TIME-RELATED FACTOR ANALYSIS

OF LABOR TURNOVER DATA

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PREFACE

This study is concerned with the use of factor analysis in the study of labor turnover data. The first of two objectives of the study is to determine elements comprising the decision to leave a job voluntarily. The question of whether individuals react in an economically rational manner when changing jobs is considered. The second goal of the study is to determine the utility of factor analysis to the study of labor turnover. A total of 52 variables are subjected to factor analysis using the P, R, and T data slices.

I wish to express my sincere appreciation to my major adviser, Dr. Kent Mingo, for his continued guidance and direction throughout the study. His expertise in factor analysis was invaluable in the early stages of the study, and the many hours of discussion he freely gave are gratefully acknowledged. Appreciation is also expressed to Dr. John C. Shearer for guidance in the manpower economics focus of the study. Dr. Wayne Meinhart, through the Department of Administrative Sciences, provided computer funding for the study. For this, plus his assistance throughout the doctoral program, I am grateful. Dr. Larry Perkins and Dr. Ralph Catalanello provided suggestions and much encouragement throughout the study, for which I am appreciative. Lastly, I must express my unending gratitude to my wife, Lois, who, in addition to typing the study in all phases, exhibited a tremendous degree of understanding during the period.

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SEP	Separation rate
QR	Quit rate
LR	Layoff rate
ΔQ	Incremental change in quit rate
ΔL	Incremental change in layoff rate
AR	Accessions rate
LAR	Lagged accessions rate
NH	New hire rate
LNH	Lagged new hire rate
NAW	Non-agricultural employment
PW	Production workers
%NP	Percent non-production workers
GWE	Gross weekly earnings
ΔWE	Incremental change in weekly earnings
HE	Hourly earnings
SE	Spendable earnings
U	Unemployment rate
U_{ad}	Average duration of unemployment
LFPR	Labor force participation rate
CPI	Consumer price index
WPI	Wholesale price index
GNP	Gross national product
ΔGNP	Incremental change in gross national product

DJSA	Dow-Jones stock average
G	Government spending for goods and services
ΔG	Incremental change in government spending
ENP	Expenditure for new plant
BS	Business sales
I/S	Inventory/sales ratio
DP	Durables purchases
WR_I	Wage range (all industries)
WR_M	Wage range (manufacturing)
HWI	Help-wanted index
Un	Percent unionization
ULP	Unfair labor practices filed
WS	Work stoppages
TLWS	Time lost due to work stoppages
%FE	Percent female employment
%MFE	Percent married female employment
U_{20}	Unemployment in the 20-24-year age group
U_B	Black unemployment
ΔBS	Incremental change in business sales
Δ%NP	Incremental change in percent of non-production workers
ΔU	Incremental change in unemployment
ΔCPI	Incremental change in consumer price index
$L\Delta G$	Previous year (lagged) change in government spending
ΔENP	Incremental change in expenditure for new plant
ΔHWI	Incremental change in help-wanted index
ΔUn	Incremental change in percent unionization
ΔWR_I	Incremental change in all-industry wage range

MFG	All manufacturing
DUR	Durable goods
ORD	Ordnance and accessories
LUM	Lumber and wood products
FURN	Furniture and fixtures.
SC&G	Stone, clay, and glass
PRIM	Primary metal industries
FAB	Fabricated metal products
MACH	Machinery, except electrical
ELEC	Electrical equipment and supplies
TRANS	Transportation equipment
INST	Instruments
MISC	Miscellaneous manufacturing
N-DUR	Non-durable goods
FOOD	Food and kindred products
TOB	Tobacco manufactures
TEX	Textile mill products
APP	Apparel and other textile products
PAP	Paper and allied products
PRINT	Printing and publishing
CHEM	Chemicals and allied products
PETRO	Petroleum and coal products
RUB	Rubber and plastics
LEA	Leather and leather products
AUTO	Motor vehicles and equipment
AIR	Aircraft and parts
SHIP	Ship and boat building and repairs

RR	Railroad equipment
R-TV	Radio and television equipment
T&T	Telephone and telegraph equipment
CARP	Floor covering mills (carpets)
PLAST	Plastics materials and synthetics
DRUGS	Drugs and medicines
FTWR	Footwear, except rubber
CEM	Cement, hydraulic
TIRE	Tires and inner tubes
AGRI	Agricultural machinery
IPI	Industrial Production Index

CHAPTER I

INTRODUCTION

A. Nature of the Problem

Labor turnover is an area of continued concern both for economists and for organizational analysts. To the theoretical economist, low turnover rates (worker mobility) may suggest inadequate or improper allocation of resources among firms. The organizational analyst, whether academician or practicioner, is concerned since turnover retards production and may be an indicator of other dysfunctional processes within the organization.

The theoretical economist may not support excessively high turnover, but he would prefer that turnover reflect the free operation of the labor market. These economists would seek to eliminate any immobilizing elements such as unions, seniority, company fringe benefits, etc. that would serve to reduce the effectiveness of the forces of supply and demand. Opposed to this are the desires of those for whom the organization is the focal point. This group is concerned with reducing turnover either through increasing inducements for individual participants or through controlling dysfunctional aspects of the work environment. Since all turnover is costly, the desired rate of voluntary turnover would be near zero. Perhaps midway between the two extremes are the manpower economists, whose primary concern is meeting manpower needs given the realized constraints imposed by firms and

other institutions such as unions and government. To this group, low turnover may require either retraining or the services of one of the manpower agencies in order to secure a new and suitable job.

A considerable amount of published research has been directed toward causes of labor turnover. As far back as 1919, Sumner Slichter (30) published his work studying turnover of factory labor. Reynolds and Shister (26) studied turnover as affected by job satisfaction. In an often-quoted study, Ross (27) assessed the existence of an "industrial feudalism" designed to reduce the mobility of workers through benefits, seniority, etc. More recently, other researchers have focused on turnover, particularly from an economic viewpoint.

The general question of concern to most researchers is whether individuals react in an economically rational manner when changing jobs rather than reacting to psychological stimuli outside the domain of the labor market. Stated differently, the task is to determine how closely the individual rationality exhibited by workers mirrors administrative or economic rationality. Most researchers timidly conclude that individuals, in general, do react in a rational manner, although this is normally qualified as a rational manner from the worker's viewpoint. Rationality from the worker's viewpoint need not be the same as rationality from the economist's viewpoint.

Research on labor turnover has yielded some relationships which are unquestionable. It is generally accepted, for example, that voluntary turnover decreases with age and tenure, and that quits decrease as the economy contracts and increase as the economy expands. Conflicting and/or inconclusive results arise, however, in regard to other variables included in turnover research. The effect of wages on

turnover is unclear. The effect of unions on both voluntary and involuntary turnover has been questioned repeatedly with inconsistent results. Even layoffs, commonly thought to be inversely related to quits, were found in one study to be positively related. These results suggest that either published research has not uncovered all of the complexities surrounding labor turnover or that the phenomenon is not stable over time.

The methodology used in most of the published research may be a contributor to the incongruities in results. Almost all instances of turnover research have used multiple regression as the analytical tool. This method of analysis is beset with problems when considering a phenomenon as complex as the decision process underlying turnover. Part of the problem is the limited number of variables that may be included. If more than a few variables enter into a regression analysis, problems of intercorrelation among supposedly independent variables are probable. If the number of variables is limited to truly independent variables, then the probability of omitting functional variables increases. Severn (29), for example, utilized a model including wages and unemployment to predict turnover. Yet, the effects of unions, job vacancies, layoff rates, and many other variables were omitted.

Associated with the number of variables problem is the variable/case ratio that must be considered. A rule of thumb normally used by statisticians is ten cases for each variable included. Thus, an analysis considering eight variables should have eighty cases. If an analysis were of the cross-industry type, this would require eighty industries while a time-series would require eighty time periods.

Aside from the specific methodological problems affecting all regression analyses are problems unique to those analyses including a time dimension. A researcher is faced with doing either a cross-sectional analysis in which the time dimension is difficult to include, or doing a time-series analysis in which problems of auto-correlation must be dealt with.

From the above it is noted that the usefulness of regression analysis is somewhat limited in studying a phenomenon such as labor turnover, which may be a function of several variables with the functional relationship changing over time. There is a need then for an analytical tool which can make use of time-related data, can include a large number of variables, and can unearth differences in relationships over time.

B. Purpose of the Study

The purpose of this study is to utilize factor analysis to study labor turnover as it relates to selected variables over time. Factor analysis is a multivariate analytical tool based upon the correlation matrix and thus related to regression analysis. The major difference is that factor analysis can consider the interrelationships between a large set of variables regardless of the interdependence among variables, whereas regression analysis attempts to predict the value of a dependent variable based upon a limited number of independent variables.

The analysis is targeted toward two goals. First, elements entering into the decision process underlying turnover are determined. The results of previous studies are re-evaluated to determine if

relationships derived from a small set of variables hold when the variables are included in a larger data set. The interrelationships of variables affecting turnover are analyzed from a time-related viewpoint to determine if the turnover decision is based upon the same set of relationships throughout time. Of particular interest is the stability of relationships in periods of economic growth compared to periods when the economy is vacillating. Although macro data is used, discussion maintains a behavioral focus, i.e., emphasis will be placed on individual responses to information of a macro nature.

The measure of voluntary turnover used in this study, as well as in most studies reported, is the quit rate. Quits are terminations of employment initiated by employees, failure to report after being hired, and unauthorized absences, if on the last day of the month the person has been absent seven consecutive calendar days.[1] The quit rate is the number of quits per 100 employees in firms reporting to the Bureau of Labor Statistics. Labor turnover is considered since it is a topic of common interest to both the economist and the organizational analyst, and as such reflects the author's interest and training in both disciplines.

The second goal of the study is the demonstration of factor analysis to be a viable tool for use in organizational analysis and economics. This method of analysis has been used in psychology for some time, although its use was limited in the pre-computer era due to the complex calculations involved. The tool has received only recent

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[1]U. S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, United States, 1909-1967, Bulletin 1312-5 (1967), p. 847.

application to the areas outside psychology, and very little use has been made of it as a research tool in the economics discipline.

The study attempts to demonstrate that factor analysis can be applied to labor turnover, one of the many topic areas within economics or organizational analysis. In particular, a purpose of the study is the determination of the feasibility of time-related factor analysis to satisfy the methodological vacuum that cannot be met by other methods. This goal will be approached by presenting results that confirm, clarify, or extend the theory of labor turnover suggested by earlier research. Once the utility of factor analysis is demonstrated in the labor turnover area, the tool may then be utilized to study other areas of organizations or many areas within economics. It would seem to be especially well suited for analysis of manpower programs, the delineation of organization structure; and conceivably it could even be applicable to selected topics in macro or micro economics.

The analytical focuses of the study are:

(1) The analysis of labor turnover and other economic variables as they interrelate over time,

(2) The analysis of static and dynamic relationships among variables over time,

(3) The comparison of cross-sectional analyses of variables in years of high and low levels of economic activity, and

(4) The analysis of similarities among years as measured by the quit rate for several industries.

C. Hypotheses

The hypotheses to be examined in this study can be stated in terms

of a general hypothesis and several more specific operational hypotheses. In general, it is hypothesized that individuals react more to opportunities to move than to incentives to move; and they will act in an economically rational manner only in periods of economic growth when many jobs are available.

Six major operational hypotheses are tendered. These are:

I. The relationship between the quit rate and the level of business activity will differ depending on the stability of the economy.

Ia. During periods when the economy is predominantly rising (1960-1969) the quit rate will be directly related to the level of economic productivity.

Ib. During unstable years the quit rate will not be closely related to measures of productivity.

II. Layoffs will load highly on the same factor as the quit rate, but with opposite sign.

III. Gross weekly earnings, the range of wages throughout the manufacturing industry and other industries, the Consumer Price Index, and the total employment level will be unrelated to quit rates.

IV. All classes of unemployment will be negatively related to turnover.

V. Spendable average weekly earnings will be more closely related to quit rates than will gross weekly earnings.

VI. The amount of union work stoppages will be positively related to quits, while the percent of unionization will be negatively related.

In addition to the major hypotheses, several less significant hypotheses are considered. For example, each of the data units analyzed enters the analysis with the hypothesis that it is in some way related to turnover. Once the factorization has been done, the factor loadings will give an indication of the actual relationship. Chapter III will discuss these hypothesized relationships more fully.

The factor patterns developed are used to examine the hypotheses. It should be noted here that in some instances support for hypotheses is of a qualitative nature resulting from factor interpretations rather than a quantitative statistical test. This is a difference in the tasks set before factor analysis as opposed to regression analysis. In the latter type of analysis, statistical tests of significance may be made for each coefficient. Since the results of factor analysis are primarily descriptive in nature, statistical tests are not made.

D. Data and Methods

Data for the initial analysis are 39 variables that are hypothesized to influence labor turnover. These variables fall generally into three groups: labor market variables, economic activity variables, and institutional/organizational variables. They are variables which may either affect the amount of turnover directly or may affect an individual's perception of the ease or desirability of changing jobs. In later stages of the study, incremental changes in many of the above variables are added to the analysis.

The data are from secondary sources of an aggregate nature. Sources are publications of the Department of Labor's Bureau of Labor

Statistics and the Department of Commerce's Office of Business Economics. The data consist of annual data from 1947 to 1970.

Variables are initially submitted to a P-analysis to determine relationships among variables over a 24-year time period. The developing factor patterns reflect groups of variables over time, some of which are turnover variables. Variables are added to the data set which measure annual incremental changes in key variables. These variables are also factor analyzed. A somewhat smaller set of static variables is selected from the initial P-analysis for a separate analysis. The logic behind this analysis is to compare an analysis of static variables to the dynamic analysis and to the original analysis. The latter comparison provides a measure of the invariant nature of the factors.

Four R-analyses are made of cross-industry data. Each of these determines relationships among characteristics for a single year based upon the industries sampled. The four years analyzed are the recessionary 1958, the expansion year, 1966, and the two years immediately following the recession and expansion, 1959 and 1967. The purpose of these is the determination of differences in the structure of relationships for recession years, expansion years, and change years.

Finally, measurements of the quit rate for the 24 years are factor analyzed for selected industries to determine groups of years which reflect similar quit rates for the industries. From this, one can determine if quit rates are the result of similar forces throughout time or if the quit rates vary in different ways in different time periods.

E. Limitations

Three limitations are evident in the study, all relating to the data. The first is a total absence of aggregated intra-organizational data of a socio-psychological nature. Thus, while it is projected that items such as supervisor/subordinate ratio, psychological climate of the firm, or the amount of absenteeism do have an effect on turnover, no aggregate data are available for analysis. Data in the study will thus be limited to economic data available in aggregate form.

The second limitation is that some of the variables are available only at the "all economy" level and are not available at the industry level. Thus, one set of analyses which makes use of industry data is restricted to a smaller data set.

In some analyses, the number of variables exceeds the number of cases. This is not considered to be a severe limitation for the purposes here; yet, a firmer statistical base is obtained when cases exceed variables. Throughout the analysis, note will be made of this situation when it occurs.

F. Organization of the Study

The following chapter, the review of relevant literature, is broken into three parts. The first portion of the chapter is concerned with theoretical models developed in recent contributions to the literature. Emphasis is placed upon variables included, methodology used, and the empirical results. The second and third sections concern the theory and application of factor analysis, respectively. In these sections, the theory underlying the tool is developed, followed by applications of the tool to topics outside psychology. The discussion

of applications demonstrates the utility of the tool in previous research.

The third chapter discusses the methodology and data used in the study. Emphasis is placed upon the specific analyses made and the justification for the inclusion of each variable. Chapter IV discusses the results of the study, emphasizing the factor patterns and the logic underlying the patterns developed. Chapter V expands this discussion, focusing upon the hypotheses set forth above, the relationship among analyses, and general relationships among variables. The final chapter will then summarize the study with implications for future research.

CHAPTER II

REVIEW OF THE LITERATURE

In a study which has the dual goals of developing a content area and developing the use of a methodological tool, it is necessary to review the literature germane to both concepts. The first portion of this chapter will be concerned with recent studies which contribute to the theoretical modeling of the labor turnover process. The latter two portions will focus upon the theory and applications of factor analysis.

A. Theoretical Models Relating to Turnover

A number of researchers have developed models which purport to explain the turnover phenomenon. This section will discuss these models as well as inferences to turnover gleaned from researchers who treated turnover as a corollary to their research of related topics.

A.1 An Opportunity-Incentive Model

Professors John F. Burton and John E. Parker made two studies of voluntary labor mobility (22) (5). The first attacked the problem using time-series data from 1930 to 1966, while the latter study utilized cross-sectional data from the 1960 census. In both studies the authors suggested a model

$$QR = f(I, O, P, X) \qquad (1)$$

where I is a set of variables which measure incentive to quit; O is a set of variables which measure the cyclical or short-run variations in opportunities to move; P is a set of variables which measure factors that influence voluntary mobility which are subject to control by public policy; and X is a set of variables which measure all other factors that influence the quit rate. They included variables such as inter-industry wage differentials, geographic differentials, and intra-industry differentials as incentive variables. These were variables that would induce one to leave one job for a superior job. Opportunity variables included the unemployment rate and the accessions rate. The expected relationship is that accessions are positively related to turnover while unemployment is negatively related.

The third set, P, reflects those variables which supposedly could be regulated by public control to alter the amount of mobility. The prime variable here is the extent of unionism, although the effect of employment services could also fall here. Theoretically, unions are restrictive in regard to mobility, although the effect desired by those who feel that the primary goal of mobility is the efficient allocation of resources would be that changes in unionism will not have an effect on mobility. If the P relationships are insignificant, then no public policy concern is warranted.

The last type of variable is the X variable, which includes those that do not easily fall in one of the other classes. These variables may affect turnover but are not subject to public policy. Variables such as the sex and age composition or skill mix of an industry's labor force fall here. The time-series analysis in the earlier study also included a time variable. The theoretical relationship here is

that if the coefficient for T is negative, then after adjusting for incentive and opportunity variables, quit rates are in fact decreasing. If T is significant when all other variables are included, we have an indication that we have left some explanatory variable out of the analysis.

