.991
4116.109	9507.368	5863.489	9215.750	12794.489	4218.225
4053.070	9551.1[illegible]0	5975.269	9083.514	12643.187	4097.826
4175.236	9507.886	5965.368	9033.696	12631.157	3982.057
4120.293	9470.219	6004.348	9055.195	12654.504	4101.311
4095.488	9508.4[illegible]3	5959.052	8868.906	12679.909	4139.120
4164.054	9529.843	6072.432	8994.606	12695.847	4157.957
4189.245	9480.249	5959.870	9081.720	12680.355	4193.699
4288.100	9605.016	6006.472	9044.728	12771.335	4134.884
4332.640	9788.1[illegible]8	6046.537	9090.522	12727.473	4140.371
4309.698	9621.481	6235.167	9110.521	12801.752	4108.796
4298.851	9559.834	6145.788	9158.342	12667.029	4228.538
4340.648	9437.045	6273.412	9210.359	12644.324	4293.242
4305.439	9413.043	6119.530	8990.526	12679.266	4400.000
4248.441	9424.274	6065.591	8972.689	12756.438	4104.966
4350.569	9566.398	5962.726	8918.325	12861.290	4027.964
4427.386	9543.0[illegible]5	6077.460	89[illegible]8.333	12832.438	4048.919
4463.212	9679.461	6124.336	8972.660	12753.219	4068.182
4422.798	9779.275	6013.859	9044.351	12744.865	4370.629
4447.095	9873.444	6260.085	9023.305	12862.256	4118.119
4409.326	9905.602	6204.473	9023.379	12842.684	4141.714
4351.408	9985.447	6306.144	9028.391	12903.784	4162.685
4291.925	9884.615	6346.766	9147.368	13019.417	4242.906
4344.398	9968.815	6382.260	9212.788	13151.386	4130.872
4212.944	9908.524	6398.942	9156.677	13223.784	4268.208
4426.349	10032.191	6413.574	9152.632	13188.925	4074.661
4430.801	10146.266	6325.902	8845.188	13165.584	4229.471
4417.101	10061.2[illegible]3	6330.149	9073.529	13174.431	4064.073
4380.605	10133.195	6408.705	9021.097	13052.174	4103.687
4362.786	10247.925	6439.701	9035.941	12835.691	4035.963
4464.876	10249.480	6424.455	8975.687	12819.869	4013.777
4397.089	10210.417	6486.111	8952.331	12758.772	4006.977
4415.193	10631.360	6593.817	8991.444	12790.055	4006.961
4417.879	10245.559	6704.989	8958.199	12875.278	4087.861
4509.927	10384.134	6545.161	9029.979	12758.315	3994.062
4470.650	10340.671	6585.761	91[illegible]8.369	12920.404	3754.366
4568.134	10344.864	6604.978	9177.039	12837.808	3745.882
4458.639	10371.459	6665.227	9116.379	12805.339	3969.566
4523.109	10300.318	6716.757	9277.238	12823.661	3996.407
4389.529	10356.164	6834.236	9294.748	12844.027	3984.778
4488.959	10351.579	6837.310	9295.064	13013.304	3922.807
4471.144	10172.594	6816.534	9234.857	13119.734	3950.992
4413.136	10236.345	6817.008	9275.532	13018.681	3998.834
4363.636	10357.817	6871.212	9164.905	13080.044	3973.533
4393.651	10189.133	6734.123	9265.048	13183.896	3838.524
4345.263	10242.7[illegible]8	6690.733	9175.789	13002.181	3935.110
4371.188	10169.811	6817.503	8924.290	12878.821	3814.007
4307.612	10312.898	6864.461	9028.361	12764.069	3868.119
4279.167	10433.472	66[illegible]2.988	9045.311	12756.230	3877.153
4301.867	10456.816	6595.494	9186.709	12773.463	3798.864
4289.885	10523.818	6688.934	9241.816	12875.810	3900.115
4306.165	10512.988	6818.376	9183.069	12802.151	3881.007
4180.962	10362.878	6497.450	9285.789	12787.487	3933.107
4275.026	10707.724	6810.695	9109.705	13023.835	3923.164
4334.728	10590.814	6874.464	91[illegible]9.244	13189.805	3877.690

4296.875	10609.148	6855.165	9148.847	13208.649	3854.214
4280.793	10535.491	6989.293	9149.789	13178.687	3886.207
4396.246	10534.860	6996.788	9339.169	13205.184	3821.759
4276.440	10442.708	6944.385	9331.919	13238.095	3785.961
4421.218	10464.100	7025.614	9278.013	13356.446	3895.954
4306.485	10568.158	7146.368	9325.263	13359.002	3838.857
4430.672	10500.008	7092.357	9331.237	13451.299	3920.323
4368.092	10658.333	7206.603	9338.176	13458.787	3832.377
4327.424	10709.979	7157.614	9364.398	13400.000	3892.045
4308.655	10709.375	7118.463	9354.232	13399.354	3846.066
4394.572	10649.269	7093.617	9400.419	13559.140	3722.412
4300.940	10814.583	7069.968	9333.681	13621.767	3990.909
4314.256	10771.160	7036.325	9536.201	13526.372	3881.490
4316.337	10900.524	7055.143	9436.649	13599.783	4036.613
4264.092	10860.879	7067.308	9431.579	13566.343	3916.854
4240.125	10936.524	7052.463	9362.971	13503.792	3916.290
4311.272	11047.967	7211.091	9388.309	13755.651	3919.955
4296.066	11113.779	7295.624	9314.802	13729.904	3909.400
4271.682	11114.823	7400.000	9113.779	13816.524	4007.839
4327.443	11054.110	7436.816	9307.692	13728.922	4024.554
4385.492	11034.304	7385.760	9379.167	13712.607	3914.414
4426.365	11009.317	7213.830	9386.694	13807.487	3818.994
4447.095	10957.688	7377.258	9382.690	13798.722	3812.852
4432.851	10969.979	7386.823	9501.571	13795.940	3794.413
4504.673	10956.522	7312.500	9448.637	13770.789	3876.404
4467.425	11046.632	7317.697	9486.486	13874.334	3833.149
4550.155	11155.280	7219.149	9451.512	13877.790	3971.302
4610.134	11256.995	7313.034	9464.583	13941.676	4170.354
4499.480	11310.488	7322.650	9734.164	13960.722	4132.369
4577.963	11293.264	7238.466	9513.514	14040.212	4203.947
4567.456	11427.979	7273.305	9430.657	14133.262	3961.454
4608.290	11367.495	7255.567	9336.809	13055.143	4020.496
4794.819	11401.036	7274.176	9290.758	14162.590	4009.858
4703.320	11452.675	7440.338	9550.936	14125.000	4005.453
4574.974	11488.108	7458.774	9672.878	14119.450	3963.323
4667.010	11565.531	7481.560	9718.880	14032.666	3944.873
4730.849	11660.825	7505.796	9682.099	14063.291	3912.949
4764.463	11830.072	7450.157	9680.742	14299.370	3938.111
4757.796	11979.381	7607.966	9705.761	14303.253	4132.400
4824.742	11791.967	7639.424	9766.287	14351.097	4003.215
4719.876	11837.449	7581.152	9743.563	14721.875	3887.097
4727.085	11762.834	7536.765	9761.317	14471.757	3875.135
4690.010	11860.378	7524.160	9787.474	14373.041	3850.972
4687.307	11905.447	7533.684	9845.838	14425.131	3719.222
4642.268	12095.581	7655.391	9824.074	14770.921	3801.733
4630.658	12168.898	7636.555	9886.831	14494.229	3906.725
4590.769	12360.082	7596.639	9979.445	14409.234	3877.440
4692.784	12332.645	7633.891	9884.103	14279.749	3828.819
4672.802	12446.281	7890.985	9895.984	14310.740	3623.391
4625.387	12680.378	7908.142	9982.474	14351.042	3671.756
4554.082	12652.577	7977.825	10060.575	14551.255	3781.385