The cross-section study, using several more variables than did the early study, found the following variables to be significant: wage level (-), employment change (-), accessions rate (+), layoff rate (-), and unemployment rate (-). The signs in parenthesis indicate the direction of the relationship. These variables fell in the I and O category. A significant result is desirable in these variables since they suggest responsiveness to labor market conditions. Note that a negative relationship between the quit rate and layoff rate was indicated, suggesting that as layoffs increase, quit rates will decrease. In the study by Stoikov and Raimon (33) to be considered next, a positive relationship was obtained. It should also be noted in passing that Burton and Parker obtained significant results for the hourly wage level but not for the annual earnings level. They suggested that part of the problem is that quit rates are determined monthly rather than annually.

Some of their X variables were significant. The concentration ratio (-), the percent of the labor force that was male (-), and the percent that was white (-) were significant at the .01 level. Significance in these variables is of little concern to those seeking to change the amount of turnover since demographic characteristics of the labor force cannot be easily altered. There were also several

variables which were not determined to be significant. Non-significant variables and their indicated direction will be listed in footnotes for each study, unless included in the text.[1]

The time-series analysis, though aimed at determining the existence of a decreasing quit rate, found relationships between quit rates and unemployment (-), and accessions (+), similar to the cross-sectional study, and also found significant results for the manufacturing/all economy wage differential in some but not all of their equations. The other variable they used was the intra-manufacturing wage dispersion which was insignificant. Neither the cross-sectional nor time-series studies found a significant coefficient for unionization when other variables were included in the analysis.

Returning to their model

$$QR = f(I, O, P, X)$$

the two studies together concluded that incentives and opportunities to change jobs do influence mobility. Some unclassified variables of a demographic nature were found to influence the quit rate. Evidence would not support the hypothesis that unionization restricts mobility, nor that the quit rate has decreased in the post-war period.

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[1]For Burton and Parker's (5) cross-sectional analysis, these included: firm size (-), unionization (-), percent production workers (+), skill mix (+), percent in South (-), percent rural (+), wage change (-), employment change (-), annual earnings (-), and earnings change (-). Their time-series study found intra-industry wage differentials and unionization to be insignificant (22). In their time-series analysis, the conclusion was reached that the quit rate had not declined significantly during post-war years, although they did find a difference between war years and post-war years.

A.2 A Behavioral Approach to the Opportunity-Incentive Model

Stoikov and Raimon (33) completed a study of 52 industries to analyze the determinants of differences in the quit rate among industries. Nine variables were proposed for their cross-sectional multiple regression. To check for differences in levels of business activity, separate regressions were run for 1963 and 1966 data.[2]

In somewhat the same vein as the Burton and Parker (5) (22) studies, Stoikov and Raimon propose two broad classes of variables. The first includes those variables which reflect an individual's incentive to move, while the second includes those variables which pertain to a worker's perceived difficulty or ease of moving between employers.

For those who would make the attempt to link traditional labor market theory to the study of organizations, it is comforting to look at the paths by which the Burton and Parker studies and Stoikov and Raimon's study arrive at their respective categories of variables.

Burton and Parker suggested that significant opportunity and incentive variables reflect responsiveness to the labor market and mobility patterns which improve the allocation of labor.[3] Stoikov and Raimon approach the analysis from the viewpoint of March and Simon's (19) inducement-contribution utilities. Whereas the former would suggest that an individual will leave only when he sees a more highly remunerative job elsewhere, the latter suggests that one will leave

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[2]The reason for their usage of 1963 rather than 1958 or 1960 in the analysis is not clear.

[3]John F. Burton and John E. Parker, "Interindustry Variations in Voluntary Labor Mobility," Industrial and Labor Relations Review, XXII (January, 1969), p. 215.

when contribution utilities, i.e., work expended, exceed inducement utilities. This is consonant with comments by Reynolds and Shister, who state that individuals are "pushed" into the labor market rather than "pulled" by concrete knowledge of job opportunities.[4] Myers and Shultz (21) concluded the same after interviewing workers faced with a mill shutdown. They suggest that most do not appear to make systematic search although they are rational from their point of view. Thus, the two approaches lead from different origins to the same conclusion in regard to variable categories.

Under the category of incentive variables--those reflecting the desirability of quitting--Stoikov and Raimon (33) include gross annual earnings; wage increases over the past three years; a conglomerate variable represented by the percentage of employment in large firms but suggesting size of establishment, quality of personnel management, and concentration; the union occupancy rate;[5] and the layoff rate. These merit some discussion. The suggested relationship between wages and turnover is negative, as it is in most studies. To get a more accurate picture, the authors standardized the wages by skill mix of the industries. This does add precision to the analysis but causes some loss in comparability with other studies. The wage change variable is the percentage change in wages since the absolute change is correlated with the level of wages. The expected relationship between size of firm and turnover is unclear. March and Simon (19) suggest that turnover will

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[4]Lloyd G. Reynolds and Joseph Shister, Job Horizons: A Study of Job Satisfaction and Labor Mobility (New York, 1949), p. 87.

[5]Apparently this is measured by the percent of the non-agricultural work force who are union members, but the authors are unclear.

be less for small work groups or companies. Yet, large companies yield more opportunities for intra-company transfer which is not included in the quit rate as measured by the Bureau of Labor Statistics. There is also a prestige-status-company benefits factor which should have a restrictive effect as firm size increases. The net effect is uncertain.

Some studies include the union occupancy rate as a mechanism to reduce opportunity to move. Particularly, economic theorists suggest unions as a hindrance to optimum allocation of labor. Perhaps a more appropriate approach is taken by Stoikov and Raimon, who consider a union as a means to reduce incentive to move. The existence of grievance procedures may reduce dissatisfaction within the job context; and this, as well as the existence of seniority systems, may reduce the quit rate. Thus, the same relationship is predicted but for different reasons.

The last incentive variable, the layoff rate, is interesting. Stoikov and Raimon (33) theoretically and empirically present a justification for a positive relationship between layoffs and quit rates. They submit that as layoffs increase, individuals will look for greener pastures, thereby increasing the quit rate. But Burton and Parker (22) obtained significant results for a negative relationship, suggesting that as layoffs increase individuals will hold on to their jobs. A case could be made for either. If layoffs were concentrated in one industry, then voluntary movement to more stable industries could occur. On the other hand, if layoffs were increasing throughout the economy due to lower levels of business activity, decreases in quit rates would be predicted.

The opportunity variables--those which reflect ease or difficulty of movement--are the percent Negro, the percent female, the percent with brief tenure, and the quality of the work force. One of these, the percent Negro, merits further discussion. March and Simon (19) state that the perceived amount of outside alternatives is inversely related to the individual's social status.[6] On the basis of this, Stoikov and Raimon (33) predict a negative relationship between the percent Negro and the quit rate. This is a questionable relationship at best. Smith and Holt (31), in studying the black/white unemployment ratio, found a black separation rate of double that of white. They submit as reasons for this: (1) low pay, (2) higher layoffs due to lack of education, experience, and motivation, (3) shorter duration of jobs, (4) lower union seniority, and (5) less search for the good jobs.[7] In the Pencavel (24) study to be discussed later, a negative, but insignificant, relationship between the proportion of black employees and the turnover rate was obtained. Unfortunately, this variable was not available throughout the 1947-1970 time-series and hence was omitted from the present study.

The authors use the amount of new hires as a proxy for the percent with short tenure, due to data difficulties with the latter variable. Pencavel's study used the average monthly accessions rate lagged one year as a measure of those with short tenure. It would appear that each of these would underestimate the amount of short-term employees in

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[6]James G. March and Herbert L. Simon, Organizations (New York, 1958), pp. 93-106.

[7]Ralph E. Smith and Charles C. Holt, "Analysis of the Black-White Unemployment Ratios," Proceedings of the 23rd Annual Winter Meeting, Industrial Relations Research Association (1970), pp. 76-86.

an organization. A more accurate variable would be the sum of the prior six months' accessions or new hires; however, this is impossible when using average annual data. To achieve the best measure, given the data availability, the present study included the accessions rate, the new hire rate, lagged accessions, and, in later analyses, lagged new hires.

The remaining variable, quality of the work force, is the same variable used to standardize the earnings variable. The model thus developed was tested both for 1963, a year of lower business activity, and, in a slightly modified version, in 1966.

Stoikov and Raimon (33) found "reasonably significant" results for most of their variables, with the relationships suggested above.[8] The expected relationships for size of establishment and percentage female were uncertain. The first of these turned out to be negative, while percent female was not significant. In comparing results of the 1963 regression to those of the 1966 analysis, interesting results were obtained. They concluded that those variables which could be classed as "economic" increased in significance with a change from low to high business activity, while the "institutional" variables (union occupancy rate, percent Negro, and percent with short tenure) decreased in significance. The layoff rate dropped considerably in significance in the 1966 regression. In addition, when the new hire rate was substituted for the percent with brief tenure, the relationship between layoffs and quits reversed direction. It should be recalled that this

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[8]To be "reasonably significant" required significance at only the 80% level. This appears somewhat liberal. Only three variables achieved significance at the 95% level and only four at the 90% level.

is the variable for which Burton and Parker found a negative rather than positive relationship. This casts doubt on the validity of the relationship.

The contribution of Stoikov and Raimon (33) can be summarized by the following statements:

1. A negative relationship exists between the quit rate and annual earnings, recent wage increases, union occupancy rate, and the quality of the work force. A positive relationship exists between the quit rate and the percent with brief tenure. Unclear or questionable results are obtained for the percent Negro, the percent female, the size of the establishment, and the layoff rate.

2. The general level of business activity is related positively to quit rates. Further, the significance of relationships between the quit rate and other variables considered changes as a function of the level of the economy; "economic" variables gain in importance as the economy level rises while "institutional" variables decrease in importance. These changes in relationships over time suggest a need for further study of the relationships over time.

A.3 A Wage-Unemployment Model

A third study which focused on opportunities and incentives to explain quit rates was done by Alan K. Severn (29). His model was somewhat simpler, utilizing only the variables unemployment and the ratio of a given industry's wage to the average industrial wage. His model was of the form

$$Q_{it} = \alpha_o + \alpha_1 U_{it} + \alpha_2 (W_{it}/W_t') + V_{it} \qquad (2)$$

where i and t refer to industry and time period, respectively. Q = quit rate, U = unemployment rate, W_{it}/W_t' = wage of industry i as a ratio of average wage during the year, and V_{it} = unexplained residual.

Somewhat unique to studies of turnover, Severn (29) attempted to substitute unemployment in better-paying industries for average unemployment. The R^2 for this equation was similar to the original equation using average unemployment. Severn concluded that individuals respond to general indications of opportunity rather than to specific knowledge of better-paying job opportunities. This is similar to the Myers and Shultz (21) and Reynolds and Shister (26) results mentioned earlier.

A regression using annual data for the period 1950 to 1965 was made with a resulting R^2 of .57. Experimentation with the form of the model revealed that the best fit was an R^2 = .79 using the model

$$Q_{it} = \alpha_o + \alpha_1 W_{it}/W_t + \alpha_2 \ln U_{it} \qquad (3)$$

No theoretical support for this latter model was given. In this model the logarithm of unemployment accounted for more of the explained variance, whereas in the earlier model the wage ratio accounted for slightly more.

Although Severn concludes that his results show that "the production worker in manufacturing reacts to his economic environment in a very rational way," his empirical results leave the reader somewhat uncomfortable.[9]

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

A.4 An Inter-industry Variant of the Wage-Unemployment Model

In a study aimed specifically at inter-industry labor mobility, Lowell E. Galloway (35) used a model very similar to Severn's initial model. Galloway's model was

$$P_{si} = a + bw_i + cU_i + u \qquad (4)$$

where P_{si} represents the proportion of workers who stay in an industry, w_i is the earnings level in the industry, U_i is the unemployment rate in the industry, and u is the random error term.[10]

There are some differences in the study which make it not strictly comparable to others for our purposes here. First, the target is net flows between industries, such that a movement from industry i to industry j would offset a movement from industry j to industry i. Further, no separation between voluntary and involuntary movement is made. The report is included in the literature review to show evidence of a particular segment of the labor market at work. This is the direction of movement during a downswing in business activity.

During recessionary times, as in 1957-58, Galloway (35) suggests that involuntary movement dominates voluntary movement. He states that:

> the business cycle acts as a catalyst by producing displacements who then move to inferior jobs or withdraw from the labor force. The pattern is more pronounced among Negro men who seem to be much more adversely affected by the operation of the business cycle. The female reaction to downswings is

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[10]The major difference between this and Severn's (29) initial model is w_i versus w_i/w, the ratio of an industry's wage level to the average wage. Severn's dependent variable was Q_{ij}, the quit rate, instead of P_{ij}, the proportion staying in the industry. Hence, the relationships should have opposite signs.

> predominantly labor force withdrawal rather than movement to lower earning jobs.[11]

Thus, although Galloway concludes, as have others, that movement is a function of wages and unemployment (incentive and opportunity), he stresses downward mobility rather than upward mobility.

Galloway reaches two other conclusions that should be mentioned in passing. First, he concludes that mobility takes place primarily among those with low levels of earnings rather than high-earnings workers in the labor force. Secondly, he concludes that "although age is an important variable in explaining movement, it is dominated by earnings."[12] Reynolds (25) suggested that age was one of the most important explanations of job changes, and he noted that voluntary movement failed to show any strong drift toward better jobs even in levels of high demand.[13]

A.5 The Industrial Feudalism Hypothesis

In considering relevant literature of the last two decades, the often-quoted study by Arthur M. Ross (27) cannot be omitted. Using a time-series study with yearly data from 1910 to 1956, Ross analyzed the quit rate to determine if a decline in quit rates has existed over the past four decades and, if so, the cause of the decline. His main

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[11]U. S. Department of Health, Education, and Welfare, Social Security Administration, Inter-industry Labor Mobility in the United States 1957-1960, by Lowell E. Galloway, Research Report No. 18 (Washington, 1967), pp. 118-119.

[12]Ibid., p. 138.

[13]Lloyd G. Reynolds, The Structure of Labor Markets (New York, 1951), p. 215.

target was to determine if an "industrial feudalism" exists--an immobilization of workers due to pension plans or other company-sponsored benefits.

Ross' conclusions were admittedly tenuous for two reasons. First, the data in the earlier years is somewhat eclectic and fragmentary. Secondly, there are few periods from 1910 to 1956 which are similar enough for valid comparisons. For example, it is necessary to go back to the 1920's to find an interval which can be roughly compared to the period between 1948 and 1956.

Data problems notwithstanding, Ross' contribution to the literature is significant. He found that there was a decline in quit rates during the twenties, but attributed the decrease to a desire by employers for increased productivity, yielding increased benefits to workers, and to a stabilization of the manufacturing work force. He suggested that the effect of unions on decreased turnover was not as significant as might be expected.

He found, as have other authors both before and after, that the primary contributor to turnover is the short-service individual--the one who had been on the job only a short period. A closely related contributor to turnover is the youthful worker. These are so overlapping that many researchers combine the two variables into one.

Ross submits four causes for what he calls a moderate decline in turnover in the recent years included in his study:

(1) The spread of unionism. Unions have served to correct many of the poor conditions to which workers have been subjected in the past.

(2) Aging of the labor force. The proportion of workers in the younger age groups has decreased. In the 40's and 50's this was caused by smaller numbers of individuals reaching working age.[14]

(3) Stability of manufacturing employment. The amount of production workers has remained fairly stable relative to the amounts of non-production and white-collar workers. He substantiates this with evidence that the manufacturing labor force has "aged" more than the total labor force.

(4) Effect of seniority rules. Although few statistics are available on the seniority status of individuals, the quit rate is almost negligible for individuals with more than five years of employment in a given establishment. New employees may stay with a firm several weeks before deciding to work in that job indefinitely. It is suggested that the seniority given by the firm after a short probationary period may protect a worker until he decides voluntarily to remain with the firm. This is particularly important in seasonal industries such as automobile or ladies' garment manufacture.

After suggesting the causes for a slightly declining quit rate, Ross concludes his analysis by suggesting that "little evidence can be found for the position that labor resources have become immobilized and a new feudalism has been created because men can no longer afford to

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[14]He did, however, predict somewhat of a "de-aging" of the work force in the 60's due to the products of the post-war baby boom reaching working age. This would increase the turnover rate. He suggests this effect would be softened, however, due to individuals increasingly taking non-manufacturing jobs. His prediction proved to be correct. Pencavel (24) showed that the quit rate "bottomed out" in 1959 and has been increasing since.

quit their jobs.[15] Later studies, particularly that of Pencavel (24), re-evaluated the industrial feudalism hypothesis.

A.6 Pencavel's Model

One of the most recent and most encompassing studies of mobility was done by John H. Pencavel (24). Using cross-sectional analysis of census data for 1960, Pencavel performed a number of multiple regression analyses and later attempted a set of simultaneous equations to explain the quit rates. He began his analysis by positing the following model

$$Q_i = \alpha_o + \alpha_1 W_i + \alpha_2 V_i + \alpha_3 A_i + \alpha_4 SM_i + \alpha_5 C_i + \alpha_6 U_i + \alpha_7 F_i + \qquad (5)$$

where Q_i = quit rate in industry i
W_i = median wage and salary income
V_i = standard deviation of wages and salaries by individuals
A_i = proportion of employees under 30 years of age
SM_i = proportion of employment in large SMSA's
C_i = accessions rate lagged one year
U_i = proportion of employees covered by collective bargaining
F_i = ratio of female to male employment
= stochastic disturbance term

He predicts the coefficients for W_i and U_i to be negative, those for A_i, SM_i, and C_i to be positive, and the coefficients of V_i and F_i to be ambiguous.

Some of the variables Pencavel used merit discussion. V_i is the standard deviation of wages and salaries by individuals. This is his measure of the dispersion of wages. The theoretical implication is that the greater the dispersion, the greater the opportunity for

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[15] Arthur M. Ross, "Do We Have a New Industrial Feudalism," The American Economic Review, XLVIII (December, 1958), pp. 903-919.

increasing remuneration by changing jobs. As will be seen, the coefficient was grossly insignificant. The present study will substitute the range of wages for this variable.

The second variable meriting attention is SM_i, the percent of employees in large SMSA's. The theoretical argument here is that, in larger cities, one can change jobs within the area without suffering the pecuniary costs of geographical movement.

To test the model, Pencavel selected data from 49 industries for which both turnover data and census data were available.[16] He submitted the data to multiple regression analysis and achieved an R^2 of .778. Each of the coefficients was significant at the 2.5% level except V_i and A_i. (The coefficient for A_i is significant at the .05 level.) Pencavel suggests that the most important variable is W_i. An increase of $100 in annual salary would reduce quits by 27 per 1000 employees.[17] The accessions rate and the percent under 30 years of age are also important in the magnitude of their influence. The variable F_i, the percent female, possessed a positive coefficient.

A second regression added a variable B, for the proportion of black employees. The resulting coefficient was negative, but insignificant.[18] It was omitted from later regressions.

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[16]Since census data is available only on a decennial basis, some of the results in cross-sectional analysis may not be strictly comparable to time-series analysis. Further, census industries include a combination of two-, three-, and four-digit SIC industries.

[17]Beta coefficients were used to determine the effect of a change in an independent variable upon the dependent variable. The beta coefficient for a regressor $x = B(s/s_y)$ where B is the estimated regression coefficient on x, s is the standard deviation of x, and s_y is the standard deviation of the dependent variable.

[18]The Burton and Parker (5) (22) and Stoikov and Raimon studies concluded opposite and statistically significant results here.

The variable U_i, reflecting percent of unionization, was significant and negative. In later regressions, the U_i times the number of work stoppages, ST, gives a variable which Pencavel suggests is an indicator of the work unions do for their members. This predicts that the militancy of unions as well as their mere presence significantly affects the quit rate. This variable was also significant. A number of other variables were tested but were insignificant.[19]

As a further step, Pencavel attempted the use of four simultaneous equations. His discussion of this is rather detailed and will not be repeated here. The differences in the coefficients for variables discussed above were negligible.

Pencavel then attempted to test the industrial feudalism hypothesis submitted earlier by Ross. Data problems were somewhat severe, but Pencavel did conclude timidly that "there does appear to be limited evidence supporting the thesis that growing wage supplements have contributed to the decline in the quit rate." He qualified this by adding that changes in industrial and demographic composition of the manufacturing work force are at least of equal importance.[20] A problem that continues to plague attempts to determine a relationship between turnover and benefits is a lack of data over time. No variables that measure firm-sponsored impediments to voluntary turnover were available throughout the 24-year period.

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[19]These included size of firm, coefficient of variation of employment by quarters from 1956 to 1959, the percent operatives and laborers in employment, the percent of managers, salesmen, etc., and the proportion of craftsmen in employment.

[20]John H. Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry (Princeton, New Jersey, 1970), p. 50.

A.7 The Effect of Wages

As opposed to Pencavel's (24) extensive study of the turnover concept, Bunting (4) made an intensive study of the relationship of wages to mobility. He is primarily interested in whether mobile workers improved their earnings by more than did those who did not change jobs.

Bunting used as his data source the statistics from the Bureau of Old-Age and Survivors Insurance. The data provides a large sample; the information extracted is the earnings, employer, and location for workers who worked throughout the year. Although the data has limitations, it does provide a good source to determine the relationship between wages and mobility. A limitation which should be mentioned is that the sample is restricted to those who made less than $3600 in 1953.

Bunting's initial results showed that those who changed jobs at least once during the year averaged increases of eleven percent while those who had not changed jobs averaged increases of only six percent. These results, however, merit some discussion. First, it was impossible using Old-Age and Survivors Insurance data to separate voluntary from involuntary changes. Thus, those who were involuntarily separated and later obtained another job could be expected to have a dampening effect on the wage increase of movers.

Another point made by Bunting, as well as Reynolds (25), is that turnover statistics are biased upward due to the "hypermobile" individual. Bunting's work shows that 3.6% of the workers had more than three jobs during the year. The wage improvement over a year's time was less for these hypermobile workers than for those who had changed jobs once

or twice. Thus, we can say there is not a linear relationship between wage increases and the number of job changers. As Bunting mentioned, this does not pose any great threat to those who see the wage-mobility relationship as a labor allocating mechanism. No one perceives that these hypermobile workers, who normally have personal characteristics which lead to their high amount of voluntary or involuntary job-changing, would be considered as an integral part of labor market theory. Most would agree that these are exceptions rather than the norm.

A.8 The Effects of Unions and Pensions

Before leaving the review of literature relevant to labor turnover, two variables which have received inadequate attention merit some discussion. These variables are the effects of unions and pension plans. Some studies have considered the union occupancy rate, but these were cross-sectional rather than time-series studies (5) (33) (24).

Although many theoretical economists insist that labor unions do exert a negative effect on turnover, a case can be made suggesting that any effect at all is of minor significance. Howard D. Marshall (20) summarizes this view very well. He concludes that:

1. Any desire unions have to keep their memberships low is marginal compared with firms' desires to keep their work force low. Further, many restrictive practices, such as high initiation fees, have decreased in recent years due to competition between unions.

2. Workers' attachment to unions themselves has been overstated. Although most workers support the unions to which they belong, this has

little effect on their propensity to change jobs.

3. Seniority systems, perhaps the most important method of reducing mobility, appeal more to older than to younger workers. These are the workers who in most cases would not change jobs anyway.

4. Many of the "fringe" benefits gained by unions have been granted by non-union firms. Further, many of these benefits are the same in one company as in another. One of these benefits, the pension, will be discussed shortly.[21]

While Marshall does not argue that unions have not deterred mobility, he does suggest strongly that the effect is much less than popularly supposed. Further, the turnover enhancing actions of unions, e.g., pushing for increased severance pay and disseminating job information, may act to soften the effect of involuntary turnover even more.

The second variable of interest is the number of private pension plans in effect. In studying the effect of private pension plans on labor mobility, Folk (11) found that firms with pensions do exhibit lower turnover than do non-pension firms. He suggests, however, that this does not prove that pensions themselves reduce turnover. He cites several reasons for this belief.

1. Pensions are more common in high-wage firms. From earlier discussion we have seen a negative relationship between high wages and turnover.

2. Pensions are more common in unionized firms which have strict seniority rules.

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[21]Howard D. Marshall, "Union and Labour Mobility," Labor Law Journal, VII (February, 1956), pp. 83-97.

3. Firms in seasonal industries which traditionally exhibit higher turnover are less likely to have pensions.

4. Pension firms have lower accessions rates than non-pension firms. (Since accessions are positively related to quits, the direction of causality here is unclear.)[22]

In other words, pensions are more likely to be present in firms which have a lower turnover rate for reasons other than the pensions.

The weakness of the pension-turnover relationship brings up the question, "Why have pension plans continually increased?" Both the number of plans and the number of workers have increased in recent years.[23] Due to non-availability of time-series data, the answer to this question will not be attempted in the present study, although the presence of unions and a certain amount of welfare capitalism could be postulated as possible causes.

A.9 Summary

We can now summarize recent contributions of the labor turnover literature. Theoretical economics posits that man is rational in his job choice decisions, always moving toward higher wages when possible. This voluntary movement when jobs are available, coupled with downward

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[22]Hugh Folk, "Effects of Private Pension Plans on Labor Mobility," Monthly Labor Review, LXXXVI (March, 1963), pp. 285-288.

[23]In the period from 1949 to 1969 the number of plans in existence increased from less than 5,000 to over 17,000, and members covered have increased from 7,000,000 to almost 20,000,000. U. S. Department of Labor, Bureau of Labor Statistics, Labor Mobility and Private Pension Plans, Bulletin 1407 (Washington, 1964), and Harry E. Davis and Arnold Strasser, "Private Pension Plans, 1960 to 1969--an Overview," Monthly Labor Review, XCIII (July, 1970), pp. 45-56.

movement of workers during a contracting economy, tend to allocate labor in an optimal manner.

Research reported in this study has shown that, in the aggregate, workers do move in a manner roughly approximating the traditional predictions. Individual moves, however, reflect a person's rationalization for his own adaptation to the environment, and these may not be rational from the economist's viewpoint. The extreme in this latter view is witnessed by Reynolds (25), who states that:

> the typical worker has no sensation of being in 'a labor market.' He has no idea of the full range of jobs, wage rates, and working conditions prevailing in the area nor does he have any idea of the hundreds or thousands of job vacancies available on a particular day. At most he knows about a few jobs which have come to his knowledge in a haphazard way. . . . If he comes across a 'good' job he takes it, not worrying about whether a better job is somewhere else.[24]

As a "general consensus" of the research reported,[25] we can say that a negative relationship exists between turnover and wages of the industry, age, seniority, the unemployment rate, the layoff rate,[26] and the quality of the work force.

A positive relationship exists between turnover and the accessions rate, the economy level, the percent Negro in the work force, and the percent with brief tenure.

Ambiguous or conflicting relationships were found by researchers for the union occupancy rate, size of the firm, percent of workers in

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[24]Reynolds, p. 85.

[25]By "general consensus" is meant the relationships upon which most of the investigators agreed. If gross disagreement exists, a variable will be included in the "ambiguous" category.

[26]Stoikov and Raimon (33) were exceptions.

SMSA's, percent female, employment change, industrial wage differentials, pensions, and change in wages.

In addition to the above variables, some studies included unique variables such as the standard deviation of wages, or wages standardized by skill mix; and some made use of lagged variables. In general, the added contribution of these variables was not substantially greater than that of the more traditional variables.

Several authors agreed that both incentive and opportunity variables operated in producing a move, while a few suggested that individuals are "pushed" rather than "pulled" into the labor market.

The review of recent literature may be closed with the appropriate, as well as somewhat inconclusive, statement by Reynolds and Shister, "Worker behavior is in general a rational adaptation to the circumstances as the worker sees them."[27]

Attention is now turned to literature relevant to the theory and applications of the factor analysis tool.

B. Factor Analysis Theory

This section is concerned with the utility of factor analysis and the theory underlying the factor analysis tool. The next section presents a sampling of the applications of the method to the organizational behavior and labor economics areas. The discussion of the theoretical underpinnings of factor analysis will follow closely that of Harmon (14) and Rummel (28). For a brief and non-mathematical review of factor analysis, see a summary work by Harmon (15).

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[27]Reynolds and Shister, p. 87.

B.1 The Utility of Factor Analysis

The utility of factor analysis is suggested by Cattell (6) (7), who has applied the tool to a great number of studies in the socio-psychology area. He states:

> The factor analytic method, as developed in psychology, begins with a population of organisms all of which are measured with respect to the same set of variables, chosen to have maximum relevance to the life processes which are to be studied. The variables are then intercorrelated, so that if the experimenter begins with n variables, he ends with a matrix of correlations representing all the $\frac{n(n-1)}{2}$ possible relationships among the variables taken two at a time. Instead of examining these variables superficially for clusters which merely indicate some sort of covariation in each of a rather indefinite number of subgroups, one obtains by factor analysis the actual number of independent directions of variation observed among the n variables and something of their nature too.[28]

Rummel (28) justifies the use of the tool by suggesting that factor analysis can:

(1) Analyze such a large number of phenomena that 100-variable analyses become routine.

(2) Disentangle complex interrelationships among the phenomena and identify independent influences or causes at work.

(3) Handle social phenomena in the situation. Interrelationships between behavior and the environment can be analyzed as they exist in real life.

(4) Accommodate a wide range of research designs and data.[29]

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[28] R. B. Cattell and M. Adelson, "The Dimensions of Social Change in the USA as Determined by P-Technique," Social Forces, XXX (1951), p. 190.

[29] R. J. Rummel, Applied Factor Analysis (Evanston, 1970), pp. 3-4.

B.2 Factor Analysis Terminology

It is necessary to introduce some terminology leading up to the general factor model before discussing the specific method used in this study. Using Harmon's (14) notation, suppose a set of n variables exists with a value for each of N individuals (cases). Then the value of a variable X_j for individual i is represented by X_{ji}. The variable may be written in the form $x_{ji} = X_{ji} - X_j$, where x_{ji} is the deviation of the observed variable X_{ji} from the mean X_j. From basic statistics the variance of the variable may be written $\sigma_j^2 = \Sigma x_{ji}^2/N$, and from this a standardized value for variable j (called the z-score) for individual i may be computed. This is given by $z_{ji} = x_{ji}/\sigma_j$. The correlation between any two variables j and k will be given by

$$r_{jk} = z_{ji}z_{xi}/N \tag{6}$$

These intercorrelations between all variables are the basis for factor analysis.

A matrix of correlation coefficients may be established with the form

$$R = \begin{bmatrix} 1 & r_{12} & r_{13} \cdots & r_{1n} \\ r_{21} & 1 & r_{23} \cdots & r_{2n} \\ r_{31} & r_{32} & 1 \cdots & r_{3n} \\ \vdots & & & \\ r_{n1} & r_{n2} \cdots & \cdots & 1 \end{bmatrix} \tag{7}$$

Eigenvalues and eigenvectors are computed from the matrix R. Factor loadings are then computed from the eigenvalues and eigenvectors.[30]

B.3 The General Model

Again from Harmon (14), the object of factor analysis is to represent a variable z_j in terms of several underlying factors, or hypothetical constructs. Employing the notation, $F_1, F_2, \ldots F_m$ for common factors, and $U_1, U_2, \ldots U_n$ for unique factors, the complete linear expression for any variable z_j may be written

$$z_j' = a_{j1}F_1 + a_{j2}F_2 + \ldots a_{jn}F_n + a_jU_j \tag{8}$$

where the prime is used to call attention to the theoretical form of the observed variable. (The prime will be assumed hereafter.) The factors, F_p, are the factors common to all variables while U_j represents the factor unique to variable j. We can now present a set of equations for the n variables. These are of the form

$$\begin{aligned} z_1 &= a_{11}F_1 + a_{12}F_2 + \ldots + a_{1m}F_m + a_1U_1 \\ z_2 &= a_{21}F_1 + a_{22}F_2 + \ldots + a_{2m}F_m \qquad\quad + a_2U_2 \\ &\vdots \\ z_n &= a_{n1}F_1 + a_{n2}F_2 + \ldots + a_{nm}F_m \qquad\quad + a_nU_n \end{aligned} \tag{9}$$

Since the variance of a standardized variable must add to unity and, in addition, factors are assumed to be in standard form, we have

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[31] An understanding of the computational steps required to determine the factor matrix from the correlation matrix assumes an in-depth knowledge of matrix algebra. The reader is referred to Rummel (28), Chapter 4, for a discussion of the matrix computations involved in the factor determination.

$$\sigma_j^2 = 1 = a_{j1}^2 + a_{j2}^2 + \ldots + a_{jm}^2 + a_j^2 \qquad (10)$$

where the a_{j1} refers to the coefficients of common factors, and a_j is the coefficient of the unique factor.[31]

The communality of a variable z_j is the contribution to total variance of a variable by all the common factors. Hence

$$h_j^2 = a_{j1}^2 + a_{j2}^2 + \ldots + a_{jm}^2 \qquad (11)$$

The uniqueness is the contribution of the unique factor and is

$$a_j^2 = 1 - h_j^2 \qquad (12)$$

Another way of viewing the communality is that it is the variance of a variable x_j in a matrix of n variables common to the other (n-1) variables.[32]

B.4 Factor Approaches

Several different "solutions" may be obtained from the correlation matrix, R. Different methods of determining factors may be used depending upon the information desired and the facilities available for computation.

Three basic approaches are in existence: the two-factor approach, the bi-factor approach, and the multi-factor approach. Within the multi-factor approach are several techniques, e.g., the centroid

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[31]This form is true only when the factors are uncorrelated. Since we will be concerned later only with orthogonal rotation of factors, this relationship will be assumed for simplicity of presentation.

[32]Rummel, p. 102. Harmon's (14) notation is maintained.

technique, the diagonal technique, and the principal axes technique.[33] The principal axes approach is often used and is the method of the present study. It is singled out from the others for the following discussion.

The principal axes approach (or principal factor or principal component) is used to determine the principal axes of an ellipse in two or more dimensions. The principal axes are the minimum orthogonal dimensions required to linearly reproduce the original data. These dimensions or factors may be basic variables, or basic dimensions of the data. The variance contributions of the factors are decreasing; successive factors account for decreasing proportions of variance. Further, the factors delineated are orthogonal.[34]

The one difference in the principal components solution and the general model (common factor analysis) presented earlier is that the unique factors are no longer of concern. In other words, the attempt is to analyze all the variance of a set of variables and determine the axes or factors most closely fitting the data.

B.5 Factor Rotation

Once the factors underlying the variables have been delineated, one may then wish to rotate the axes of the n-space to more advantageous positions.[35] Harmon suggests that:

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[33]This technique is also known as the principal factor approach and the principal component approach.

[34]Rummel, pp. 344-345.

[35]Although the term "rotated-factor matrix" and other references to rotated "factors" may be used, the axes of the n-space are rotated in a way to give the factors more meaning and to aid in explanation.

> for ease of mathematical description and psychological interpretation, it is common practice to change the frame of reference. In making such a transformation of coordinates, it must be remembered that the geometric configuration, e.g., straight line or swarm of points is left unaltered. The configuration itself is invariant.[36]

The need to rotate axes can be stated as follows. Although unrotated factors account for succeedingly smaller increments of variance--the first factor accounts for the most variance, the second factor accounts for the most of the first factor residual, etc.--these factors do not determine clusters of variables. Thus, a factor could be placed midway between two groups of variables. Rotating the axes creates factors which maximally identify clusters of variables.[37] Rotated factors do not necessarily account for decreasing amounts of variance. The variance accounted for by major unrotated factors is spread across all the rotated factors. Each of the rotated factors tends to account for about the same magnitude of variance. Thurstone calls this process "rotating to simple structure."[38] Rummel suggests that this is achieved by rotating factors around the origin until each factor is maximally colinear with a distinct cluster of vectors. The shift is from factors maximizing total variance to factors delineating separate groups of highly intercorrelated variables.[39]

In rotating the factors to simple structure it is desirable to meet the criteria set forth in Thurstone (34). His criteria,

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[36]Harry H. Harmon, Modern Factor Analysis (Chicago, 1960), p. 98.