TOTAL RAW OBSERVATIONS= 108
TOTAL OBSERVATIONS DROPPED= 3
TOTAL OBSERVATIONS IN PROBLEM= 105

UNEMPLOYMENT RATES

U1	U2	U3	U4	U5	U6	UP
0.03	0.04	0.07	0.05	0.09	0.12	0.04
0.04	0.04	0.07	0.06	0.10	0.14	0.05
0.04	0.04	0.07	0.07	0.11	0.15	0.05
0.04	0.05	0.08	0.07	0.13	0.17	0.06
0.04	0.05	0.08	0.08	0.13	0.17	0.06
0.05	0.05	0.08	0.08	0.13	0.16	0.06
0.04	0.04	0.08	0.08	0.12	0.16	0.06
0.05	0.05	0.07	0.08	0.12	0.16	0.06
0.04	0.04	0.07	0.07	0.11	0.16	0.05
0.03	0.04	0.08	0.07	0.10	0.14	0.05
0.04	0.04	0.07	0.06	0.09	0.14	0.04
0.04	0.04	0.08	0.06	0.09	0.14	0.04
0.04	0.04	0.07	0.06	0.09	0.14	0.04
0.04	0.04	0.07	0.06	0.08	0.14	0.04
0.04	0.04	0.07	0.05	0.07	0.13	0.04
0.04	0.03	0.06	0.05	0.07	0.12	0.03
0.04	0.04	0.07	0.05	0.07	0.11	0.03
0.03	0.04	0.06	0.04	0.07	0.11	0.03
0.04	0.03	0.06	0.04	0.07	0.12	0.03
0.03	0.04	0.06	0.05	0.07	0.12	0.03
0.03	0.03	0.06	0.05	0.07	0.14	0.04
0.04	0.04	0.06	0.06	0.08	0.13	0.04
0.03	0.04	0.06	0.06	0.09	0.13	0.04
0.04	0.04	0.06	0.05	0.07	0.12	0.03
0.03	0.04	0.06	0.05	0.07	0.12	0.03
0.04	0.04	0.05	0.05	0.06	0.11	0.03
0.04	0.04	0.05	0.05	0.07	0.13	0.03
0.04	0.04	0.06	0.05	0.08	0.12	0.03
0.04	0.04	0.06	0.04	0.08	0.11	0.03
0.04	0.04	0.06	0.05	0.08	0.13	0.04
0.04	0.04	0.06	0.05	0.08	0.13	0.04
0.04	0.04	0.06	0.05	0.08	0.14	0.04
0.03	0.04	0.05	0.05	0.08	0.13	0.04
0.04	0.04	0.06	0.06	0.09	0.14	0.04
0.04	0.04	0.06	0.06	0.09	0.14	0.04
0.04	0.04	0.08	0.07	0.10	0.13	0.05
0.04	0.04	0.07	0.07	0.10	0.16	0.05
0.05	0.05	0.07	0.07	0.11	0.14	0.05
0.05	0.05	0.08	0.07	0.11	0.15	0.05
0.04	0.05	0.07	0.07	0.10	0.18	0.05
0.05	0.05	0.07	0.07	0.10	0.16	0.05
0.04	0.05	0.08	0.07	0.10	0.15	0.05
0.05	0.05	0.08	0.07	0.10	0.14	0.05
0.05	0.04	0.08	0.06	0.10	0.14	0.05
0.06	0.05	0.07	0.06	0.09	0.14	0.04
0.05	0.05	0.08	0.05	0.09	0.13	0.04
0.05	0.04	0.07	0.05	0.08	0.13	0.04
0.05	0.04	0.07	0.05	0.08	0.14	0.04
0.05	0.05	0.06	0.05	0.08	0.13	0.04
0.04	0.04	0.06	0.05	0.08	0.13	0.04
0.04	0.04	0.06	0.05	0.08	0.13	0.03
0.04	0.04	0.07	0.05	0.07	0.12	0.04
0.04	0.03	0.06	0.05	0.07	0.13	0.03
0.04	0.04	0.06	0.05	0.07	0.13	0.04
0.04	0.04	0.06	0.05	0.07	0.12	0.03
0.05	0.04	0.06	0.05	0.08	0.11	0.03
0.04	0.04	0.07	0.05	0.08	0.12	0.03

0.04	0.04	0.06	0.05	0.07	0.12	0.03
0.04	0.04	0.07	0.05	0.07	0.13	0.03
0.04	0.04	0.07	0.05	0.07	0.14	0.03
0.04	0.04	0.06	0.06	0.08	0.13	0.04
0.05	0.04	0.06	0.05	0.08	0.13	0.04
0.04	0.04	0.06	0.05	0.08	0.13	0.03
0.05	0.04	0.06	0.05	0.08	0.13	0.03
0.04	0.04	0.06	0.05	0.08	0.13	0.03
0.04	0.04	0.06	0.04	0.07	0.12	0.03
0.04	0.04	0.06	0.04	0.07	0.12	0.03
0.04	0.04	0.06	0.05	0.07	0.12	0.03
0.04	0.04	0.07	0.04	0.07	0.12	0.03
0.04	0.04	0.06	0.05	0.07	0.11	0.03
0.04	0.04	0.06	0.04	0.08	0.13	0.03
0.04	0.04	0.06	0.05	0.07	0.11	0.03
0.04	0.04	0.07	0.04	0.08	0.12	0.03
0.03	0.04	0.07	0.04	0.07	0.11	0.03
0.03	0.04	0.06	0.04	0.07	0.12	0.03
0.04	0.04	0.06	0.04	0.07	0.11	0.03
0.04	0.04	0.06	0.04	0.06	0.10	0.03
0.03	0.04	0.06	0.04	0.06	0.11	0.03
0.03	0.03	0.06	0.04	0.06	0.10	0.03
0.04	0.03	0.06	0.04	0.06	0.11	0.03
0.03	0.03	0.06	0.04	0.06	0.10	0.03
0.04	0.03	0.06	0.05	0.06	0.11	0.03
0.03	0.03	0.06	0.04	0.06	0.09	0.02
0.03	0.03	0.06	0.04	0.06	0.09	0.03
0.03	0.03	0.06	0.04	0.06	0.10	0.03
0.04	0.04	0.06	0.04	0.06	0.10	0.03
0.04	0.03	0.05	0.04	0.05	0.09	0.02
0.03	0.03	0.06	0.04	0.06	0.09	0.02
0.03	0.03	0.06	0.04	0.06	0.07	0.02
0.03	0.03	0.06	0.04	0.06	0.09	0.02
0.04	0.03	0.05	0.04	0.06	0.08	0.02
0.03	0.03	0.05	0.03	0.05	0.07	0.03
0.03	0.03	0.05	0.04	0.05	0.09	0.02
0.03	0.03	0.05	0.03	0.05	0.08	0.02
0.03	0.03	0.05	0.03	0.05	0.08	0.02
0.04	0.03	0.05	0.03	0.05	0.07	0.02
0.03	0.03	0.04	0.03	0.04	0.07	0.02
0.03	0.03	0.04	0.03	0.04	0.07	0.02
0.03	0.03	0.05	0.03	0.04	0.07	0.02
0.03	0.03	0.05	0.03	0.04	0.07	0.02
0.03	0.03	0.05	0.03	0.04	0.07	0.02
0.03	0.03	0.05	0.03	0.04	0.08	0.02
0.03	0.03	0.05	0.03	0.05	0.08	0.02
0.02	0.03	0.05	0.03	0.05	0.08	0.02
0.03	0.03	0.04	0.02	0.04	0.08	0.02
0.02	0.03	0.05	0.03	0.04	0.07	0.02
0.03	0.03	0.04	0.03	0.04	0.08	0.02
0.02	0.03	0.05	0.03	0.04	0.08	0.02

TOTAL RAW OBSERVATIONS= 108
TOTAL OBSERVATIONS DROPPED= 3
TOTAL OBSERVATIONS IN PROBLEM= 105

AVERAGE EMPLOYMENT BY OCCUPATION (000)