[37]Varimax rotation is used in the present study. Attention is invited to Rummel, Chapter 16, for a discussion of this method.

[38]L. L. Thurstone, Multiple Factor Analysis (Chicago, 1947), p. 335.

[39]Rummel, p. 377.

summarized by Harmon, are:

(1) Each row of the factor matrix should have at least one zero.

(2) If there are m common factors, each column of the factor matrix should have at least m zeros.

(3) For every pair of columns of the factor matrix, there should be several variables whose entries vanish in one column but not in the other.

(4) For every pair of columns of the factor matrix, a large proportion of the variables should have vanishing entries in both columns when there are four or more factors.

(5) For every pair of columns of the factor matrix, there should be only a small number of variables with non-vanishing entries in both columns.[40]

As will be seen later, the factors derived through rotation do, in fact, meet these criteria quite well.

B.6 Factor Scores

Once factors have been determined and rotated as desired, it is then convenient to obtain profiles for individuals in terms of the factors. Harmon states:

> If we can get linear expressions for the factors in terms of the observed variables, then upon substituting the values of such variables for an individual, we can get his corresponding 'factor score.'[41]

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[40]Harry H. Harmon, "Factor Analysis," Handbook of Measurement and Assessment in Behavioral Science, ed. Dean K. Whitla (Reading, Massachusetts, 1968), p. 148.

[41]Ibid., p. 149.

Rummel (28) summarizes the process of obtaining factor scores in the following way:

> Each variable is weighted proportionally to its involvement in a factor; the more involved a variable, the higher the weight. Variables not at all related to a factor would be weighted near zero. To determine the score for a case on a factor, then the case's data on each variable is multiplied by the factor weight for that variable. The sum of these weight-times-data-products for all variables yields the factor score. This weighted summation will give cases high (or low) scores if their values are high (or low) on the variables involved with a factor.[42]

Factor loadings (entries in the factor matrix) tell us what the hypothetical construct is, while the factor scores tell us how a given case contributed to the creation of the factor.

B.7 Relationship to Regression Analysis

Since earlier studies have, with almost no exceptions, utilized multiple regression analysis to analyze labor turnover, it is of interest to compare that method with the present tool. The two methods are similar in some respects while quite different in other respects.

Harmon suggests that regression analysis falls in the category of statistics called "analysis of dependence," whereas factor analysis could be classified as "analysis of interdependence." He qualified this by adding that factor analysis lies far on the scale toward the analysis of dependence. The important distinction is that regression analysis requires one or more variables to be considered as "dependent" while factor analysis focuses attention on relationships among all the variables without singling out any for special consideration.[43]

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[42] Rummel, p. 150.

[43] Harmon, 1968, p. 145.

Rummel takes exception to Harmon's discussion to some extent. Although the researcher may be interested in the total set of variables, often the interest lies in the relationship of a given variable to all the others. As was discussed earlier in this section, an equation may be presented as

$$z_j = a_{j1}F_1 + a_{j2}F_2 + a_{j3}F_3 + \cdots + a_{jp}F_p \qquad (13)$$

where z_j is a particular standardized variable, a_{ji} is the factor loading on factor F_i. This may be compared with the standard multiple regression equation

$$z_j = \beta_{j1}Z_1 + \beta_{j2}Z_2 + \beta_{j3}Z_3 + \cdots + \beta_{jm}Z_m \qquad (14)$$

where the β_{ji} are the regression coefficients for the m standardized variables. In the latter case, the variable z_j is a variable dependent upon m "independent" variables. In the former case the variable z_j is a function of p truly independent (orthogonal) factors.[44] The difference is that the orthogonal factors are derived based upon a large number of variables. This, then, is one of the beneficial aspects of factor analysis. If regression analysis attempted to use a large number of variables, problems of intercorrelations among supposedly independent variables would arise. Factor analysis takes these variables and from their intercorrelations derives independent factors. These factors may then serve as the "independent" variables with the factor loadings being the regression coefficients contributing to a given "dependent" variable.

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[44]Rummel, pp. 203-204.

It should be noted that a major difference between the two methods is the use desired of the results. In regression analysis the concern is with the fit of vector X_j in the vector space defined by the independent variables and the contribution of the other m-1 vectors to this fit. In factor analysis, the focus is on the question, "What is the smallest number of linear independent dimensions (factors) that will span the vector space defined by data on a set of vectors?"[45] There is no knowledge before the analysis of either the dimensions nor the loadings of each variable on the dimensions. Thus, instead of trying to arrive at the best fit of the dependent variable on known dimensions, interest is in determining what those dimensions are and the contribution of each variable to the dimensions.

B.8 Summary

A set of variables relating to an area of interest may be factor analyzed to obtain groups of variables which exhibit similar characteristics. Raw data for each variable are first transformed to standard z-scores. From these z-scores the correlation matrix is obtained. The correlation matrix is the basis for all factor analyses.

From the correlation matrix factors are derived each of which represents clusters of variables accounting for successively smaller amounts of variance. For each variable, the sum of the squared factor loadings is the communality of the variable, or the amount of variance explained by the factors. Prior to interpretation, factors are rotated orthogonally, giving a set of independent factors explaining the

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[45] Ibid.

variance in the data set. The rotated factor loadings may then be interpreted. To aid in interpretation and to determine the contribution of each case to a given factor, a factor score is obtained by multiplying the factor loading of a variable by the case's value for that variable.

C. Applications of Factor Analysis

Attention is now turned to look at recent examples of factor analysis applied to the study of organizations and economics. Applications in the area of economic development are presented first, followed by more specific applications to organizations and/or manpower economics. These examples will simultaneously lend credence to the viability of factor analysis as a tool and show some of the subject areas to which the tool has been applied.

C.1 Applications in Economic Development

Jonassen and Peres (16) utilized factor analysis to determine relationships among economic variables for 88 counties in Ohio. Utilizing both U. S. census data and reports from other government and private agencies, they developed a list of 82 variables--certainly too many to analyze through regression analysis. By using factor analysis they were able to include the 82 variables for each of the 88 counties. From these variables, seven factors were determined, which reflect different dimensions of communities and were identified as urbanism, welfare, influx, poverty, magni-complexity, educational effort, and proletarianism. A similar analysis was done by Lawson and Rice (18). Like the Jonassen and Peres study, the target of the analysis was

political subdivisions. Lawson and Rice collected data on 44 variables for each of 17 western states. A second analysis considered 40 variables and 44 counties in Idaho. The data source in each study was the 1963 Census of Manufacturing. Five factors were rotated and identified as dimensions of economic development in each study.

Berry (3) subjected 43 indices dealing with the economic development of 95 countries to factor analysis. From these variables he was able to determine four primary factors that influenced economic development. These were the technological pattern, the demographic pattern, the contrast in income and external relations, and the large versus the small.

C.2 Applications in Organizations

Tied somewhat more closely with organization behavior, Coombs and Satter (8) factorized 54 jobs in a large midwestern paper mill. After collecting data from interviews, they prepared job descriptions containing 104 elements in five categories--educational skills, application skills, social and personal skills, work skills, and activity distribution. These were subjected to factor analysis which resulted in four factors of interest. From these factors job families could be grouped based upon (1) self-responsibility, (2) routine, entry occupations, (3) skilled machine jobs, and (4) clerical jobs. Their particular study was a pilot study to determine the feasibility of this type of analysis in job family determination. They concluded that factor analysis was, indeed, a viable tool for studies in job analysis.

Stogdill (32) utilized factor analysis to study relationships among foremen in a work situation. He included 30 work-related

variables with values for each of 30 foremen and a manager in a manufacturing plant. Factor analyzing the 30 variables resulted in three distinct factors that could adequately describe a work situation. These were employee satisfaction, supervisory behavior and status, and group performance. Thus, three factors or constructs were sufficient to describe the work situation rather than 30 different variables.

C.3 Applications to Mobility and Wage Structures

A work which is related to the present study was done by Jack Ladinsky (17). He was interested in the geographic mobility of professional and technical manpower. Using the 1/1000 1960 census data, he first utilized a multiple regression analysis to explain migration. His results showed that, in order of importance, age, income, education, regional location, sex, family size, and marital status were the primary variables accounting for migration; but the total variance explained was only 20%. He then factorized these plus other variables. He concluded that six factors--family life cycle, work context, professional status, career stage, urbanism, and regionalism--were independent factors underlying migration. Note the change here is from seven variables, which in all likelihood are highly intercorrelated and do not account for a large amount of variance, to six factors which are uncorrelated and which account for almost all the variance.

A second study closely related to the present study is that of Goldner (12). He utilized the tool in the study of wage rates in metropolitan areas. His study was in actuality a follow-up on his earlier work in which he utilized regression analysis to study wage rates. However, "the complexity of dealing with a long list of jobs in

many labor markets makes necessary some device for abstracting from this detail."[46]

Goldner factor analyzed wage rates for 25 occupations in each of 80 metropolitan areas (SMSA's). Using the principal factor solution, Goldner obtained two quantitative measurements which account for 80% of the variation reflected in the original structure of rates. The first factor measured deviations of the metropolitan wage level from the composite of all wage levels. This factor represented inter-metropolitan wage structure and reflected geographical differences. The second factor converted skilled-unskilled wage differentials in individual labor markets into a quantitative measurement and provides the basis for analyzing geographical differences in wage differentials. Thus, the first factor represents geographical differences in wage levels while the second factor represents geographical differences in wage differentials.

This interpretation was determined in the following way. The loadings on the first factor were all positive with most of them near unity regardless of occupation. Moving from the factor loadings to factor scores consists of multiplying factor loadings by the individual z-scores. Thus, the factor scores for individual SMSA's very closely paralleled the original deviation from the average wage. From this, it is concluded that the factor represented geographical differences in wage levels.

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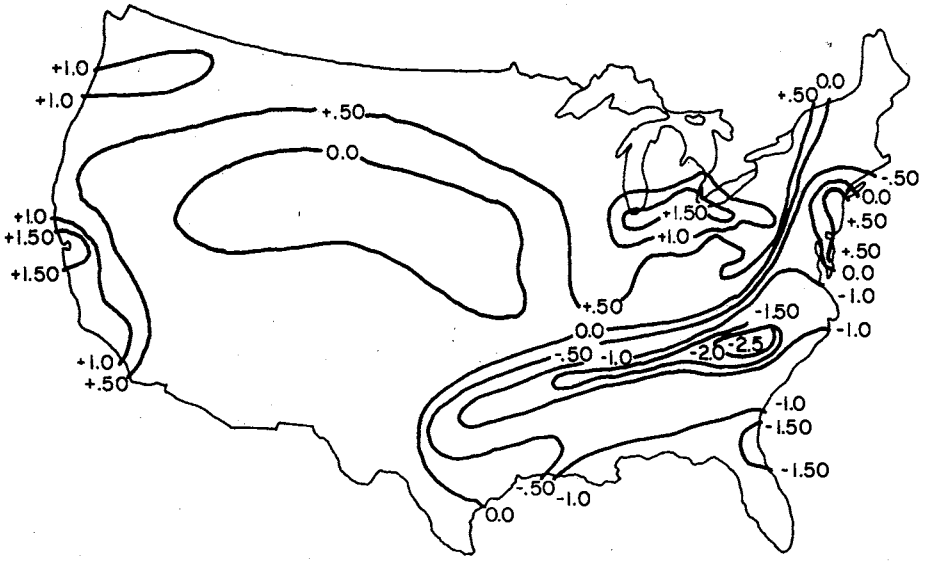
[46]William Goldner, "Level and Structure in Wage Rates of the Metropolitanized Work Force," Human Resources in the Urban Economy, ed. Mark Perlman (Washington, 1963), p. 222.

The second factor loadings were bipolar, i.e., large positive and large negative loadings existed with near zero loadings between. In looking at the variables it became apparent that highly skilled occupations had high positive loadings while unskilled or semi-skilled occupations had negative loadings. Thus, it could be determined that the second factor measured geographical differences in wage differentials rather than wage levels.

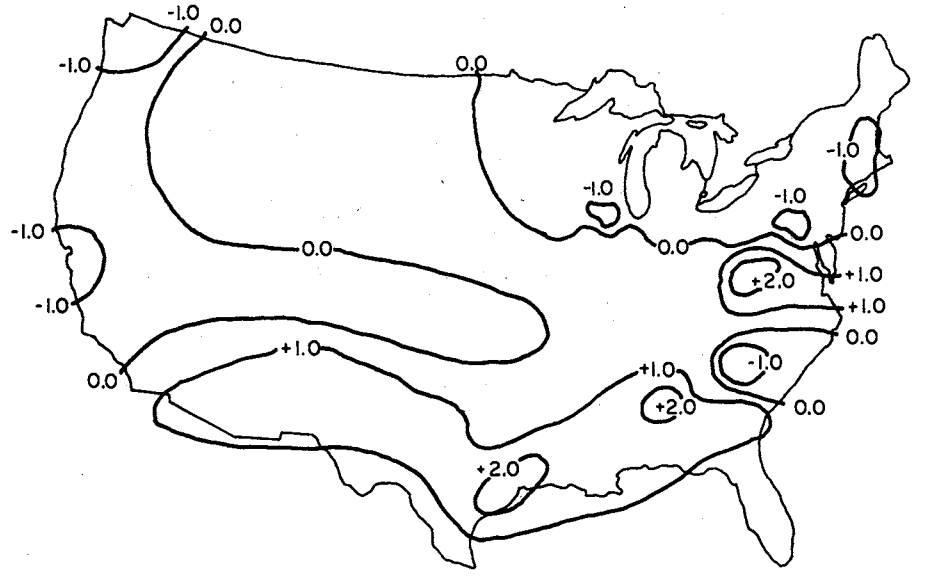
The Goldner study illustrates another very useful facet of factor analysis. This is the mapping of factors. The accompanying diagrams show the isometric lines connecting areas of equal wage levels (Figure 1) and wage differentials (Figure 2). Any contours with positive notation are those with higher than average wage levels or differentials while negatively marked lines denote areas with lower than average wage levels or differentials. Note in Figure 1 the high scores in the upper midwest and west coast with high negative scores in the Appalachian area. Although not so obvious, similar statements could be made in Figure 2. Large differentials apparently exist in the upper Appalachian area, the Birmingham area, and the Houston area. In retrospect, this could be expected.

Goldner mentioned in closing that it appears that wage levels and wage differentials do not respond to identical influences. Even though this statement may have been prompted by subject area considerations, this is the very essence of factor analysis. The fact that factors are orthogonal suggests by itself that the underlying concepts respond to different influences. If the variance among a set of variables is associated with a single causal variable, only one factor would be derived.



SOURCE NO. 12

Figure 1. Geographical Distribution of Metropolitan Wage Levels: 1960-1961



SOURCE NO. 12

Figure 2. Geographical Distribution of Metropolitan Skilled-Unskilled Wage Differentials: 1960-1961

C.4 A Time-related Application

One last contribution to the literature is reported even though it does not relate closely to turnover analysis. Carl W. Hale (13) applied factor analysis to the study of regional economic analysis and specifically to the creation of an industrial linkage index. The significance of Hale's contribution to the present study is that his work was one of very few to include the time dimension in the analysis. He used time-series data "because these data present an historical view of the region's industrial structure and thus measure an additional dimension of a region's industrial activity--that is, change over time."[47] As suggested in Chapter I, the inclusion of the time dimension in the present study forms part of the uniqueness of this study relative to other studies of turnover.

Hale did not attempt to interpret factors as will be done in the present study. Instead, he used the factors along with partial correlations to determine his "Industrial Linkage" between one industry and other industries. This, he suggests, is a measure of complementarity or how industries have related over time.

This chapter has presented a review of recent literature on the subject of labor turnover, followed by the theory of factor analysis and recent applications of the tool to the organization and manpower economics area. The discussion of labor turnover has served to identify models that have been suggested and, in particular, variables that were submitted to analysis. Most of the variables included in the

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[47]Carl W. Hale, "Factor Analysis, Industrial Linkage, and Industrial Structure," The Review of Regional Studies (Virginia Polytechnical Institute, n.d.), p. 20.

earlier studies were also included in the present study. The discussion of the theory and applications of the factor analysis tool provides support for the analytical tool. Through the discussion of the theoretical underpinnings of factor analysis and recent applications in the general area being studied, the utility of the tool in non-psychological areas is substantiated and its viability as a research tool in labor turnover analysis is supported.

The next chapter examines the methodology used in the present study, followed in Chapter IV by the presentation and analysis of results.

CHAPTER III

METHODOLOGY AND DATA

The previous chapter discussed the theoretical underpinnings of labor turnover and of the factor analytic method used in the study. The present chapter is concerned with the specific methods used in the study and the data analyzed. Chapters IV and V will, in turn, discuss the empirical results of the analyses, followed by a discussion of the results and their relationships to the hypotheses tendered, as well as the broader area surrounding labor turnover itself.

This chapter will first be concerned with the "data slices" used in the study. This will be followed by a discussion of each variable included in the analysis. The last section will then focus upon the purpose of the specific analyses which were made.

A. The Data Slices

It is necessary, in order to have a full understanding of the relationships between the analyses, to discuss the various data configurations, or "data slices," that may be used in a factor analysis. When analyzing any set of data, regardless of the method of analysis, one looks at one or more of the three possible "dimensions" of raw data. For example, the interest may lie in several characteristics of a given person or entity over a period of time, or it may center on the values of a given characteristic for several different individuals,

again over time. The third possible configuration is the study of several characteristics for a group of individuals at one specific time period. Different authors have different names for these dimensions.[1] The symbolism suggested by Rummel will be used in this study. Given possible entities (persons, subjects, industries), characteristics (blood pressure, stock prices, quit rates), and time periods (years, quarters, months), we can form the six possible data "slices" and types of analysis.

1. If the variables of interest are entities, while cases are characteristics at a single time period, a Q data slice, or a Q-analysis, is made.

2. If the focus is on the opposite relationship, i.e., characteristics as variables and entities as cases, an R data slice, or R-analysis, is used.

3. If the variables are entities, as in the Q-analysis, but the cases are values of a single characteristic over several "occasions," an S-analysis is made, using an S data slice.

4. The transpose of the S data slice, with occasions as variables and the single characteristic of several entities as cases, produces a T data slice, or a T-analysis.