Occupation 1 L1	Occupation 2 L2	Occupation 3 L3	Occupation 4 L4	Occupation 5 L5	Occupation 6 L6
3932.000	9111.000	5465.000	8673.000	12023.000	3695.000
3925.000	9014.000	5536.000	8822.000	11740.000	3458.000
3870.000	9056.000	5510.000	8676.000	11558.000	3454.000
3935.000	9032.000	5412.000	8543.000	11144.000	3518.000
3979.000	9042.000	5512.000	8311.000	11027.000	3329.000
3939.000	9063.000	5524.000	8367.000	11098.000	3441.000
3963.000	9052.000	5530.000	8186.000	11171.000	3481.000
3985.000	9101.000	5617.000	8338.000	11312.000	3501.000
4051.000	9120.000	5495.000	8446.000	11425.000	3594.000
4108.000	9192.000	5568.000	8493.000	11673.000	3556.000
4168.000	9377.000	5587.000	8536.000	11582.000	3569.000
4133.000	9227.000	5780.000	8573.000	11688.000	3550.000
4114.000	9187.000	5691.000	8618.000	11641.000	3645.000
4154.000	9069.000	5828.000	8713.000	11696.000	3748.000
4116.000	9093.000	5734.000	8541.000	11741.000	3872.000
4087.000	9085.000	5641.000	8542.000	11889.000	3637.000
4207.000	9222.000	5599.000	8517.000	11961.000	3601.000
4268.000	9209.000	5713.000	8552.000	11947.000	3559.000
4307.000	9331.000	5763.000	8533.000	11886.000	3580.000
4268.000	9437.000	5641.000	8565.000	11789.000	3790.000
4287.000	9518.000	5897.000	8518.000	11859.000	3591.000
4255.000	9549.000	5926.000	8491.000	11674.000	3624.000
4173.000	9606.000	5953.000	8586.000	11936.000	3659.000
4146.000	9509.000	5985.000	8690.000	12069.000	3738.000
4188.000	9590.000	6044.000	8789.000	12336.000	3693.000
4036.000	9532.000	6047.000	8708.000	12232.000	3692.000
4267.000	9661.000	6048.000	8695.000	12147.000	3602.000
4258.000	9781.000	5959.000	8456.000	12165.000	3760.000
4236.000	9699.000	5963.000	8638.000	12160.000	3552.000
4201.000	9738.000	6037.000	8552.000	12038.000	3562.000
4197.000	9879.000	6034.000	8548.000	11796.000	3479.000
4322.000	9860.000	6073.000	8491.000	11743.000	3496.000
4230.000	9802.000	6071.000	8451.000	11636.000	3446.000
4243.000	10238.000	6185.000	8437.000	11575.000	3454.000
4250.000	9805.000	6182.000	8358.000	11562.000	3536.000
4316.000	9948.000	6087.000	8434.000	11508.000	3363.000
4265.000	9865.000	6105.000	8489.000	11525.000	3225.000
4358.000	9869.000	6103.000	8593.000	11477.000	3184.000
4258.000	9884.000	6172.000	8460.000	11512.000	3263.000
4306.000	9775.000	6213.000	8600.000	11490.000	3537.000
4192.000	9828.000	6308.000	8672.000	11611.000	3403.000
4269.000	9834.000	6304.000	8663.000	11738.000	3354.000
4261.000	9725.000	6278.000	8690.000	11834.000	3386.000
4166.000	9745.000	6333.000	8719.000	11847.000	3431.000
4128.000	9871.000	6349.000	8670.000	11929.000	3453.000
4152.000	9751.000	6256.000	8774.000	12116.000	3328.000
4128.000	9833.000	6209.000	8717.000	11923.000	3396.000
4157.000	9702.000	6388.000	8487.000	11797.000	3322.000
4131.000	9921.000	6432.000	8595.000	11794.000	3373.000
4108.000	10037.000	6187.000	8584.000	11774.000	3377.000
4147.000	10049.000	6147.000	8709.000	11841.000	3343.000
4114.000	10166.000	6260.000	8752.000	11923.000	3397.000
4121.000	10124.000	6382.000	8678.000	11906.000	3392.000
3997.000	9938.000	6269.000	8774.000	11854.000	3469.000
4057.000	10258.000	6368.000	8636.000	12021.000	3472.000
4144.000	10146.000	6407.000	8672.000	12161.000	3424.000

4125.000	10206.000	6437.000	8728.000	12218.000	3384.000
4131.000	10093.000	6528.000	8674.000	12243.000	3381.000
4216.000	10124.000	6535.000	8845.000	12228.000	3302.000
4044.000	10025.000	6493.000	[illegible]	12232.000	3290.000
4209.000	10056.000	6583.000	8777.000	12328.000	3370.000
4117.000	10156.000	6469.000	8859.000	12317.000	3359.000
4218.000	10101.000	6681.000	8902.000	12429.000	3395.000
4169.000	10232.000	6767.000	[illegible]	12404.000	3338.000
4150.000	10303.000	6721.000	8943.000	12395.000	3425.000
4132.000	10281.000	6670.000	8952.000	12448.000	3373.000
4210.000	10202.000	6668.000	8968.000	12610.000	3272.000
4116.000	10382.000	6568.000	8951.000	12641.000	3312.000
4146.000	10308.000	6586.000	9088.000	12566.000	3439.000
4146.000	10410.000	6653.000	9012.000	12539.000	3328.000
4065.000	10383.000	6615.000	8960.000	12576.000	3486.000
4079.000	10510.000	6587.000	8951.000	12464.000	3462.000
4169.000	10595.000	6736.000	8994.000	12779.000	3477.000
4150.000	10647.000	6836.000	8914.000	12810.000	3452.000
4068.000	10648.000	6919.000	8731.000	12877.000	3379.000
4163.000	10623.000	6955.000	8954.000	12864.000	3606.000
4232.000	10615.000	6950.000	9034.000	12835.000	3476.000
4298.000	10635.000	6781.000	9030.000	12910.000	3418.000
4267.000	10618.000	6942.000	8998.000	12957.000	3382.000
4291.000	10597.000	6951.000	9074.000	12913.000	3396.000
4338.000	10584.000	6903.000	9014.000	12917.000	3450.000
4320.000	10660.000	6864.000	9126.000	13028.000	3469.000
4400.000	10776.000	6786.000	9064.000	13059.000	3598.000
4458.000	10863.000	6845.000	9086.000	13147.000	3770.000
4324.000	10892.000	6854.000	9374.000	13151.000	3715.000
4404.000	10898.000	6812.000	9152.000	13268.000	3834.000
4435.000	11028.000	6866.000	9044.000	13257.000	3597.000
4447.000	10981.000	6842.000	8954.000	12311.000	3727.000
4627.000	11002.000	6845.000	8947.000	13360.000	3661.000
4534.000	11132.000	7046.000	9188.000	13334.000	3673.000
4424.000	11109.000	7056.000	9344.000	13357.000	3674.000
4527.000	11207.000	[illegible]	9369.000	13317.000	3578.000
4570.000	11311.000	7123.000	9411.000	13332.000	3596.000
4612.000	11487.000	[illegible]	9430.000	13613.000	3627.000
4577.000	11620.000	7258.000	9434.000	13631.000	3839.000
4680.000	11450.000	7267.000	9444.000	13734.000	3735.000
4583.000	11506.000	7240.000	9461.000	14133.000	3615.000
4590.000	11457.000	7175.000	9488.000	13835.000	3600.000
4554.000	11552.000	7163.000	9533.000	13755.000	3566.000
4542.000	11584.000	7157.000	[illegible]	13776.000	3444.000
4503.000	11769.000	7242.000	9549.000	14121.000	3509.000
4501.000	11816.000	7270.000	9610.000	13813.000	3602.000
4476.000	12014.000	7232.000	[illegible]	13732.000	3575.000
4552.000	11938.000	7299.000	9637.000	13688.000	3534.000
4570.000	12048.000	7528.000	[illegible]	13724.000	3377.000
4482.000	12338.000	7576.000	9683.000	13777.000	3367.000
4463.000	12273.000	7555.000	9799.000	13911.000	3494.000

TOTAL RAW OBSERVATIONS= 108
TOTAL OBSERVATIONS DROPPED= 3
TOTAL OBSERVATIONS IN PROBLEM= 105

SALES

SH1	SH2	SH3	SH4	SH5	SH6
8852013.080	1336436.440	3345476.540	9713689.210	457830.090	3086322.570
8753227.720	1319966.880	3008032.940	9463076.240	453565.130	3006991.390
8689104.500	1318656.640	2984181.980	9256023.470	451258.590	2942274.950
8740654.340	1327920.950	2993845.490	9164782.590	453462.540	2913261.660
8812478.700	1334418.170	3020736.170	9253713.530	457389.780	2941493.900
8881438.290	1348781.300	3058520.380	9488125.300	461580.340	3017121.900
8988061.850	1362870.490	3089432.220	9532459.820	466116.410	3030855.770
9074298.800	1380435.440	3126338.940	9673327.770	470588.530	3076642.440
9033835.420	1379128.050	3123917.660	9856541.830	470095.440	3135057.510
9088401.670	1385622.880	3152375.720	10050097.020	473437.410	3196900.790
9245779.610	1413606.260	3206844.130	10200605.110	480123.610	3245353.540
9376801.670	1426465.180	3234924.590	10273779.600	485499.660	3266244.020
9445996.720	1437533.080	3266414.620	10418230.130	489499.440	3312858.090
9555652.830	1451462.250	3312269.640	10752303.490	495485.260	3418516.550
9623202.310	1468935.340	3341760.660	10873400.760	499096.660	3457082.670
9768035.070	1484176.460	3402254.970	11217034.290	506652.440	3567086.840
9891434.510	1500180.880	3447796.390	11398558.450	512684.880	3624798.230
9868578.260	1505941.220	3439767.460	11393233.220	512330.850	3623379.810
9874344.840	1508850.910	3435898.680	11175865.130	512603.410	3555146.830
9718330.500	1493465.980	3353442.890	10429434.190	504562.560	3318208.300
9676948.770	1495957.540	3348896.140	10346217.580	503828.930	3293840.970
9678093.950	1489809.070	3341573.190	10401327.270	504583.060	3309346.880
9558459.200	1488810.640	3320547.870	10283026.800	500937.830	3275397.380
9724225.440	1497161.250	3401168.570	11116424.080	510489.470	3538019.360
9936072.630	1519966.360	3471026.230	11488184.310	519748.760	3654358.940
9891228.820	1525134.360	3456120.340	11357237.070	517847.520	3614062.960
9876235.400	1513980.360	3441010.760	11237089.530	517277.750	3574426.580
10026477.290	1541122.930	3481563.220	11172764.820	523077.420	3554591.600
9877817.410	1521781.910	3433105.420	11068196.310	517742.420	3521250.730
9903210.400	1513998.420	3433658.400	11038035.610	518927.220	3510178.220
9857782.740	1506886.850	3421663.270	11027915.790	517661.170	3507082.900
9808085.000	1506827.680	3398406.600	10797414.280	515347.410	3434573.700
9876934.550	1511641.460	3424672.950	10929962.830	519352.500	3476290.460
9879775.600	1518645.650	3419792.490	10785039.210	519775.840	3438755.780
9744322.660	1509197.830	3378061.320	10582916.180	515031.600	3368033.590
9754506.270	1508135.810	3387248.230	10679898.180	516221.990	3398857.850
9639339.920	1502179.380	3341454.100	10346490.490	511098.010	3294034.930
9688041.090	1507804.370	3361023.530	10372967.270	513655.260	3302807.180
9795270.940	1522816.010	3402544.970	10564591.530	519154.030	3363952.140
9736467.900	1517322.370	3388554.520	10639973.080	517926.350	3387826.540
9839164.390	1527750.450	3424215.000	10825822.210	523170.190	3446115.660
9929379.550	1544564.530	3464104.080	11008027.620	527819.420	3504941.180
9936937.800	1547357.700	3458956.410	10884294.690	528119.080	3465505.490
10060883.660	1562307.790	3507729.560	11126936.040	534213.190	3542584.360
10113639.830	1565131.860	3523133.540	11221706.780	537152.250	3571691.420
10185442.310	1583678.710	3553349.640	11266981.820	540828.750	3587604.080
10266389.360	1598336.610	3582605.500	11417216.290	545061.180	3635250.600
10363489.790	1605330.410	3618514.880	11650623.850	550241.260	3708417.870
10427863.430	1618629.510	3643797.410	11782702.260	553772.090	3758603.730
10442552.620	1615514.840	3644966.510	11826724.960	555096.210	3763424.240
10588504.040	1632242.910	3694484.560	12081629.890	562110.270	3843589.630
10633991.180	1641581.820	3709284.850	12072450.970	564578.460	3840896.430
10641773.440	1646427.100	3708065.220	12022293.250	565359.120	3824958.320
10563002.710	1644827.060	3685878.110	11801708.640	562331.010	3757044.740
10653780.400	1650879.270	3709852.240	11932878.130	566460.180	3797021.080
10672890.200	1652849.840	3716838.370	12006541.170	567882.350	3820806.400
10718619.030	1660080.500	3727768.840	11877226.900	569863.930	3780087.320

10719445.080	1667390.190	3728037.610	11900123.990	570808.320	3796279.300
10865333.710	1687034.840	3778422.530	1202[illegible]865.260	577497.920	3825608.740
10778675.570	1687737.5[illegible]0	3744441.550	11824097.430	573842.980	3763085.800
10867933.310	1685817.130	377[illegible]362.110	12043360.980	578289.490	3837295.790
10944762.910	1705972.350	3814498.930	12251418.350	582695.360	3899461.000
11012549.070	1712623.850	3833283.890	12274029.400	585828.200	3906133.970
11035735.010	1719612.770	3851153.780	12402853.690	587957.010	3947914.110
11025571.600	1709564.240	3847342.340	12496177.470	588396.200	3976157.600
1112[illegible]446.050	1728276.650	3877429.340	12591324.700	592923.070	4003264.530
11247145.010	1751832.290	3933579.120	12855562.670	599577.850	4091579.230
11112836.090	1746058.180	3843996.430	12537281.060	594302.630	3991805.270
11116857.560	1749419.530	3897115.490	12455182.840	595198.380	3966675.640
11209066.000	1764441.6[illegible]0	3923378.900	12756379.040	600208.190	4061616.440
11193278.400	1752865.780	3906366.190	1262[illegible]869.220	599942.740	4017102.220
11476755.220	1785866.620	4[illegible]058[illegible]0.080	12858223.870	612822.510	4092972.010
1155[illegible]655.230	1806425.470	4[illegible]47938.320	13145294.160	617924.560	4191847.510
1156[illegible]365.450	1815114.640	4[illegible]41005.760	130993[illegible]5.860	618768.780	4170263.990
11556632.790	1813302.960	4[illegible]39595.770	13046936.730	619437.070	4153764.390
1174[illegible]642.700	1827029.7[illegible]0	4103358.920	1334[illegible]1[illegible]9.390	628361.170	4245581.340
11861195.140	1854677.310	4145346.950	1330[illegible]942.510	633683.370	4235100.140
11807098.830	1855729.910	4125478.630	13213762.160	632118.690	4207709.660
11972142.930	1870920.790	4192399.870	1365[illegible]144.060	64[illegible]671.180	4345546.280
11989446.940	1882227.820	4192115.300	13347694.580	64[illegible]768.050	4249938.020
12031510.020	1887944.480	4195937.810	13414952.390	643239.610	4270986.300
11802771.510	1867679.290	4137967.680	13073383.430	635022.550	4166629.470
11931914.800	1886235.9[illegible]0	4187052.060	13401643.990	641617.040	4270393.400
12431665.730	1937232.9[illegible]0	4346855.950	14144271.900	653285.540	4502072.960
12394470.930	1942195.990	4331410.980	14052619.180	662232.620	4473429.250
1238[illegible]569.360	1935447.310	4316132.410	14016193.790	662233.370	4460061.200
12588165.760	1974785.050	4423956.890	14522034.080	673652.340	4624084.480
12586192.240	1970002.370	4414399.660	14375343.280	674121.150	4577431.940
12718051.070	1991225.270	4444587.170	14252741.920	679536.630	4538337.330
12727793.620	1994846.530	4451142.360	1431576[illegible].430	681285.160	4558445.540
1299[illegible]299.530	2021212.880	4548375.730	149265[illegible]7.310	694383.910	4750526.120
12848452.050	2012281.330	4494443.340	14589932.000	688975.970	4644626.270
12852652.170	2021562.360	4492421.850	14469975.980	689628.600	4607329.920
13055577.890	2049365.330	4553017.980	14644076.390	698521.330	4661599.630
13281485.250	2083883.710	4637328.430	14942067.900	709052.800	4757083.480
13471830.200	2094758.050	4706755.440	15343286.290	718856.310	4582745.520
13608144.380	2146000.430	4759250.990	15387421.230	725441.680	4901729.160
13581229.870	2137594.520	4757274.230	15424296.840	725529.170	4912127.390
13933219.540	2189266.830	4888733.830	15927746.830	741963.800	5072948.190
13722422.400	2153999.830	4814987.090	15628992.740	734624.280	4977683.800
13699005.870	2140986.170	4817039.580	15734754.880	735960.710	5011011.080
13962798.730	2199155.980	4901916.120	15816036.210	747360.430	5038765.270
13967360.540	2182598.080	4892441.980	15877865.420	749212.770	5055143.630
14024430.270	2202135.190	4912410.880	15829954.810	752744.780	5041328.850
14005278.750	2196015.460	4898434.830	15852399.750	752895.240	5046706.940
13986285.130	2195714.350	4903952.090	16047886.860	754052.230	5108988.340
14004147.290	2185707.4[illegible]0	4695819.660	15971039.710	755285.890	5082319.410
14152339.590	2213563.980	4967492.360	16271182.170	770922.740	5179176.470