5. When the variables are occasions, and characteristics of a single entity are the cases, an O data slice, or O-analysis, is made.

6. Lastly, the transpose of the O data slice, with characteristics as the variables and occasions as cases, identifies a P-analysis,

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[1]Rummel, p. 192, footnote 21.

using a P data slice.[2] The occasions may be any time units; the present study utilized annual data.

The present study utilized three of the six data slices, the R, T, and P. Major emphasis was focused upon the P-analysis. Variables were economic characteristics relating to labor turnover measured on an economy-wide or manufacturing-wide basis. The cases were the annual averages for each variable in each of the years 1947-1970. This stresses the relationships among characteristics as they vary over time.

The use of the T-analysis also includes a time dimension, but in this case, the time units are the variables rather than the cases. The cases in the T-analysis were the quit rates for each of several industries. The results of the analysis reflected groups of similar years based upon the quit rate among industries.

The R-analysis, in its normal form is not concerned with relationships over time. Its variables are characteristics as in the P-analysis, but the cases are values registered by several industries at one specific time period. A measure of time can be injected into the R-analysis by making two or more R-analyses using data from different time periods.

These data slices will be discussed further in the last section of the chapter. The next section identifies the data that were analyzed.

B. Data and Sources

Factor analysis, as opposed to regression analysis, allows the

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[2]Ibid., pp. 192-202.

inclusion of a large number of variables in a study. This section discusses the variables selected for inclusion in the study, the reason for their inclusion, and the sources from which the variables were obtained.

A total of 52 primary or derived variables was identified for the analysis. These variables included:

(1) Variables considered by other investigations and reported in the literature review,

(2) Variables which may affect turnover for numerical reasons only, e.g., total employment, percent of employment in minority groups, etc.,

(3) Variables which an individual contemplating a change in jobs might perceive as an influence either on incentives or opportunities to leave a job. Examples here would include unemployment, wage levels, layoffs, job vacancies, etc., and

(4) Variables which are considered by some to impede turnover, but whose effect is questionable. The percentage unionization exemplifies this category of variable.

Each of the variables included in the study entered the analysis with a hypothesized relationship to turnover. The following discussion considers each of these variables, along with the direction of the relationship expected and the theoretical justification for the inclusion of the variable.

1. Separation Rate (SEP). This variable measures the combined turnover rate for an industry. It includes quits, layoffs, discharges, and miscellaneous separations, as in entering the armed forces.

2. Quit Rate (QR). This is the key turnover variable and the target of the analysis. It is the only turnover variable reflecting voluntary changes. Thus, it is the only change directly under the control of the individual.

3. Layoff Rate (LR). The layoff rate is also of prime importance in the study. It may be hypothesized to be the antithesis of the quit rate. The expected relationship was that layoffs would coload highly with the quit rate, but with opposite sign, although Stoikov and Raimon (32) found a positive relationship between the two in a cross-sectional study.

4, 5. Annual Incremental Change in Quits and Layoffs (ΔQ, ΔL). The incremental change in quits and layoffs were included to determine if recent changes are the result of the same force that determines the absolute level of the variables. From a behavioral point of view, the interest is whether an individual reacts to levels of variables or recent changes in variables.

6. Accessions Rate (AR). The accessions rate is the number of additions to the firm's work force per 100 employees. This includes both new hires and recalls of previously laid-off employees. The accessions rate may be a measure of three different concepts, each of which should relate positively to the quit rate. First, it is accepted that quits are concentrated among new employees. Thus, increased accessions should increase quits. Secondly, increased accessions suggest an expansionary economy and hence a more favorable job market, also increasing the amount of quits. The third relation has the same sign, but the direction of the cause/effect relationship is opposite,

i.e., increased quits will require employers to increase accessions to replace those who left.

7. Lagged Accessions Rate (LAR). When annual data is used in a study, it is recognized that some of those who quit in a given year were accessions in the same year. This would suggest that the unlagged accessions rate is a measure of the number of new employees. An equally valid argument would submit that the lagged accessions rate is the appropriate measure of the new employees while the accessions rate measures opportunity in the job market. As a result, both measures were included.

8. New Hire Rate (NH). The new hire rate comprises part of the accessions rate, while recalls of previously laid-off workers make up the remainder. From the "new employee turnover" viewpoint, new hires should be more closely related to quits than are accessions. Perhaps somewhat incidental to the analysis is the fact that, in upswings, new hires should lag the accessions rate, since early accessions will be made up of recalls rather than new hires.

9. Lagged New Hire Rate (LNH). This variable was not included in initial analyses due to its similarity to lagged accessions. It was included in a later analysis, although no substantial difference between it and lagged accessions was expected.

10, 11. Non-Agricultural Workers (NAW), Production Workers (PW). Most studies of turnover include a variable which measures the level of employment in an industry or the economy, commonly one of these two. The expected relationship was unclear. Theoretically, increases in employment suggest a more productive economy and, hence, more opportunities. On the other hand, if most turnover occurs among lower level

workers, it may be that the number of production workers is more important to the production worker contemplating a job change than total non-agricultural employment.

12. Percentage of Non-Production Workers (%NP). That firms have continually increased the percentage of non-production workers cannot be debated. Theoretically, increases in this percentage should have a deleterious effect on the number of opportunities for production workers contemplating job changes.

13, 14, 15. Gross Weekly Earnings (GWE), Annual Incremental Change in Weekly Earnings (ΔWE), and Hourly Earnings (HE). Some form of these statistics are used in nearly all studies. Some utilize annual wages rather than hourly or weekly earnings. The change in wages was included to determine if individuals respond to absolute wage levels or recent changes in wages.[3]

16. Spendable Earnings (SE). No studies reported using spendable earnings as a variable. Yet, from an individual's viewpoint, spendable income rather than gross income should be more important.

17. Unemployment Rate (U). Like wages, unemployment is included in nearly all studies. The expected result was a highly negative relationship to the quit rate.

18. Average Duration of Unemployment (U_{ad}). Individuals contemplating leaving a job will consider how many of their acquaintenances are out of work. Perhaps of more importance, they will be concerned

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[3]Stoikov and Raimon (33) utilized changes over three years to account for changes in collective bargaining agreements. Although they have a valid point, it is doubtful that individuals would respond to changes over that long a time period. Annual changes seem much better and were used in this study.

with how long those acquaintenances have been without work. The longer the average duration of unemployment, the lower will be the propensity to quit.

19. Labor Force Participation Rate (LFPR). Much of the labor turbulence, i.e., total accessions and total separations, is associated with movements into and out of the labor force. Movement into the labor force can be expected to occur predominantly in females and young males. Movement out of the labor force is predominantly females and older males, with some young males leaving the civilian labor force, either to return to school or enter the military. The relationship between the labor force participation rate and quits was expected to be positive but weak, since the statistic is a net measure and, as such, does not consider the absolute amount of inflows and outflows.

20, 21. Consumer Price Index (CPI), Wholesale Price Index (WPI). These two variables are major measures of the cost of living for individuals and the cost of operation for firms, respectively. Any relationship between these and quits was expected to be weak, although the cost of living would reduce real wages and could thereby affect a decision to leave a job. The expected relationship was unclear.

22, 23. Gross National Product (GNP), Annual Incremental Change in GNP (ΔGNP). The level of gross national product is a statistic frequently reported as an indicator of the health of the economy as well as an indicator of productivity. Both it and the annual change in GNP may have an effect on turnover. ΔGNP was expected to have the greater effect on an individual's perception of opportunities, while GNP should relate more to actual opportunities.

24. Dow-Jones Stock Average (DJSA). This is a major indicator of the health of the economy. This statistic is available to the individual via news media and is often used as a proxy for the overall economic outlook.

25. Government Spending (G). Increased government purchases either directly or indirectly result in more jobs for workers. Thus, the expected relationship between government spending and quits was positive since more jobs imply greater opportunities to move. It is suggested, however, that a lag may occur in some cases, although this was not considered in initial analyses.

26. Lagged Government Spending (LG). To determine if a one-year lag in government spending would be more closely related than current spending, this variable was included in a later analysis.

27. Expenditure for New Plant (ENP). Expenditures for new plant may affect turnover in two ways. First, as expenditures in a given plant increase, the incentive for advancement within that firm increases, thus decreasing turnover. On the other hand, new employees hired because of increased plant expenditures would add to turnover, since they would be counted by firms from which they came, if this were the case, and also because of the new hire relationship discussed earlier.

28. Business Sales (BS). The amount of business sales was included since it is a major indicator of economic activity. A positive relationship was posited between this variable and quits although it was hypothesized that this relationship would hold only in growth years, while the relationship would not be close in unstable years.

29. Inventory/Sales Ratio (I/S). The I/S ratio is a commonly-used ratio which measures the extent of the precautionary outlook of employers. The implication was that a high ratio would be coupled with low accessions and a higher layoff rate and, hence, lower quits.

30. Durables Purchases (DP). Durables form a major expense item for the individual and a major income sector in the economy. Thus, the effects on turnover could be from: (1) the need for higher income due to purchase of an auto, washer, etc., (2) the hesitancy to quit a satisfactory job for the same reason, and (3) the contribution of overall purchases to the economy.

31, 32. All-Industry Wage Range (WR_I), Manufacturing Wage Range (WR_M). Pencavel (24) utilized the standard deviation of wages as a measure of dispersion of wages within manufacturing. The implication was that the higher the dispersion, the higher the quit rate should be due to movement to better jobs. Others have used the manufacturing-all economy wage differentials (22) or the ratio of one industry's wages to the average wage (29) to get at the same phenomenon. The present study made use of the wage range for all industries as a measure of incentives to move in or out of manufacturing, and the within manufacturing wage range to measure the incentives for intra-manufacturing job shifts.

33. Help-Wanted Index (HWI). There was a desire to include the variable job vacancies, which would measure opportunities to move. Unfortunately, this was not available prior to 1958 and was omitted as a result. A proxy for the job vacancies variable which was available was the help-wanted index. Both the help-wanted index and the reported job vacancies should underestimate the opportunity phenomenon, since

many jobs are filled through recommendations and hence are never officially reported as vacancies nor listed in the help-wanted advertisements. The expected relationship would be positive.

34. Percentage Unionization (Un). The hypothesized relationship between unionization and the quit rate was negative. As unions represent larger amounts of the non-agricultural work force, the effects of seniority, grievance procedures, etc., should reduce the amount of voluntary turnover, although the effect on involuntary turnover is debatable. Opposed to the expected negative relationship are the almost totally inconclusive results presented throughout the review of the literature.

35. Unfair Labor Practices Filed (ULP). The number of unfair labor practices cases filed with the National Labor Relations Board was included as an admittedly poor measure of dissatisfaction within a firm. The measure is questionable since only unionized firms would be included, and the variable may reflect militancy of unions rather than dissatisfaction of employees. The expected relationship to voluntary turnover was negative but weak.

36. Work Stoppages (WS). To some extent, the number of work stoppages may indicate dissatisfaction with management, although this variable, too, may reflect militancy of unions. The variable was included, however, for a different reason. The expected relationship was that during a work stoppage, some of the workers would obtain a second job. They would then either keep the second job and be counted as a quit in the first firm, or they would return to the original firm at the end of the stoppage, hence, a quit from the second firm. Thus,

a positive relationship between work stoppages and the quit rate was predicted.

37. Time Lost to Work Stoppages (TLWS). The time lost to work stoppages as a percentage of total estimated working time entered the analysis with the same relationship to turnover as did the number of work stoppages. It was expected, in addition, that the time lost to work stoppages should be negatively associated to production.

38. Female Employment as a Percent of Total Employment (%FE). Burton and Parker (5) found a negative relationship between the percent male in work force and voluntary turnover. This is the same as a positive relationship between the percent female and voluntary turnover. Stoikov and Raimon (33) found insignificant results. Pencavel (24) found a positive relationship between the ratio of female to male employees and turnover. Thus, the variable entered with an expected positive but questionable relationship to turnover.

39. Percent Married Female Employment (%MFE). The number of married women in the labor force has increased in recent years. It was then of interest to determine if this would affect the quit rate. The expected relationship for young married women was positive, although older married women may have less turnover than men. The overall relationship was expected to be positive.

40. Unemployment in the 20-24-Year Age Group (U_{20}). This variable is correlated with the overall unemployment rate. It was included since the 20-24-year age group experiences higher turnover than older groups. It was of interest then to determine if a special relationship would appear between turnover and unemployment in that age group.

41. Black Unemployment (U_B). Like the younger worker, black turnover is higher than white turnover. Also, like unemployment in younger age groups, black unemployment is far higher than white unemployment. This variable was expected to coload with U_{20} and U, and exhibit a high negative relationship to voluntary turnover.

It was of interest to determine if individuals react more to yearly changes than to absolute levels of variables. Using economic terminology, this is equivalent to determining if short-run relationships differ from long-run relationships. Thus, a dynamic analysis included several variables reflecting yearly incremental changes in selected key variables. Theoretically, the same direction of relationships should be obtained for the change variables as for their static counterparts. These will be listed without individual comment.

42. Change in Business Sales (ΔBS).

43. Change in Government Spending (ΔG).

44. Change in New Hire Rate (ΔNH).

45. Change in Unemployment (ΔU).

46. Change in All-Industry Wage Range (ΔWR_I).

47. Change in Percentage of Non-Production Workers (Δ%NP).

48. Change in the Consumer Price Index (ΔCPI).

49. Change in the Percent Unionization (ΔUn).

50. Change in Help-Wanted Index (ΔHWI).

51. Change in Expenditure for New Plant (ΔENP).

52. Lagged Change in Government Spending (LΔG).

In addition to the listed variables, a trend variable consisting simply of the numbers 47 through 70 was included in some analyses to determine if variables were in fact reflecting trends. These numbers

reflect the years included in the study. They form a constantly increasing variable which may be considered a trend variable.

Data for the analyses came from the following sources:

1. Employment and Earnings, United States, 1909-1970 (39)
2. 1971 Handbook of Labor Statistics (40)
3. 1969 Business Statistics (38)
4. Issues of the Survey of Current Business (39)
5. Issues of the Monthly Labor Review (42)

Table I shows the variables included in the analysis, the symbolic notation for each, and the source of the variable. The numbers in the source column correspond with the sources listed above. Many variables were reported in more than one source. In these cases, the sources from which the data were actually obtained are noted.

C. The Analysis

Data were collected and subjected to factor analysis one or more times utilizing the BMD 03M "General Factor Analysis" program.[4] The program makes the following computational steps.

(1) Means, standard deviations, and correlation coefficients are determined for each variable.

(2) From the correlation matrix, eigenvalues and eigenvectors are determined; and from these the factors are determined. Communalities are computed.

(3) Factors are rotated and final communalities are computed.

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[4]W. J. Dixon, ed., Biomedical Computer Programs (Los Angeles, 1968), pp. 169-184.

TABLE I

VARIABLES INCLUDED IN THE STUDY

	Variable	Symbol	Source
1.	Separation Rate	SEP	1, 2, 5
2.	Quit Rate	QR	1, 2, 5
3.	Layoff Rate	LR	1, 2, 5
4.	Change in Quit Rate	ΔQ	1, 2, 5
5.	Change in Layoff Rate	ΔL	1, 2, 5
6.	Accessions Rate	AR	1, 2, 5
7.	Lagged Accessions Rate	LAR	1, 2, 5
8.	New Hire Rate	NH	1, 2, 5
9.	Lagged New Hire Rate	LNH	1, 2, 5
10.	Non-Agricultural Workers	NAW	1, 2, 5
11.	Production Workers	PW	1, 2, 5
12.	Percentage Non-Production Workers	%NP	2
13.	Gross Weekly Earnings	GWE	1, 2
14.	Change in Weekly Earnings	ΔWE	1, 2
15.	Gross Hourly Earnings	HE	1, 2
16.	Spendable Earnings	SE	1, 2
17.	Unemployment Rate	U	2
18.	Average Duration of Unemployment	U_{ad}	2
19.	Labor Force Participation Rate	LFPR	2
20.	Consumer Price Index	CPI	2, 3, 4
21.	Wholesale Price Index	WPI	2, 3, 4
22.	Gross National Product	GNP	3, 4
23.	Change in GNP	ΔGNP	3, 4
24.	Dow-Jones Stock Average	DJSA	3, 4
25.	Government Spending	G	3, 4
26.	Lagged Government Spending	LG	3, 4
27.	Expenditures for New Plant	ENP	3, 4
28.	Business Sales	BS	3, 4
29.	Inventory/Sales Ratio	I/S	3, 4
30.	Durables Purchases	DP	3, 4
31.	Wage Range (All Industries)	WR_I	1, 2, 5
32.	Wage Range (Manufacturing)	WR_M	1, 2, 5
33.	Help-Wanted Index	HWI	2
34.	Percentage Unionization	Un	2
35.	Unfair Labor Practices	ULP	2
36.	Work Stoppages	WS	2
37.	Time Lost to Work Stoppages	TLWS	2
38.	Percent Female Employment	%FE	1, 2
39.	Percent Married Female Employment	%MFE	2
40.	Unemployment in 20-24-Year Age Group	U_{20}	2
41.	Black Unemployment	U_B	2
42.	Change in Business Sales	ΔBS	3, 4
43.	Change in Government Spending	ΔG	3, 4
44.	Change in New Hire Rate	ΔNH	1, 2, 5
45.	Change in Unemployment	ΔU	2
46.	Change in All-Industry Wage Range	ΔWR	1, 2, 5
47.	Change in Percentage of Non-Production Workers	Δ%NP	2
48.	Change in Consumer Price Index	ΔCPI	3, 4
49.	Change in Percent Unionization	ΔUn	2
50.	Change in Help-Wanted Index	ΔHWI	2
51.	Change in Expenditure for New Plant	ΔENP	3, 4
52.	Lagged Change in Government Spending	LΔG	3, 4

(4) Factor scores are computed from the factor loadings and case values for each variable.

The number of factors rotated was determined by the size of the eigenvalues for the factors. Initially, only factors with eigenvalues greater than 1.0 were rotated. In some cases, an additional factor was rotated if the eigenvalue for the factor in question was close to 1.0 and substantially larger than succeeding eigenvalues.

Five major analyses were made using different combinations of data. The first three of these made use of the P data slice. The fourth used the R data slice, while the last utilized a T data slice. To substantiate the results of the T-analysis, a simple regression analysis was run. Each of these will be discussed in turn.

C.1 The Initial Analysis

In the first analysis 39 variables were factor analyzed. The variables included in the analysis were variables one through forty-one in Table I, with the exception of the lagged new hire rate and lagged government spending. The cases for the analysis were values for the variables for the years 1947-1970. Of the 39 variables, 35 were static and four were dynamic or change variables.[5]

This analysis was the key to the entire study. The results of this analysis assisted in the evaluation of each of the hypotheses stated in Chapter I. Interest also centered on the possible location of the quit rate among the factors rotated. Three different

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[5]Changes in the quit rate and layoff rate were included in most analyses. Changes in wages and GNP were included in the intial analysis and the dynamic analysis only.

configurations were possible. A possible combination would be the quit rate loading on a factor by itself, while all other variables loaded on other factors. In this case the indication is that the quit rate is a function of variables other than the economic, organizational, and labor market variables that were included in this study. This would suggest that the decision to change jobs was a complex function of individual or psychological influences rather than the "rational" decision process suggested by theoretical economists. A second possibility was that the quit rate could load on a factor shared by a large majority of the other variables. In this case the quit rate is highly correlated with other variables which are also intercorrelated among themselves. This would suggest that studies supposedly measuring quit rates are in fact measuring a complex group of interrelated variables rather than supposedly independent variables which influence the quit rates. The third possibility, and the most likely, was that a few variables would coload with the quit rate while most others did not. This case would suggest that many of the variables which are normally thought to influence the quit rate have a negligible effect over time, while a few variables are highly correlated with the quit rate.

Returning to the initial analysis, the 39 variables were subjected to factor analysis and orthogonal rotation. The factor loadings and factor scores were then analyzed in order to determine the meaning of the factors. Factor analysis, opposed to regression analysis, does not have the primary goal of "predicting" one variable based upon others. In fact, the quit rate makes up only one part of the data set. Yet, the factors could be interpreted in light of, or focusing upon, the loading by the quit rate relative to other variables.

C.2 The Dynamic Analysis

Of the entire set of 52 variables, 15 were dynamic variables derived from corresponding static variables which were considered to be key variables in the data set.

These dynamic variables are listed in Table I as variables 4, 5, 14, 23, and 42-52. They are measures of the annual change in variables rather than the static level of the variables. These variables, like those in the initial analysis, were measured annually over time. The time period for the yearly changes was 1948-1970. The object of this analysis was to determine if the dynamic variables in an analysis would load similar to their static counterparts. Of particular interest was the location of the primary turnover variables. Since changes in quits and layoffs were included in the initial analysis, the desire was to see if the relationship between factors encompassing ΔQ and ΔL in a dynamic analysis and factors in a predominantly static analysis were different.

It may be recalled that Hypothesis III stated that earnings variables would be unrelated to quits over time. A corollary to this proposition would be that changes in wages could be unrelated to changes in the quit rate over time. Similar corollaries for the other hypotheses could be made. If the dynamic analysis can be considered an analysis of short-run relationships, then the analysis may be considered as a test for the short-run corollaries for each of the hypotheses in Chapter I, with the exception of Hypothesis IV and the first part of Hypothesis V.

C.3 The Static Analysis

The initial analysis considered 39 variables, four of which were dynamic, and several of which were closely tied to others. It was of some importance to determine the relationship of turnover variables to other variables when the dynamic variables and some of the look-alike variables were omitted. Two reasons for this were submitted.

The first was to determine the stability of the factors. If factors delineated from factor analyzing a smaller set of variables was substantially different from those found in factorizing a larger but similar data set, then one could question the viability of the tool. On the other hand, if factors were invariant over minor changes, then the tool would appear more useful.

The second reason for the static analysis using a smaller data set was to see if additional relationships might be found which were masked by the inclusion of larger amounts of data. Factor analyzing data develops clusters of variables or data points which may be thought of as an ellipsoid. It is conceivable that the inclusion of additional data may change the shape or axis of the ellipsoid slightly, hence developing slightly different factors. Using this framework, the previous paragraph suggests that the cluster should not disappear when some data are removed. The present discussion implies that there may be some slight changes. Any such changes in the configuration are of importance in this analysis.

C.4 Comparative R-analyses

The R-analysis is not normally used in a time-related study since the P, O, and T data slices include the time dimension. The utility

of the R-analysis in the present study was that cross-industry variations could be found. A second reason was that relationships at a specific time period were expected to differ from relationships over time.

Even though the R data slice comprises an analysis without regard to time, the use of comparative R-analyses was important to this study. Comparative R-analyses means that cross-sectional factor analyses are done at different points in time, with the resulting structures compared. It was of particular importance in this study since Hypothesis I suggested that quit rates would be related to business activity in good times but not in bad times. R-analyses were done for the years 1958, a deep recession year, and 1966, a peak expansionary year. To serve as an additional check on the structural differences among economic variables in recessionary and expansionary year, R-analyses were also run for the years following each of the two years. This was to see if the upswing year, 1959, and the temporary downturn year, 1967, were related to their preceding years, as well as determining any common structure between two change years.

Sixteen variables were selected for the comparative R-analyses. All but one of these were variables which were also included in the P-analyses. It is evident upon inspection of the entire data set that many of the variables are not available at the industrial level. For example, gross national product, unemployment, the Dow-Jones Stock Average, and others are not reported on an industry basis. The additional variable not included in the P-analyses was IPI, the industrial production index. This variable was a standard index of production and served as a proxy for business sales and individual industry

contribution to gross national product. The business sales variable was available but not used since dollar sales may be an indication of product type or industry size rather than a measure of production. It was felt that the index was a better cross-industry measure of production for a given year.

The four comparative R-analyses were made of the 16 variables. The cases were values for 21 industries. The results were then compared in order to determine if cross-sectional factor patterns were stable throughout time or if entire structures of relationships between variables changed as the economy level changed.

C.5 T-analysis and a Regression

A T-analysis considers the relationships among groups of years based upon the values for a single variable in each of the years across several industries. Since the target of the study was voluntary turnover, a T-analysis of the quit rate was made. Two analyses were made although results were comparable. The first included the value of the quit rate for the years 1947-1970 for 23 industries. The second analysis covered 36 industries but only the years 1950-1970, since data for the 13 additional industries were not available before 1950.

The object of this analysis was to provide a further test of the hypothesis that the quit rate varies differently in different years. If there were no significantly different relationships among the years, then a single factor would be rotated. If, however, more than one factor appeared and the relationships were interpretable, i.e., not an apparently random structure, then the hypothesis would be supported.

Based upon the results of the T-analyses, and to obtain a purer statistical basis for evaluation of Hypothesis I, a simple regression analysis was made using the quit rate as the dependent variable and the level of business sales as the independent variable measuring economic activity.[6] To test the two parts of the hypothesis, two regressions were run. The first considered the years 1960-1969, the growth years. The second utilized values for the years 1951-1958, the years of a somewhat unstable economy. The significance of the correlation coefficient was then determined for each.

This chapter has discussed the data slices that were used in the study, the variables that were included, and the specific analyses which were made. The steps in the analysis are shown in Figure 3. From it, the reader may note the flow of the study and the contribution of the separate analyses to the study of labor turnover. The following chapter discusses the analytical results of the analyses.

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[6]Factor analysis, though an excellent tool for discovering interrelationships, is not normally conducive to formal statistical testing, nor is that its goal.

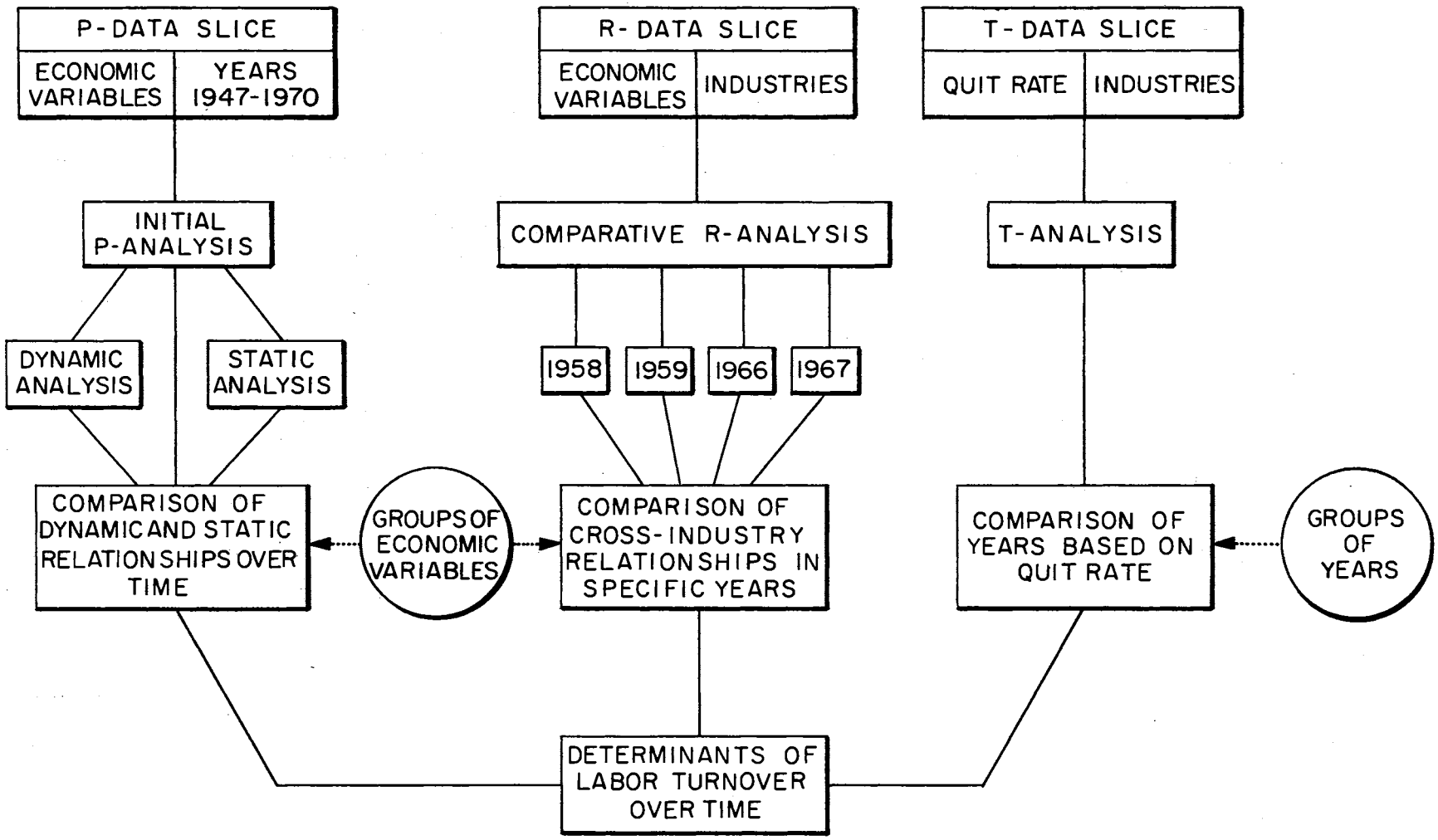

Figure 3. Schematic of Study

CHAPTER IV

ANALYSIS OF RESULTS

The previous chapter delineated the methodology used in the study. This chapter will present the results of the data analysis. Emphasis in this chapter is on the description and interpretation of factor patterns that were determined, along with discussions of theoretical relationships which may account for the factor patterns that were identified. Chapter V discusses the factor patterns in more depth with the emphasis on the relationships between analyses and the significance of the loadings of key variables on the different analyses. Emphasis will also be placed on general relationships and implications involving the turnover variables.

Chapter III stated that three P-analyses were made followed by four comparative R-analyses and two T-analyses. The results of these will be discussed in turn.

A. The P-analyses

The discussion in Chapter III noted that a P-analysis forms groups of variables which covary over the time periods forming the cases. The factors which are formed in the analysis represent distinct groups of variables (economic characteristics). Variables within groups are highly interrelated. Variables which load on different factors are unrelated over time. Values for each variable were collected for each

of the years 1947 through 1970. In each case the annual average for the year was used.

A.1 The Initial P-analysis

The initial analysis included 39 variables which could conceivably affect turnover.[1] Individuals contemplating leaving a job may consider any or all of the variables. Some of the variables reflect actual opportunities or incentives to move while others are more nearly reflections of an individual's perception of his probable success in obtaining a better job.

Help-wanted advertising exemplifies the opportunity variables; gross weekly earnings is an example of the incentive variable; while the Dow-Jones Stock Average would fit in the category of variables with more of a perceived effect than actual effect on movement potential.

Of the 39 variables four reflected the incremental changes in four of the static variables. These were the changes in the quit rate, the layoff rate, weekly earnings, and gross national product. It was felt that the last three of these would be key variables in explaining the quit rate, and it was of interest to see how the annual change fit into the factor patterns.

The variables were factor analyzed with factors rotated orthogonally. Five factors, accounting for 93.1% of the total variance, were rotated. Table II shows the factor pattern that was generated.

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[1]See Table I, page 68. Variables in the data set were the first 41 variables except variables 9 and 26.

TABLE II

INITIAL P-ANALYSIS FACTOR LOADINGS

VARIABLES	SYMBOLS	FACTORS I	II	III	IV	V
Separation Rate	SEP	--	(.819)	--	--	--
Quit Rate	QR	--	(.917)	--	--	--
Layoff Rate	LR	--	(-.723)	-.566	--	--
Change in Quit Rate	ΔQ	--	--	(.887)	--	--
Change in Layoff Rate	ΔL	--	--	(-.905)	--	--
Accessions Rate	AR	--	(.753)	--	--	--
Lagged Accessions Rate	LAR	--	.699	--	--	--
New Hire Rate	NH	--	(.850)	--	--	--
Non-Agricultural Workers	NAW	(.990)	--	--	--	--
Production Workers	PW	.584	(.727)	--	--	--
Percent Non-Production Workers	%NP	(.904)	--	--	--	--
Gross Weekly Earnings	GWE	(.991)	--	--	--	--
Change in Weekly Earnings	ΔWE	--	--	.696	--	--
Hourly Earnings	HE	(.992)	--	--	--	--
Spendable Earnings	SE	(.991)	--	--	--	--
Unemployment Rate	U	--	(-.930)	--	--	--
Average Duration of Unemployment	U_{ad}	--	(-.895)	--	--	--
Labor Force Participation Rate	LFPR	.570	--	--	-.655	--
Consumer Price Index	CPI	(.990)	--	--	--	--
Wholesale Price Index	WPI	(.959)	--	--	--	--
Gross National Product	GNP	(.988)	--	--	--	--
Change in Gross National Product	ΔGNP	--	--	(.878)	--	--
Dow-Jones Stock Average	DJSA	(.905)	--	--	--	--
Government Spending for Goods and Services	G	(.956)	--	--	--	--

TABLE II (Continued)

VARIABLES	SYMBOLS	FACTORS I	II	III	IV	V
Expenditure for New Plant	ENP	(.977)	--	--	--	--
Business Sales	BS	(.989)	--	--	--	--
Inventory/Sales Ratio	I/S	--	--	-.607	-.655	--
Durables Purchases	DP	(.973)	--	--	--	--
Wage Range (all industries)	WR_I	(.993)	--	--	--	--
Wage Range (manufacturing)	WR_M	(.958)	--	--	--	--
Help-Wanted Index	HWI	.499	.471	.419	--	--
Percent Unionization	Un	--	--	--	(-.805)	--
Unfair Labor Practices Filed	ULP	.576	--	--	.647	--
Work Stoppages	WS	--	.589	--	--	.507
Time Lost Due to Work Stoppages	TLWS	--	--	--	--	(.819)
Percent Female Employment	%FE	(.989)	--	--	--	--
Percent Married Female Employment	%MFE	(.969)	--	--	--	--
Unemployment in the 20-24-Year Age Group	U_{20}	--	(-.893)	--	--	--
Black Unemployment	U_B	--	(-.963)	--	--	--

A.1.1 The Trend Factor. Inspection of Table II shows the first factor to be a trend factor. Most of the variables which load on it load very heavily, i.e., greater than .95. Looking at the raw data for these variables shows that each has increased almost monotonically throughout the 24-year period. This is as would be expected in that wages, the cost of living, government spending, employment, etc. have all experienced upward trends.

The validity of the trend aspect of Factor I was checked in a subsequent analysis. An analysis was made which was identical to the first except that a trend variable was included. This variable could have been any constantly increasing variable; the numbers 47 through 70, representing each of the years in the study, were included in the present case. The trend variable loaded .980 on Factor I with all other loadings remaining essentially the same. A further substantiation for the trend factor is found in looking at the factor scores. Factor scores, in general, reflect those cases (years) which were important in forming the factor. These are quite often important in interpreting the meaning of factors. The factor scores for Factor I are highly negative in 1947, increasing consistently to highly positive in 1970.[2] These scores roughly parallel the standardized data units for the variables which have very high factor loadings.

A small number of variables loaded in the lower end of the "moderate" category suggesting that they were of relatively minor importance in the factor. This could reflect a variable which exhibited very

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[2]Factor scores for this analysis are presented in Appendix B, Table XV.

little change over time, as in the case of the labor force participation rate (58.9% in 1947, 61.3% in 1970), or it could reflect a variable with a general upward trend with a few exceptional years as in the case of the unfair labor practices variable. (The years immediately following the passage of the Taft-Hartley Act saw a large number of unfair labor practices filed.)

The significance of Factor I is in the variables which did not load on the factor. None of the turnover variables loaded on the first factor. Thus, the decision to leave a job does not appear to be based upon the variables loading on Factor I.

A.1.2 The Turnover Opportunity Factor. The second factor could be called the turnover opportunity factor. It establishes basic relationships that hold through time. As could be expected, the quit rate and the accessions variables load high positive, while the layoff rate and all unemployment variables load high negative. It should be noted that the number of production workers loads higher (.727) on this factor than on Factor I (.584), while the total number of non-agricultural workers does not load at all on Factor II. Literature suggests that quits are concentrated among production workers far more than among office workers or professionals. Thus, the level of total employment is not as important to the potential job changer as is the amount of production workers. This, along with the moderate loading by the help-wanted index supports the opportunity hypotheses tendered by Burton and Parker (5) and Stoikov and Raimon (33).