TOTAL RAW OBSERVATIONS= 108
TOTAL OBSERVATIONS DROPPED= 3
TOTAL OBSERVATIONS IN PROBLEM= 105

MONEY WAGES (00)

WH1	WH2	WH3	WH4	WH5	WH6
60.402	45.992	38.007	62.414	45.162	37.045
60.051	45.456	37.851	59.898	44.483	35.528
59.995	45.693	37.792	61.779	44.785	36.667
59.596	45.7[illegible]7	38.241	61.876	44.629	36.716
60.329	46.249	38.594	63.190	45.155	37.511
61.024	46.669	38.843	63.266	45.648	37.546
61.321	46.8[illegible]6	38.830	63.746	45.843	37.838
61.657	47.2[illegible]1	38.961	64.774	46.381	38.449
62.228	47.6[illegible]9	38.990	65.440	46.924	38.844
62.070	47.596	39.095	65.668	46.886	38.981
62.322	47.622	38.840	64.237	47.119	38.098
63.068	48.076	38.962	64.466	47.721	38.224
62.879	47.884	38.940	64.481	47.413	38.245
62.919	47.903	39.129	63.513	47.395	37.649
63.654	48.559	39.438	64.868	48.153	38.458
63.800	49.068	40.161	66.229	48.489	39.267
64.138	49.4[illegible]1	40.527	66.842	48.753	39.634
64.455	49.7[illegible]5	40.755	67.582	49.031	40.078
64.405	49.3[illegible]3	40.539	67.015	48.570	39.760
64.166	49.187	40.502	67.702	48.377	40.186
64.224	49.071	40.385	66.432	48.321	39.416
63.769	48.968	40.359	66.881	48.139	39.689
63.832	48.656	40.173	65.176	47.843	38.664
64.446	49.515	40.288	67.238	49.358	39.877
64.322	49.296	40.165	65.940	48.832	39.085
63.909	49.026	40.254	65.454	48.425	38.797
64.106	49.115	40.341	65.918	48.396	39.089
63.980	49.213	40.872	66.939	48.196	39.717
64.608	49.763	41.275	67.372	48.874	39.960
65.022	50.061	41.446	67.993	49.072	40.337
65.281	50.146	41.670	68.860	49.137	40.875
64.647	49.861	41.531	68.837	48.815	40.860
64.703	49.926	41.339	68.895	48.978	40.892
64.490	49.827	41.245	69.185	48.849	41.073
64.050	49.124	40.971	66.177	48.066	39.259
63.738	48.815	40.727	65.237	47.728	38.695
64.254	49.240	40.654	67.759	48.314	40.229
64.061	49.147	40.675	67.358	48.214	39.981
64.358	49.311	40.916	66.836	48.343	39.659
64.984	49.886	41.532	67.325	48.827	39.940
65.525	50.5[illegible]9	41.026	68.812	49.552	40.824
66.273	51.141	42.440	7[illegible].129	50.173	41.614
66.465	51.1[illegible]8	42.406	7[illegible].100	50.113	41.606
66.059	51.130	42.473	7[illegible].897	50.132	42.081
66.135	50.917	42.346	7[illegible].063	49.819	41.592
66.469	51.490	42.432	71.445	50.690	42.400
66.778	51.5[illegible]5	42.329	7[illegible].064	50.811	41.555
67.072	51.627	42.380	69.184	50.998	41.010
66.272	50.891	42.073	67.508	50.154	40.007
66.202	50.976	42.147	68.127	50.212	40.381
66.733	51.462	42.446	69.83[illegible]	50.684	41.413
67.147	52.010	43.064	7[illegible].815	51.141	41.997
67.489	52.375	43.559	71.909	51.370	42.659
67.960	52.666	44.064	71.401	51.980	42.343
67.878	52.658	44.095	72.607	51.471	43.087
67.580	52.584	44.062	72.982	51.357	43.315
67.781	52.688	43.77[illegible]	73.220	51.631	43.457

67.234	52.400	43.710	72.735	51.226	43.105
67.613	52.322	43.492	70.936	51.348	42.067
68.067	52.507	43.498	70.302	51.615	41.675
67.443	52.041	43.086	70.510	51.136	41.821
67.387	51.933	43.147	69.468	50.984	41.101
67.949	52.433	43.489	71.147	51.452	42.201
67.879	52.638	44.086	71.747	51.349	42.502
68.683	53.423	44.558	73.272	52.264	43.466
69.176	53.897	45.019	73.966	52.730	43.873
68.725	53.494	44.915	73.729	52.178	43.747
68.626	53.423	44.895	74.178	52.068	44.027
69.199	53.860	44.861	74.555	52.733	44.241
69.196	54.018	44.966	75.466	52.877	44.792
68.805	53.377	44.561	71.997	52.308	42.684
69.315	53.667	44.489	72.248	52.765	42.828
68.037	52.686	44.133	70.472	51.563	41.771
68.851	53.379	44.494	72.469	52.308	42.976
69.142	53.613	44.490	73.078	52.485	43.347
69.513	54.234	45.396	74.287	53.017	44.811
70.058	54.723	45.922	75.185	53.432	44.598
70.211	55.062	46.402	75.447	53.726	44.738
70.162	54.872	46.493	75.404	53.348	44.731
70.217	55.081	46.470	76.410	53.659	45.333
70.220	54.976	46.306	74.694	53.688	44.279
70.130	54.926	46.247	76.819	53.515	45.598
70.424	54.847	45.906	74.694	53.614	44.298
71.068	55.458	45.906	75.915	54.534	45.814
70.384	54.797	45.528	74.643	53.803	44.257
70.657	55.018	45.800	74.755	53.968	44.321
71.106	55.509	46.142	75.836	54.498	44.964
70.652	55.283	46.640	74.978	53.856	44.450
71.589	56.147	47.098	77.596	54.793	46.030
71.275	56.113	47.394	77.155	54.694	45.751
71.613	56.177	47.662	77.434	54.598	45.933
71.764	56.274	47.648	78.314	54.711	46.474
71.763	56.186	47.375	77.011	54.809	45.672
72.017	56.570	47.389	78.910	55.263	46.820
72.017	56.239	47.117	76.253	55.037	45.205
72.481	56.597	47.097	77.589	55.478	46.016
71.828	56.047	46.742	76.552	54.848	45.397
78.328	61.175	51.015	83.570	59.948	49.555
71.939	56.413	47.122	77.861	55.191	46.183
71.972	56.448	47.509	77.074	55.033	45.703
72.548	56.867	47.953	77.583	55.432	46.805
72.948	57.367	48.508	78.974	55.862	46.838
72.883	57.167	48.663	79.449	55.381	47.154
72.405	56.967	48.394	79.123	55.309	46.948
72.636	57.228	48.027	80.018	55.828	47.480
72.562	57.181	48.015	79.936	55.775	47.453
72.498	56.777	47.870	77.264	55.343	45.815
72.935	57.114	47.883	78.786	55.708	46.743

TOTAL RAW OBSERVATIONS= 108
TOTAL OBSERVATIONS DROPPED= 3
TOTAL OBSERVATIONS IN PROBLEM= 105

SUMS OF 108 RAW OBSERVATIONS

REAL WAGES (00)

E1	E2	E3	E4	E5	E6
59.759	45.533	37.388	62.570	44.822	37.150
59.538	45.148	37.286	60.504	44.340	35.902
59.681	45.634	37.478	62.823	44.882	37.299
59.417	45.682	37.985	62.654	44.734	37.188
60.123	46.220	38.335	63.992	45.261	37.997
60.906	46.645	38.614	63.749	45.749	37.838
61.295	46.855	38.675	64.341	46.002	38.197
61.547	47.164	38.732	65.251	46.453	38.739
62.106	47.522	38.754	65.535	46.941	38.902
61.998	47.536	38.862	65.785	46.940	39.053
62.234	47.578	38.473	64.412	47.154	38.204
62.813	47.891	38.713	64.467	47.590	38.228
62.616	47.715	38.728	64.526	47.290	38.275
62.575	47.664	38.876	63.468	47.188	37.626
63.231	48.267	39.178	64.781	47.868	38.411
63.380	48.810	39.969	66.229	48.220	39.271
63.744	49.168	40.368	66.890	48.497	39.666
64.347	49.645	40.747	67.535	48.951	40.050
64.526	49.4.3	40.649	67.171	48.641	39.854
64.352	49.258	40.576	67.450	48.424	40.035
64.428	49.227	40.570	66.358	48.464	39.366
64.356	49.345	40.671	67.057	48.512	39.789
64.547	49.116	40.529	65.440	48.304	38.817
65.107	49.934	40.636	67.442	49.481	39.993
64.806	49.621	40.472	66.075	49.134	39.161
64.459	49.399	40.604	65.655	48.773	38.912
64.448	49.390	40.680	66.045	48.621	39.159
64.609	49.731	41.412	67.396	48.659	39.983
65.384	50.368	41.833	67.902	49.459	40.267
65.944	50.755	42.286	68.639	49.722	40.716
66.169	50.8.3	42.337	69.160	49.739	41.043
65.687	50.583	42.206	69.182	49.494	41.055
65.833	50.722	42.055	69.332	49.746	41.141
65.749	50.775	42.113	69.867	49.763	41.466
65.408	50.123	41.875	66.913	49.022	39.686
65.127	49.852	41.665	66.033	48.724	39.157
65.435	50.194	41.548	68.821	49.207	40.854
65.296	50.148	41.610	68.481	49.154	40.643
65.604	50.315	41.858	67.953	49.284	40.317
66.445	50.953	42.494	68.142	49.848	40.415
67.214	51.689	42.877	69.695	50.742	41.337
68.297	52.515	43.493	71.214	51.566	42.249
68.580	52.578	43.607	71.030	51.596	42.142
68.045	52.534	43.634	71.753	51.558	42.571
68.345	52.476	43.629	71.124	51.369	42.205
68.716	53.091	43.720	72.552	52.328	43.058
69.019	53.090	43.614	71.150	52.422	42.181
69.063	53.070	43.614	7..136	52.440	41.556
68.049	52.219	43.287	68.370	51.449	40.500
68.222	52.458	43.484	68.867	51.680	40.795
68.857	53.027	43.836	70.658	52.251	41.878
69.488	53.712	44.559	71.790	52.827	42.550
69.902	54.098	45.173	72.884	53.064	43.214
70.553	54.493	45.642	72.480	53.383	42.961
70.319	54.251	45.712	71.879	53.002	42.604
70.082	54.389	45.714	73.750	53.131	43.739
70.342	54.661	45.642	74.314	53.544	44.072

69.995	54.448	45.555	73.854	53.246	43.796
70.360	54.324	45.324	71.696	53.331	42.474
70.827	54.468	45.252	71.979	53.565	42.040
70.282	54.074	44.938	71.305	53.160	42.250
70.430	54.090	45.023	71.388	53.148	41.691
71.230	54.725	45.431	72.174	53.767	42.774
71.274	54.999	46.062	72.819	53.741	43.161
71.911	55.692	46.539	74.250	54.520	44.009
72.437	56.218	47.167	74.740	54.983	44.289
72.122	55.982	47.264	74.780	54.567	44.327
72.389	56.173	47.282	75.461	54.865	44.739
72.816	56.463	47.222	75.692	55.282	44.872
72.753	56.6.9	47.367	76.613	55.388	45.429
72.422	56.055	47.030	73.317	54.919	43.423
73.203	56.494	47.042	73.732	55.518	43.606
71.563	55.270	46.676	71.160	54.019	42.126
72.556	56.016	47.022	73.118	54.830	43.309
73.023	56.370	47.282	73.835	55.149	43.744
73.508	57.081	48.073	75.039	55.759	44.450
74.178	57.631	48.636	76.036	56.237	45.049
74.477	58.052	49.227	76.068	56.601	45.047
74.409	57.9.2	49.446	76.129	56.216	45.101
74.453	58.092	49.378	77.072	56.527	45.665
74.399	57.981	49.279	75.139	56.540	44.476
74.258	57.885	49.247	77.158	56.282	45.733
74.751	57.948	48.979	75.286	56.530	44.585
75.465	58.6.8	49.017	76.563	57.511	45.333
74.626	57.875	48.647	75.282	56.659	44.572
74.848	58.050	48.932	75.034	56.778	44.416
75.359	58.610	49.340	76.169	57.383	45.089
74.856	58.434	49.998	75.448	56.728	44.655
75.802	59.325	50.599	77.747	57.653	46.039
75.392	59.360	51.120	77.523	57.546	45.886
75.733	59.393	51.443	77.440	57.390	45.849
75.731	59.347	51.330	78.100	57.346	46.260
75.854	59.377	51.134	77.024	57.579	45.593
76.128	59.755	51.216	78.559	57.995	46.519
76.059	59.444	51.036	76.112	57.767	45.030
76.485	59.824	51.136	77.199	58.184	45.685
75.558	59.135	50.738	76.102	57.389	45.032
75.650	59.4.0	51.093	76.562	57.675	45.297
75.822	59.779	51.530	77.823	57.929	46.058
76.106	60.022	52.178	77.037	57.940	45.572
76.605	60.364	52.691	77.153	58.190	45.659
77.167	61.014	53.455	78.670	58.741	46.544
77.006	60.8.5	53.767	78.870	58.185	46.691
76.562	60.680	53.678	78.439	56.141	46.415
76.996	61.094	53.402	79.526	58.836	47.061
77.380	61.332	53.583	79.758	59.046	47.203
77.511	61.045	53.486	77.337	58.734	45.739
78.053	61.436	53.541	78.854	59.151	46.662

TOTAL RAW OBSERVATIONS= 108
TOTAL OBSERVATIONS DROPPED= 3
TOTAL OBSERVATIONS IN PROBLEM= 105

CONSTRUCTION AND SOURCES OF SAMPLE DATA

The construction of the sample data used in the regression analysis is described below and a listing of the data sources follows. Monthly observations were obtained for the period 1958 to 1966. The subscript j refers to the jth industry, j=1,...,6. The six industries examined in the study are numbered as follows: construction, 1; durable goods manufacturing, 2; nondurable goods manufacturing, 3; wholesale trade, 4; retail trade, 5; and services, 6. The subscript q refers to the qth occupational group, q=1,...,6. The six major occupations considered are: clerical workers, 1; sales workers, 2; service workers, 3; craftsmen and foremen, 4; operatives, 5; and laborers, 6. It was decided to report the empirical results in the text with clerical workers labeled the first occupation and sales workers the second. However, in the data fed to the computer, the order of these two occupations was reversed. Hence, for example, the data series labeled LD1 above is the number of employed sales workers, while LD2 is the number of employed clerical workers.