Since the unemployment variables load inversely to turnover, they may be considered as a negative opportunity or lack of opportunity. The negative relationship implies the higher the unemployment, the

lower the turnover. Similarly, the inverse relationship between the quit rate and the layoff rate suggests the higher the layoff rate, the lower the quit rate. These, then, also support the opportunity hypothesis.[3]

The loading of .589 by "work stoppages" supports Hypothesis VI that work stoppages are positively related to turnover. This may be considered an opportunity variable but not in the same sense that the unemployment and help-wanted variables are. The hypothesis that work stoppages are related to turnover is tendered since some workers will use the incidence of a work stoppage to seek actively either a new job or a secondary job. The work stoppage does not reflect additional job opportunities, but rather opportunities to search for existing vacancies.

Two incidental relationships in Factor II should be mentioned in passing before looking at Factor III. Note that new hires loads somewhat higher than does the accessions rate. New hires are a part of the accessions rate, but the latter also includes recalls of former employees who had been laid off. Thus, the theory that quits are concentrated among those new at a job suggests that new hires should be more closely related to quits than would accessions. Reflecting this point, Pencavel (24) used lagged accessions as a variable. In the present study, the lagged accessions variable also loaded higher than did accessions, suggesting that it is a better measure of the number of short-term employees than is the unlagged rate. A later analysis will

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[3]Stoikov and Raimon (33) considered layoffs an incentive variable rather than an opportunity variable since they found a positive relationship between quits and layoffs.

add more to this discussion.

The second relationship of interest is that the separation rate loads highly positive on the turnover factor. Separations include voluntary separations or quits as well as involuntary separations, as in layoffs and discharges. Apparently, total separations are influenced far more by quits than layoffs and discharges.

A.1.3 The Change Factor. Factor III can be called a "change" factor. It is loaded heavily by each of the four incremental change variables included in the analysis. With the exception of the layoff rate (-.566), none of the key static variables coloaded with their respective change variables. This suggests that causes of changes in characteristics are not the same forces that determine the general level for the variable. It was because of this factor that several more incremental change variables were added in later analyses, and one of the later runs consisted only of change variables.

A moderate loading was recorded for the inventory/sales ratio. This was the only non-change variable which loaded significantly. As will be seen, it also loads moderately on Factor IV. The best explanation for its loading on Factor III is that the ratio may be very sensitive to changes. In later analyses which include more change variables the inventory/sales ratio coloads with change in business sales, change in new hires, change in unemployment and others, as well as the four already listed.

A.1.4 The Union Factor and the Work Stoppage Factor. Factor IV can be called the union factor because of the high negative loading by "the percentage unionization." However, other variables make the factor one of questionable meaningfulness since the labor force

participation rate and the inventory/sales ratio load moderately negative and the amount of unfair labor practices filed loads positively. The reason for the inverse relationship between unions and unfair labor practices is difficult to explain. The fact that the union variable loaded on Factor IV rather than the turnover factor is important. The literature suggested that unions are often considered to be impediments to labor mobility because of seniority, selective hiring rules, etc. It this were the case, unions should have loaded negatively on Factor II. The absence of loading by the percentage unionization on that factor suggests that the mobility impediment charge may be unfounded.

The final factor consists only of work stoppages (.507) and time lost due to work stoppages (.818). It is no surprise that these variables coload on a factor since increasing the number of stoppages would normally increase the amount of time lost because of the stoppages. It should be recalled that the work stoppage variable also loaded moderately on the turnover factor. Thus, the variance of the work stoppage variable is split between two distinct factors. It is not unusual to find this situation occurring for a small number of variables.

A.1.5 Summary. Five factors accounted for 93.1% of the variance associated with the 39 economic variables. Almost half of the variables loaded on a factor reflecting an increasing trend over time. This was unrelated to any of the turnover variables. The turnover opportunity factor consisted of all the turnover variables and other variables reflecting job opportunities. None of the wage variables loaded on the factor. The third factor was comprised almost totally of the four dynamic variables. The fact that these variables coloaded

with each other rather than with other variables suggested a need for study of dynamic variables by themselves. The last two factors were of somewhat less importance although the loading of the percentage unionization on Factor IV rather than on Factor II was significant.

A.2 The Dynamic Analysis

In the initial P-analysis, it was found that a change factor developed orthogonally to other static factors. This caused some question as to whether an individual contemplating leaving a job is concerned with levels of wages, involuntary turnover, the economy, etc., or whether recent changes are more important decision criteria underlying the decision to leave a job.

To determine if change relationships are, in fact, different from static relationships in their impact upon voluntary turnover, ten variables were created which reflect the incremental change in key static variables in the earlier analysis. These, plus the four change variables originally included, gave 14 variables for analysis.

It should be noted that incremental changes were used rather than percentage changes. This was done in an attempt to preserve the behavioral flavor of the research. Although macro data is used, the goal throughout the study is to determine the forces underlying an individual's decision to leave a job. Although some studies utilized percentage changes, it appeared that for variables of the type considered in this study, individuals respond to incremental changes rather than percentage changes. Thus, one will perceive a job as paying ten dollars more per week rather than 17% more per week. This may be only an

academic point since computations transform data into standardized form; yet, there is a substantive difference.

Table III shows the 14 variables included in the dynamic analysis. These variables reflect the incremental changes in corresponding variables factorized in the initial P-analysis.

TABLE III

VARIABLES INCLUDED IN DYNAMIC ANALYSIS

1. Change in Quit Rate	9. Change in Wage Range (all industries)
2. Change in Layoff Rate	10. Change in Percent Non-Production Workers
3. Change in New Hire Rate	11. Change in Consumer Price Index
4. Change in Weekly Earnings	12. Change in Percent Unionization
5. Change in Gross National Product	13. Change in Help-Wanted Index
6. Change in Business Sales	14. Change in Expenditures for New Plant
7. Change in Government Spending	
8. Change in Unemployment	

These variables represent a cross-section of the 36 static variables in the original analysis. Data were then subjected to factor analysis, producing five rotated factors which together accounted for 85.3% of the variance in the data set. The factorization produced a very different set of relationships than did the initial P-analysis discussed in A.1. Table IV shows the factor patterns that were developed.

A.2.1 The Dominant Factor. Factor I consists of high positive loadings by the changes in (1) quit rate, (2) weekly earnings, (3) gross national product, (4) business sales, (5) new hires, with a moderate positive loading by change in help-wanted index. High

TABLE IV

DYNAMIC ANALYSIS FACTOR LOADINGS

VARIABLES	SYMBOLS	FACTORS I	II	III	IV	V	VI
Change in Quit Rate	ΔQ	(.872)	--	--	--	--	--
Change in Layoff Rate	ΔL	(-.870)	--	--	--	--	--
Change in Weekly Earnings	ΔWE	(.807)	--	--	--	--	--
Change in Gross National Product	ΔGNP	(.930)	--	--	--	--	--
Change in Business Sales	ΔBS	(.848)	--	--	--	--	--
Change in New Hire Rate	ΔNH	(.714)	--	--	--	--	--
Change in Unemployment	ΔU	(-.748)	--	--	--	--	--
Change in Percent of Non-Production Workers	$\Delta \%NP$	(-.871)	--	--	--	--	--
Change in Help-Wanted Index	ΔHWI	.644	--	--	--	--	--
Change in Government Spending	ΔG	--	(.926)	--	--	--	--
Change in Consumer Price Index	ΔCPI	--	--	(.953)	--	--	--
Lagged Change in Government Spending	$L\Delta G$	--	--	--	(-.926)	--	--
Change in All-Industry Wage Range	ΔWR_I	--	--	--	--	(.962)	--
Change in Percent Unionization	ΔUn	--	--	--	--	--	(.890)
Change in Expenditure for New Plant	ΔENP	--	--	--	--	--	.599

negative loadings were registered by changes in (1) layoffs, (2) unemployment, and (3) percent non-production workers.

The last four factors were each dominated by a single variable. These were the changes in the consumer price index, government spending, the wage range, and unions. The last factor also registered a moderate loading by the change in new plant expenditures.

Factor I is, of course, the factor of interest. These variables are the ones that covary with changes in the quit rate. This does not imply that each individual contemplating leaving a job will check each of the other changes before doing so, nor does it mean that changes in the other variables cause changes in the quit rate. Factor analysis, like regression analysis, is based upon the correlation coefficient and hence cannot predict a cause/effect relationship; yet, the fact that these change variables covary is of importance.

The relationships in the change analysis results support many hypotheses tendered by economists. For example, the change in quit rate coloads with the change in wages. This supports the theory that individuals migrate toward better jobs when moving from job to job. The high positive loadings by the changes in gross national product and business sales and moderate (.662) loading by the change in the help-wanted index add to the opportunity theory suggesting again that individuals will quit jobs more readily when the job market outlook is favorable.

The high loading by the change in the new hire rate adds to the earlier contention that quits are positively related to the number of new employees, but if one considers that new hires signify more opportunities, the opportunity hypothesis is also supported.

The negative factor loadings by changes in the layoff rate, unemployment rate, and the percentage of non-production workers suggest that these, like their static counterparts, represent negative opportunity variables. It is important to note that changes in earnings and business activity coloaded with changes in quit rates whereas their static counterparts did not coload with the static quit rate. A plausible explanation may be that individuals respond more to recent changes in their economic environment than to the general level of variables surrounding them. This will be discussed more thoroughly in Chapter V.

A.2.2 The Remaining Factors. The four factors orthogonal to the first merit some discussion, even though only one variable loaded heavily per factor. Factor II, loading heavily on the consumer price index, might have been expected to load as it did. Though the cost of living is of importance to individuals or families, the year-to-year changes of the consumer price index should hardly be an important criterion in making a job change decision.

Similarly for Factor III, changes in government purchases should not affect quits, except through expenditures in the manpower area or those in the goods and services areas that would eventually appear in the business sales and gross national product accounts. The effect here may easily be lagged more than a single year.

To check for this possibility, the change data were re-analyzed, with a lagged change in government spending included. The expectation was that this variable would coload with the changes in quit rates, business sales, and other variables in Factor I. Surprisingly, however, lagged government spending loaded singularly on a factor

different from Factor I and also different from the unlagged change in government spending factor. Rather than loading on one of the five existing factors, a sixth orthogonal factor was created. Thus, either government spending does not affect turnover for at least two years, or the variance associated with the changes in spending over time is unique to the extent that lagging the variable produces still another unique factor.

The fourth factor, dominated by the change in wage range, is of some importance. It may be recalled from the literature review that Pencavel (24) utilized the standard deviation of wages as a measure of wage dispersion, hypothesizing that the greater the dispersion, the greater the voluntary turnover. In the present study the decision was made to use the wage range instead of the standard deviation. The high loading on Factor IV and total lack of loading on Factor I requires one to reach a conclusion similar to that of Pencavel, i.e., that the dispersion of wages apparently does not affect voluntary turnover. This suggests that the change in wages is associated with changes in the amount of turnover, but also that the range of wages throughout all industries is not important. Two reasons are posited for lack of consideration of the wage range. First, though one may be aware of wage changes within his own company and perhaps a few others, it is doubtful that an individual is cognizant of the entire range of wages. Further, even if one did possess full knowledge of wage ranges, it is doubtful that he would respond accordingly. To change from a low wage to a high wage industry may require geographical movement, learning a new skill, or changing work roles. Any of these may be an impediment to job changes. Evidence of existing inter-industry job changes indicates,

however, that these impediments are not totally restrictive.

Factor V, which is dominated by the percentage unionization, seems to substantiate, as did the static variable, the lack of relationships between voluntary turnover and unions. This would require that those seeking the demise of unions find arguments other than mobility impediments to buttress their case.

A.2.3 Summary. Although earnings variables and business activity variables did not coload with the quit rate in their static form, incremental changes in these variables did coload with changes in the quit rate. Individuals apparently respond to recent changes in wages, etc. more than to the static level of the variables. Some variables, even in their dynamic form, did not coload with turnover variables. The change in the wage range loaded orthogonally to the quit rate. This cast doubt upon the hypothesis that incentives to move are important. Changes in government spending were unrelated to turnover in both the lagged and unlagged form. Changes in unions loaded orthogonally to turnover variables, further suggesting that unions have little effect on labor mobility.

A.3 The Static Analysis

The initial P-analysis discussed above in A.1 included 39 variables of which four were dynamic. The development of a change factor led to the dynamic analysis discussed in A.2. Since the initial P-analysis included both static and dynamic variables, a question arose concerning the effect on the factor patterns created by removing the dynamic variables. Reflecting also the goal of determining the utility of factor analysis, it was decided to complete a P-analysis with a

smaller set of variables to determine the stability of the factors derived in the initial P-analysis.[4] Several variables were eliminated from the data set which were conceptually similar to other variables. Examples of variables eliminated were hourly earnings and spendable earnings which were similar to gross weekly earnings. The data set for the static analysis included only 26 variables, all of which were static. Again, the purpose was to check the stability of factors determined earlier and to remove the effect of the dynamic variables.

Table V lists the 26 variables included in the data set for the static analysis. Table VI shows the factor patterns developed as a result of the analysis. The results of this particular P-analysis are important for two reasons. The first is the general stability of the factor patterns, while the second is a particular change that is important.

A.3.1 The Stability of Factors. There was little difference in the present static analysis and the earlier initial P-analysis. In each analysis, a trend factor is produced. There were less variables in the factor in the latter analysis, but each variable loading highly in the static analysis also loaded highly in the first analysis. Further, no variables loading in Factor I of the earlier analysis loaded on a different factor here.

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[4]If factor patterns are unstable, i.e., if addition or deletion of a small number of variables changes factor patterns substantially, then the utility of the tool is questionable. Although some changes are to be expected when variables are added or deleted, these should be minor unless a relatively large number of variables are changed. Even the addition of variables known to exhibit different variances should load on a new factor, leaving existing factors relatively unchanged.

TABLE V

VARIABLES INCLUDED IN STATIC ANALYSIS

1. Total Separations	14. Consumer Price Index
2. Quit Rate	15. Gross National Product
3. Layoff Rate	16. Dow-Jones Stock Average
4. Accessions Rate	17. Government Purchases
5. Lagged Accessions Rate	18. Expenditures for New Plant
6. New Hire Rate	19. Business Sales
7. Lagged New Hire Rate	20. Inventory/Sales Ratio
8. Non-Agricultural Workers	21. Wage Range (all industries)
9. Production Workers	22. Help-Wanted Index
10. Percent Non-Production Workers	23. Percent Unionization
11. Gross Weekly Earnings	24. Unfair Labor Practices Filed
12. Unemployment Rate	25. Work Stoppages
13. Labor Force Participation Rate	26. Percent Female Employment

The second factor was basically the same, registering high positive loadings by the quit rate, the accessions rate, and the new hire rate, with moderately high positive loadings by the number of production workers, the help-wanted index, and work stoppages. High negative loadings were scored by the layoff rate and unemployment.

No change factor would appear since those variables were eliminated. Factor III in the static analysis is similar to Factor IV of the earlier run with positive loadings by unionization, the labor force participation rate, and the inventory/sales ratio, and a negative loading by the unfair labor practices variable. Factor V of the static analysis included the work stoppage variable and the labor force participation rate. In the earlier analysis the last factor was comprised of work stoppages and time lost due to work stoppages. Thus, one factor disappeared as expected, and the four remaining factors reflected quite similar sets of variables.

TABLE VI

STATIC ANALYSIS FACTOR LOADINGS

VARIABLES	SYMBOLS	FACTORS I	II	III	IV	V
Separation Rate	SEP	--	--	--	(.901)	--
Quit Rate	QR	--	(.744)	--	.640	--
Layoff Rate	LR	--	(-.920)	--	--	--
Accessions Rate	AR	--	(.791)	--	--	--
Lagged Accessions Rate	LAR	--	--	--	(.919)	--
New Hire Rate	NH	--	(.813)	--	.473	--
Lagged New Hire Rate	LNH	--	.262	--	(.909)	--
Non-Agricultural Workers	NAW	(.988)	--	--	--	--
Production Workers	PW	.596	.667	--	--	--
Percent Non-Production Workers	%NP	(.901)	--	--	--	--
Gross Weekly Earnings	GWE	(.989)	--	--	--	--
Unemployment Rate	U	--	(-.806)	--	--	--
Labor Force Participation Rate	LFPR	--	--	.610	--	.513
Consumer Price Index	CPI	(.983)	--	--	--	--
Gross National Product	GNP	(.986)	--	--	--	--
Dow-Jones Stock Average	DJSA	(.906)	--	--	--	--
Government Spending for Goods and Services	G	(.955)	--	--	--	--
Expenditure for New Plant	ENP	(.975)	--	--	--	--
Business Sales	BS	(.988)	--	--	--	--
Inventory/Sales Ratio	I/S	--	--	(.787)	--	--
Wage Range (all industries)	WR_I	(.989)	--	--	--	--
Help-Wanted Index	HWI	.496	.650	--	--	--
Percent Unionization	Un	--	--	(.850)	--	--
Unfair Labor Practices Filed	ULP	.532	--	-.675	--	--
Work Stoppages	WS	.621	--	--	--	.542
Percent Female Employment	%FE	(.988)	--	--	--	--

A.3.2 An Important Change. Factor IV of the static analysis reflects the second item of major importance besides the dimensional stability of the two analyses. Factor IV is made up of total separations, lagged accessions, and lagged new hires,[5] as well as a moderate loading (.640) by the quit rate. The significance of this is that the variance associated with the quit rate is split between two orthogonal factors.

A reason for this important separation of variance is found by comparing Factor II and Factor IV. Note that in Factor II the quit rate coloads with other variables such as layoff rate (-), unemployment (-), help-wanted index (+), and amount of production workers (+), as well as the accessions and new hire rates (+). Each of these variables reflect the opportunity or lack thereof to secure a second job should one quit the first. In this case, the accessions loading implies expansion of the work force, hence more opportunities for moving to a more favorable job.