$\tilde{\ell}_q^d$: Number of employed members of the qth occupational group, thousands of workers.

$$\tilde{\ell}_q^d \text{ (=LDq) } = (1)$$

u_q: Unemployment rate in the qth occupational group, per cent.

$$u_q \text{ (=Uq) } = (2)$$

u_p: Unemployment rate of married males, per cent.

$$u_p \text{ (=UP) } = (3)$$

$\tilde{\ell}_q^s$: Number of members of occupation q, thousands of workers.

$$\tilde{\ell}_q^s \text{ (=LSq) } = \frac{(1)}{1 - (2)}$$

s_1: Sales of the construction industry.

$$s_1 = (4)$$

s_2: Sales of durable goods manufacturing, billions of dollars.

$$s_2 = (5)$$

s_3: Sales of nondurable goods manufacturing, billions of dollars.

$$s_3 = (6)$$

s_4: Sales of the wholesale trade industry, billions of dollars.

$$s_4 = (7)$$

s_5: Sales of the retail trade industry, billions of dollars.

$$s_5 = (8)$$

s_6: Sales of the services industry, billions of dollars.

$$s_6 = (9)$$

PI_1: Price index for the construction industry, 1959:100.

$$PI_1 = (10)$$

PI_2: Price index for durable goods manufacturing, 1959:100.

$$PI_2 = (11)$$

PI_3: Price index for nondurable goods manufacturing, 1959:100.

$$PI_3 = (12)$$

PI_4: Price index for the wholesale trade industry, 1959:100.

$$PI_4 = (13)$$

PI_5: Price index for the retail trade industry, 1959:100.

$$PI_5 = (14)$$

PI_6: Price index for the services industry, 1959:100.

$$PI_6 = (15)$$

CPI: Consumer price index, 1959:100.

$$CPI = (16)$$

ΔI_2: Change in inventories of durable goods manufacturing, billions of dollars.

$$\Delta I_2 = (17)$$

ΔI_3: Change in inventories of nondurable goods manufacturing, billions of dollars.

$$\Delta I_3 = (18)$$

ΔI_4: Change in inventories for the wholesale trade industry, billions of dollars.

$$\Delta I_4 = (19)$$

ΔI_5: Change in inventories for the retail trade industry, billions of dollars.

$$\Delta I_5 = (20)$$

y_1: Output of the construction industry, billions of dollars.

$$y_1 = \frac{(4)}{(10)}$$

y_2: Output of durable goods manufacturing, billions of dollars.

$$y_2 = \frac{(5) + (17)}{(11)}$$

y_3: Output of nondurable goods manufacturing, billions of dollars.

$$y_3 = \frac{(6) + (18)}{(12)}$$

y_4: Output of the wholesale trade industry, billions of dollars.

$$y_4 = \frac{(7) + (19)}{(13)}$$

y_5: Output of the retail trade industry, billions of dollars.

$$y_5 = \frac{(8) + (20)}{(14)}$$

y_6: Output of the services industry, billions of dollars.

$$y_6 = \frac{(9)}{(15)}$$

ℓ_{qjB}: Number of members of occupation q employed by industry j in the base period, 1959.

$$\ell_{qjB} = (21)$$

W_{qjB}: Wage paid to the members of occupation q by industry j in the base period, dollars.

$$W_{qjB} = (22)$$

W_j: Wage paid in the jth industry, dollars.

$$W_j = (23)$$

$\bar{s}_q$: Weighted average of the sales of industries employing members of occupation q.

$$\bar{s}_q \text{ (=SHq)} = \sum_{j=2}^{6} \left(\frac{\ell_{qjB}}{y_{jB}}\right) s_j$$

$\hat{w}_q^d$: Estimate of the real wage in the qth occupation facing employers, dollars.

$$\hat{w}_q^d \text{ (=EHq)} = \frac{\sum_{j=1}^{6} \left\{ \left[\frac{\ell_{qjB}}{y_{jB}}\right] \left[\frac{\left[\frac{W_j}{PI_j / PI_{jB}}\right]}{W_{jB}} \right] W_{qjB} \right\}}{\sum_{j=1}^{6} \left[\frac{\ell_{qjB}}{y_{jB}}\right]}$$

$\hat{w}_q^s$: Estimate of the real wage in the qth occupation facing labor suppliers, dollars.

$$\hat{w}_q^s \ (=WHq) = \frac{\left\{ \dfrac{\sum_{j=1}^{6} \left[\left(\dfrac{\ell_{qjB}}{y_{jB}} \right) \left(\dfrac{W_j}{W_{jB}} \right) W_{qjB} \right]}{\sum_{j=1}^{6} \left(\dfrac{\ell_{qjB}}{y_{jB}} \right)} \right\}}{CPI}$$

(1) Seasonally adjusted employment of the members of the qth occupational group, thousands of workers.

Bureau of Labor Statistics, Employment and Earnings and Monthly Report on the Labor Force, Vol. 14 (July, 1967), pp. 107-110.

(2) Seasonally adjusted unemployment rate in the qth occupational group, per cent.

Bureau of Labor Statistics, Employment and Earnings and Monthly Report on the Labor Force, Vol. 14 (July, 1967), pp. 114-115.

(3) Seasonally adjusted unemployment rate of married men, per cent.

Bureau of Labor Statistics, Employment and Earnings and Monthly Report on the Labor Force.

(4) F. W. Dodge Company seasonally adjusted index of the value of construction contracts in 48 states, 1957-59:100. In the construction of the output measure for the industry, the value of new construction put-in-place (seasonally adjusted), billions of dollars, is utilized.

Office of Business Economics, Business Statistics, 1967.

(5)-(8) Seasonally adjusted business sales of the jth industry (j=2,...,5), billions of dollars.

Office of Business Economics, Business Statistics, 1967.

(9) Seasonally adjusted final sales of services in GNP by major type (monthly rates), billions of dollars.

Office of Business Economics, Business Statistics, 1967.

(10) Department of Commerce Composite Construction Cost Index, 1959:100.

Office of Business Economics, Business Statistics, 1967.

(11)-(12) Wholesale price index--manufacturers, 1959:100.

Office of Business Economics, Business Statistics, 1967.

(13) Wholesale price index--all commodities, 1959: 100.

Office of Business Economics, Business Statistics, 1967.

(14) Consumer price index--commodities, 1959:100.

Office of Business Economics, Business Statistics, 1967.

(15) Consumer price index--services, 1959:100.

Office of Business Economics, Business Statistics, 1967.

(16) Consumer price index--all items, 1959:100.

Office of Business Economics, Business Statistics, 1967.

(17)-(20) First difference of the end of period book value of manufacturing and trade inventories for the jth industry (j=2,...,5), billions of dollars.

Office of Business Economics, Business Statistics, 1967.

(21) Major occupational group of employed persons by major industry group, 1959, number of workers.

Bureau of the Census, U. S. Census of Population: 1960, Subject Reports, Occupation by Industry, Table 1.

(22) Median earnings of males who worked 50 to 52 weeks in 1959, by occupational groups, dollars.

Bureau of the Census, U. S. Census of Population: 1960, Subject Reports, Occupational Characteristics, Table 30.

(23) Average weekly earnings in the jth industry, dollars. For the services industry, total employees in the current period relative to the base period was used as a proxy for relative earnings.

Bureau of Labor Statistics, Employment and Earnings Statistics for the United States--1909-1967, Bulletin No. 1312-5.

BIBLIOGRAPHY

SELECTED BIBLIOGRAPHY

Books

Alchian, Armen A., and Allen, William R. University Economics. Second edition. Belmont, California: Wadsworth Publishing Company, Inc., 1967.

Becker, Gary S. Human Capital. New York: National Bureau of Economic Research, 1964.

Cain, Glen G. Married Women in the Labor Force: An Economic Analysis. Chicago: University of Chicago Press, 1966.

Goldberger, Arthur S. Econometric Theory. New York: John Wiley & Sons, Inc., 1964.

Johnston, J. Econometric Methods. New York: McGraw-Hill Book Company, Inc., 1963.

Articles and Periodicals

Arrow, Kenneth J. "Samuelson Collected." Journal of Political Economy, Vol. 75 (October, 1967), 730-737.

Barth, Peter S. "Unemployment and Labor Force Participation." Southern Economic Journal, XXXIV (January, 1968), 375-382.

Becker, Gary S. "Investment in Human Capital: A Theoretical Analysis." Journal of Political Economy, LXX, Part 2 (Supplement: October, 1962), 9-49.

Behman, Sara. "Wage-Determination Process in U. S. Manufacturing." Quarterly Journal of Economics, LXXXII (February, 1968), 117-142.

Benewitz, Maurice C., and Zucker, Albert. "Human Capital and Occupational Choice--A Theoretical Model." Southern Economic Journal, XXXIV (January, 1968), 406-409.

Ben-Porath, Yoram. "The Production of Human Capital and the Life Cycle of Earnings." Journal of Political Economy, Vol. 75, Part I (August, 1967), 352-365.

Bowen, W. G., and Finegan, T. A. "Labor Force Participation and Unemployment." Employment Policy and the Labor Market. Edited by A. M. Ross. Berkeley: University of California Press, 1965.

Brehm, C. T., and Saving, T. R. "The Demand for General Assistance Payments." American Economic Review, LIV (December, 1964), 1002-1018.

Cain, Glen G. "Unemployment and the Labor-Force Participation of Secondary Workers." Industrial and Labor Relations Review, Vol. 20 (January, 1967), 275-295.

Carol, Arthur, and Parry, Samuel. "The Economic Rationale of Occupational Choice." Industrial and Labor Relations Review, Vol. 21 (January, 1968), 183-196.

David, Martin, and Otsuki, Toshiyuki. "Forecasting Short-Run Variation in Labor Market Activity." Review of Economics and Statistics, XLX (February, 1968), 68-77.

Dernburg, Thomas, and Strand, Kenneth. "Hidden Unemployment 1953-62: A Quantitative Analysis by Age and Sex." American Economic Review, LVI (March, 1966), 71-95.

Eckstein, Otto, and Wilson, Thomas A. "The Determination of Money Wages in American Industry." Quarterly Journal of Economics, LXXXVI (August, 1962), 378-414.

Gallaway, L. E. "Labor Mobility, Resource Allocation, and Structural Unemployment." American Economic Review, LIII (September, 1963), 694-716.

Hansen, W. Lee. "The Cyclical Sensitivity of the Labor Supply." American Economic Review, LI (June, 1961), 299-309.

Hildebrand, George H. "Structural Unemployment and Cost-Push Inflation in the United States." Monetary Process and Policy: A Symposium. Edited by George Horwish. Homewood, Illinois: Richard D. Irwin, Inc., 1967.

Johnston, Denis F. "Education and the Labor Force." Monthly Labor Review, Vol. 91 (September, 1968), 1-11.

Kasper, Hirschel. "The Asking Price of Labor and the Duration of Unemployment." Review of Economics and Statistics, XLVIV (May, 1967), 165-172.

Killingsworth, Charles C. "Structural Unemployment in the United States." Employment Problems of Automation and Advanced Technology: A International Perspective. Edited by Jack Stieber. London: Macmillan and Company, Ltd., 1966.

________. "Automation, Jobs, and Manpower: The Case for Structural Unemployment." The Manpower Revolution: Its Policy Consequences. Edited by Garth L. Mangum. Garden City, New York: Doubleday and Company, 1965.

________. "The Continuing Labor Market Twist." Monthly Labor Review, Vol. 91 (September, 1968), 12-17.

Leijonhufvud, Axel. "Keynes and the Keynesians: A Suggested Interpretation." Proceedings of the American Economic Association, LVII (May, 1967), 401-410.

Mincer, Jacob. "Investment in Human Capital and Personal Income Distribution." Journal of Political Economy, LXVI (August, 1958), 281-302.

________. "Labor-Force Participation and Unemployment: A Review of Recent Evidence." Prosperity and Unemployment. Edited by R. A. Gordon and M. S. Gordon. New York: John Wiley & Sons, Inc., 1966.

________. "Labor Force Participation of Married Women: A Study of Labor Supply." Aspects of Labor Economics. A Conference of the Universities-National Bureau Committee for Economic Research. Princeton: Princeton University Press, 1962.

________. "On-the-Job Training: Costs, Returns and Some Implications." Journal of Political Economy, LXX, Part 2 (Supplement: October, 1962), 50-79.

Moore, T. G., and Rapping, L. A. "Dismissal Pay and Flexible Wage Adjustments: A Theoretical Analysis." Southern Economic Journal, XXXIV (July, 1967), 101-112.

Oi, Walter Y. "Labor as a Quasi-Fixed Factor." Journal of Political Economy, LXX (December, 1962), 538-555.

Parks, Richard W. "Efficient Estimation of a System of Regression Equations When Disturbances are Both Serially and Contemporaneously Correlated." Journal of the American Statistical Association, Vol. 62 (June, 1967), 500-509.

Rees, Albert. "Information Networks in Labor Markets." Proceedings of the American Economic Association, LVI (May, 1966), 559-566.

Severn, Alan K. "Upward Labor Mobility: Opportunity or Incentive?" Quarterly Journal of Economics, LXXXII (February, 1968), 143-151.

Simler, N. J. "The Structural Hypothesis and Public Policy." American Economic Review, LIV (December, 1964), 985-1001.

Sjaastad, Larry A. "The Costs and Returns of Human Migration." Journal of Political Economy, LXX, Part 2 (Supplement: October, 1962), 80-93.

Stigler, George J. "Information in the Labor Market." Journal of Political Economy, LXX, Part 2 (Supplement: October, 1962), 94-105.

Strand, Kenneth, and Dernburg, Thomas. "Cyclical Variation in Civilian Labor Force Participation." Review of Economics and Statistics, XLVI (November, 1964), 378-391.

Wilkinson, Bruce W. "Present Values of Lifetime Earnings for Different Occupations." Journal of Political Economy, LXXIV (December, 1966), 556-572.

Zellner, Arnold. "An Efficient Method of Estimating Seemingly Unrelated Regressions and Test for Aggregation Bias." Journal of the American Statistical Association, Vol. 57 (June, 1962), 343-368.

________. "Estimators for Seemingly Unrelated Regression Equations: Some Exact Finite Sample Results." Journal of the American Association, Vol. 58 (December, 1963), 977-992.

Zellner, A., Huang, D. S., and Chau, L. C. "Further Analysis of the Short-Run Consumption with Emphasis on the Role of Liquid Assets." Econometrica, Vol. 33 (July, 1965), 571-581.

Public Documents

Knowles, James W., and Kalachek, Edward. Higher Unemployment Rates, 1957-1960: Structural Transformation or Inadequate Demand. Subcommittee on Economic Statistics of Joint Economic Committee, U. S. Congress (Washington: U. S. Government Printing Office, 1961).

U. S. Department of Commerce. Bureau of the Census. U. S. Census of Population: 1960. Subject Reports, Occupational Characteristics.

________. Bureau of the Census. U. S. Census of Population: 1960. Subject Reports, Occupation by Industry.

________. Office of Business Economics. Business Statistics, 1967.

U. S. Department of Labor. Bureau of Labor Statistics, Employment and Earnings Statistics for the United States--1909-1967. Bulletin No. 1312-5.

________. Bureau of Labor Statistics. Employment and Earnings and Monthly Report on the Labor Force, Vol. 14 (July, 1967).

Unpublished Material

Alchian, Armen A. "Information Costs and Unemployment." (Mimeographed.)

Alchian, A. A., Arrow, K. J., and Capron, W. M. "An Economic Analysis of the Market for Scientists and Engineers." RM-2190-RC. Santa Monica, California: The Rand Corporation, 1958.

Fisher, Anthony. "Poverty and Labor-Force Participation." Research Paper P-273. Economic and Political Studies Division, Institute for Defense Analyses, February, 1966.

Holt, Charles C. "Job Search, Phillips' Wage Relation and Union Influence, Theory and Evidence." Firm and Market Workshop Paper 6705. Madison, Wisconsin: Social Systems Research Institute, University of Wisconsin, December 14, 1967. (Mimeographed.)

Rees, Albert. "Remarks on the Nature of Our Unemployment Problem." Discussion paper for meeting with the Board of Governors of the Federal Reserve System, January 30, 1965. (Mimeographed.)

Zellner, Arnold, and Geisel, Martin S. "Analysis of Distributed Lag Models with Applications to Consumption Function Estimation." (Mimeographed.)