In Factor IV, however, the quit rate coloads only with separations, lagged accessions, and lagged new hires. There are low loadings by accessions (.375), new hires (.472), unemployment (-.430), and unfair labor practices (.463), but no high loadings, and certainly no loadings by the layoff rate or the help-wanted index. The only conclusion that can be reached is that those are non-opportunistic separations. The loadings by lagged accessions and lagged new hires implies that these separations are by individuals who joined or rejoined the company

[5]Lagged new hire rate was not included in the earlier run.

approximately one year prior.[6] Thus, the picture is of the individual who takes a job, tries it out for a while, and then becomes dissatisfied and quits (or is discharged). This type of quit is made without regard to, or perhaps in spite of, knowledge of other opportunities. The loading by unfair labor practices, albeit small, could be theoretically extended to indicate a measure of dissatisfaction within a company, perhaps adding to the number of non-opportunistic quits. Non-opportunistic turnover occurs regardless of the level of economic activity.

A.3.3 Summary. The static analysis made two important contributions to the study. First, it demonstrated that the factors derived earlier in the initial P-analysis did possess a high degree of stability when the four change variables and nine static variables were removed from the data set. This adds to the utility of factor analysis in that the inclusion or deletion of a few variables in a data set will not seriously affect existing factor patterns.

The second contribution made by the static analysis was the splitting of quit rate variance between two factors. One reflected opportunity turnover as did Factor II of the initial P-analysis. The second, comprised of lagged accessions with little or no loadings by unemployment, the help-wanted index, or layoffs, suggests strongly a non-opportunistic turnover. This implies that some voluntary turnover may be reaction in an economically rational manner while other may reflect only individual rationality.

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[6]Utilizing annual data obscures the exact nature of the lag effect, but the high loadings by lagged accession rate and lagged new hire rate, coupled with the light loadings by accessions rate and new hire rate, support the concept of the short-term worker.

B. The Comparative R-analyses

Chapter II noted that factor scores reflect the contribution of the individual cases to the formation of the factors.[7] The cases for the P-analysis discussed in part A of this chapter were the years 1947 through 1970. The factor scores for the initial P-analysis, the dynamic analysis, and the static analysis illustrate vividly that the contribution of the years to the factors developed varies widely. This is shown in Figure 4 below. The factor scores for the turnover opportunity factor in the static analysis are plotted for the 24 years.

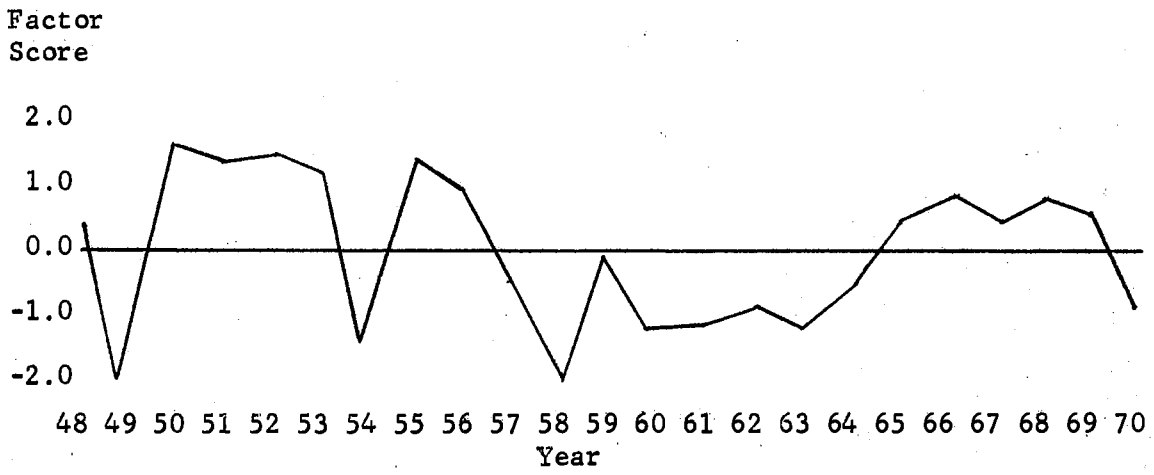

Figure 4. Factor Scores for Second Factor of Static Analysis

Note the negative scores in 1949, 1954, 1957-1964, and 1970. These were recessionary times compared to 1950-1953, 1955, and 1965-1969.

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[7]Factor scores are listed in the appendixes immediately below their respective factor matrices.

These differences suggested that the relationships between turnover and other variables may be significantly different in a recession than in an economic expansion. In fact, a different structure of variables may exist in the two periods.

To determine if there is, in fact, a different structure of relationships, four R-analyses were run. From Chapter III, the R-analysis considers groups of characteristics (economic variables) in a single time period based upon several entities (industries). It is a cross-sectional analysis rather than a time-series analysis. The utility of the R-analyses for the present study is to compare the cross-sectional factor analyses for selected years. The R-analysis differs from the P-analysis in that the R-analysis considers groups of variables at one specific time across industries rather than groups of variables over time. The time focus in the R-analysis is found when different time periods are compared.

Before discussing results of the comparative R-analyses, it is noted that relationships over time are not necessarily similar to cross-sectional relationships. As an example, in the R-analyses it will be seen that a negative relationship between wages and quit rates is found. In the P-analyses there was virtually no relationship between wages and quits. The difference is very simple. In the R-analysis case we are saying only that, at a given time, high wage industries experience lower quit rates than low wage industries. In the P-analysis we are saying that wages increase consistently over time, and since quits are more a cyclic variable rather than a trend variable, there is little relationship between the two.

The years selected for the four R-analyses were 1958, 1959, 1966, and 1967. The years 1958 and 1966 were selected because they were the low and high years in the two decades from 1950 to 1970. The years 1959 and 1967 were analyzed in that 1959 was the beginning of a recovery period following the 1958 recession and 1967, although a good year itself, was a downward change from 1966. Thus, low and high years and the change years immediately following them are analyzed.

Representative variables from the data set used in the initial P-analysis were selected based on their availability on a cross-industry basis. Variables such as unemployment, the consumer price index, government spending, etc. could not be included since they are not available at the industry level. The resultant data matrix included 16 variables for each of 21 major industry groupings.[8] The variables included are listed in Table VII. The last of these, the industrial production index for the industries, was felt to be a reasonable proxy for gross national product, business sales, and durables purchases. The amount of production for each industry was available on a dollar basis, but it was felt that this might be more a measure of industry size than of the productivity of the industry.

B.1 The Stable Relationships

The factor patterns developed in the four comparative analyses are shown in Tables VIII through XI. Most of the relationships, including most of primary concern, were stable over time. A few of the 16 variables analyzed did not exhibit the stability throughout the four years.

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[8]The industries are listed in Appendix A, Table XIV.

TABLE VII

VARIABLES INCLUDED IN COMPARATIVE R-ANALYSES

1. Quit Rate	9. Gross Weekly Earnings
2. Layoff Rate	10. Change in Weekly Earnings
3. New Hire Rate	11. Hourly Earnings
4. Change in Quit Rate	12. Percentage Unionization
5. Change in Layoff Rate	13. Work Stoppages
6. Non-Agricultural Workers	14. Percent Female Employment
7. Production Workers	15. Expenditures for New Plant
8. Percent Non-Production Workers	16. Industrial Production Index

Factor I in each of the R-analyses for the four years can be called the turnover/wage relationship. In each of the analyses wages (gross weekly earnings and hourly earnings) loaded highly positive while the quit rate and new hire rate loaded highly negative. The layoff rate varied from a very low (.296) in 1958 to a moderate (.509) in 1966. Note that this loading is in the same direction as the quit rate. This is probably strong enough to support Stoikov and Raimon's (33) contention that layoffs are positively related to quits in a cross-sectional study.[9] The negative relationship between wages and quits suggests that high wage industries exhibit lower quit rates. This could be interpreted to mean that individuals in low-paying jobs continue to move up the pay ladder by changing jobs, with a lower propensity to change as they reach successively higher-paying jobs. A more logical explanation is simply that higher-paying industries are better jobs for

[9]Stoikov and Raimon studied 1966 in their work; hence, the same relationship.

TABLE VIII

1958 R-ANALYSIS FACTOR LOADINGS

VARIABLES	SYMBOLS	FACTORS I	II	III	IV	V	VI
Quit Rate	QR	(-.965)	--	--	--	--	--
Layoff Rate	LR	--	--	--	--	(.850)	--
New Hire Rate	NH	(-.891)	--	--	--	--	--
Change in Quit Rate	ΔQ	--	--	--	--	--	(.875)
Change in Layoff Rate	ΔL	--	--	--	--	(.934)	--
Non-Agricultural Workers	NAW	--	(.973)	--	--	--	--
Production Workers	PW	--	(.977)	--	--	--	--
Percent Non-Production Workers	%NP	.470	--	.458	--	-.489	--
Gross Weekly Earnings	GWE	(.796)	--	--	--	--	--
Change in Weekly Earnings	ΔWE	--	--	(.776)	--	--	--
Hourly Earnings	HE	(.802)	--	--	--	--	--
Percent Unionization	Un	--	--	(.838)	--	--	--
Work Stoppages	WS	--	(.850)	--	--	--	--
Percent Female Employment	%FE	--	--	--	(-.885)	--	--
Expenditure for New Plant	ENP	.644	--	--	-.566	--	--
Industrial Production Index	IPI	--	--	--	-.557	--	--

TABLE IX

1959 R-ANALYSIS FACTOR LOADINGS

VARIABLES	SYMBOLS	FACTORS					
		I	II	III	IV	V	VI
Quit Rate	QR	(-.953)	--	--	--	--	--
Layoff Rate	LR	-.435	--	--	--	--	.642
New Hire Rate	NH	(-.950)	--	--	--	--	--
Change in Quit Rate	ΔQ	(-.880)	--	--	--	--	--
Change in Layoff Rate	ΔL	--	--	--	(.921)	--	--
Non-Agricultural Workers	NAW	--	(.934)	--	--	--	--
Production Workers	PW	--	(.948)	--	--	--	--
Percent Non-Production Workers	%NP	.591	--	--	.549	--	--
Gross Weekly Earnings	GWE	.690	--	--	--	--	--
Change in Weekly Earnings	ΔWE	--	--	.674	--	--	--
Hourly Earnings	HE	.762)	--	--	--	--	--
Percent Unionization	Un	--	--	--	--	--	(.827)
Work Stoppages	WS	--	(.790)	--	--	--	--
Percent Female Employment	%FE	--	--	(-.881)	--	--	--
Expenditure for New Plant	ENP	--	--	--	--	(.864)	--
Industrial Production Index	IPI	--	--	--	--	--	-.601

TABLE X

1966 R-ANALYSIS FACTOR LOADINGS

VARIABLES	SYMBOLS	FACTORS					
		I	II	III	IV	V	VI
Quit Rate	QR	(-.799)	--	--	--	--	--
Layoff Rate	LR	-.488	--	--	--	--	-.520
New Hire Rate	NH	(-.855)	--	--	--	--	--
Change in Quit Rate	ΔQ	--	--	(.800)	--	--	--
Change in Layoff Rate	ΔL	--	--	(.888)	--	--	--
Non-Agricultural Workers	NAW	--	(.972)	--	--	--	--
Production Workers	PW	--	(.979)	--	--	--	--
Percent Non-Production Workers	%NP	(.753)	--	--	--	--	--
Gross Weekly Earnings	GWE	(.938)	--	--	--	--	--
Change in Weekly Earnings	ΔWE	--	--	--	(-.820)	--	--
Hourly Earnings	HE	(.950)	--	--	--	--	--
Percent Unionization	Un	--	--	--	(.802)	--	--
Work Stoppages	WS	--	(.865)	--	--	--	--
Percent Female Employment	%FE	--	--	--	--	(-.921)	--
Expenditure for New Plant	ENP	--	.627	--	--	--	--
Industrial Production Index	IPI	--	--	--	--	(.874)	--

TABLE XI

1967 R-ANALYSIS FACTOR LOADINGS

VARIABLES	SYMBOLS	FACTORS					
		I	II	III	IV	V	VI
Quit Rate	QR	(-.926)	--	--	--	--	--
Layoff Rate	LR	-.509	--	.535	--	.561	--
New Hire Rate	NH	(-.853)	--	--	--	--	--
Change in Quit Rate	ΔQ	.567	--	--	--	.615	--
Change in Layoff Rate	ΔL	--	--	--	--	(-.786)	--
Non-Agricultural Workers	NAW	--	(.929)	--	--	--	--
Production Workers	PW	--	(.928)	--	--	--	--
Percent Non-Production Workers	%NP	(.799)	--	--	--	--	--
Gross Weekly Earnings	GWE	(.941)	--	--	--	--	--
Change in Weekly Earnings	ΔWE	--	--	--	--	--	(.833)
Hourly Earnings	HE	(.942)	--	--	--	--	--
Percent Unionization	Un	--	--	.669	--	--	--
Work Stoppages	WS	--	(.910)	--	--	--	--
Percent Female Employment	%FE	--	--	--	(-.863)	--	--
Expenditure for New Plant	ENP	--	--	--	(.838)	--	--
Industrial Production Index	IPI	--	--	(-.881)	--	--	--

reasons in addition to pay, and hence there is less dissatisfaction with the jobs in general.

Another variable of interest on Factor I for each year is the percent non-production workers (%NP) in the industries studied. Looking at the loadings on the factor for each year, it will be noted that it appears to be increasingly important in the factor (.470 in 1958, .799 in 1967). It may be recalled that in the P-analyses this variable loaded on the trend factor. It is well known that firms continually update and automate jobs resulting in a smaller ratio of production workers relative to the non-production worker. Even though automation eliminates jobs and causes involuntary turnover, it should have a dampening effect on the voluntary turnover. Further, it is generally accepted that turnover occurs more in the production jobs than in the non-production jobs. Hence, the industries with a larger percent of non-production workers should have a lower quit rate.

As a last point, it should be noted that the new hire rate coloads highly with the quit rate both in the P-analyses and the R-analyses. This suggests that the new hire rate and the quit rate are highly interrelated both over time and across industries. It is not shown here, nor did the literature review determine the direction of the cause/effect relationship. Certainly, more new hires cause more quits both from the new employee viewpoint and the opportunity viewpoint. Yet, the opposite direction of the relationship is viable to some extent, i.e., that increasing quits also requires the company to increase its hiring rate.

The second factor also remains stable for all four analyses. This factor is made up of the amount of non-agricultural workers (NAW) and

production workers (PW) and work stoppages (WS). Keeping in mind the cross-section aspect of the analyses, this is not unexpected. These are measures of the size of the industries. Certainly, the larger the number of firms in an industry, the more stoppages there will be. These are the only variables that include a size effect. Here again it should be noted that work stoppages are not related to turnover in the cross-sectional analyses whereas at least some relationships do hold in a time-series analysis.

A third set of relationships which exhibits a degree of stability over time involves the industrial production index (IPI), the layoff rate (LR), and the percentage unionization (Un). In three of the four years (1959, 1966, and 1967) the industrial production index coloads negatively with the layoff rate. This is not unexpected since decreasing production will normally cause increased layoffs. The absence of the relationship in 1958 may suggest that, as a recession reaches a low point, some industries continue to pare their work force while others have stopped laying off workers. In this situation layoffs would not necessarily be related to production.

In the two change years, 1959 and 1967, it may be noted that the percentage unionization also loads on the factor in the same direction as layoffs and opposite that of the production index. An explanation for the loading only in the change years may be that the effect of unions may be felt most, or perhaps only, in the more volatile change years. Actions of unions are often considered counter-productive in that strikes, slowdowns, and union work restrictions restrict production. In the expansion year, 1966, the level of business is such that firms are relatively unaffected by union demands. In the recession

year unions have little effect since firms may be unable to grant any demands of unions. In the change years, however, union efforts to gain economic benefits for their members will encounter resistance which in turn is countered by strikes and other counter-productive actions.

The previous paragraph noted that the percentage unionization (Un) coloaded with the production index (IPI) and the layoff rate (LR) in the two change years but not in 1958 or 1966. In the recession and expansion years unionization coloads with the incremental change in wages. In 1958, however, the relationship is positive, whereas in 1966 it is negative. Again, a logical explanation is tendered. In the recessionary year most changes in wages that workers were able to obtain were gained through unions. Non-union firms did not have the pressure to increase wages. This caused the positive relationship. In 1966, however, the negative relationship suggests that non-union firms exhibit higher wage changes from the preceding year than do union firms. The first of two reasons for this is that non-union firms traditionally lag unionized firms in increasing wages. Hence, non-union firms may be granting wage increases that unions had gained for their members earlier in the expansion period. An alternative explanation is that at least two of the highly unionized industries--the auto industry and the steel industry--have contracts which expired in 1967 and 1968, rather than in 1966. Thus, the wage increase in a non-bargaining year may not have been as great as in bargaining years.

B.2 Two Unstable Variables

Before leaving the comparative R-analyses, the task remains to

discuss the yearly changes in quit rates (ΔQ) and layoff rates (ΔL). These two variables do not appear to form anything resembling a stable structure across the four analyses. These will be discussed although it should be kept in mind that these short-run changes across industries may vary because of exogenous forces whereas their static counterpart in the cross-sectional analysis and both the static and dynamic variables over time should reflect more rational patterns of movement.

In the 1966 R-analysis, the change in quit rates (ΔQ) coloads positively with the change in layoff rate (ΔL). No other variables load on the factor. The positive loading means that both variables are moving in the same direction. Since most values of ΔL are negative in 1966 while values for ΔQ are positive, this suggests that changes in layoffs are approaching zero as the change in quit rates increases. Thus, in 1966 layoffs were becoming more and more stable across industries at some low level while the increases in quits were becoming more pronounced. Individuals, realizing that few firms are laying workers off, may feel free to quit one job to find more suitable work, thereby improving either their economic position or job satisfaction.

In 1967, the R-analysis again developed a factor consisting of the change in quits and the change in layoffs (shared by a moderate .561 loading by the static layoff rate), but in this case the relationship was negative. As would be expected, the values for ΔQ are negative in 1967, while ΔL values are positive. The negative relationship between the changes in layoffs and quits implies that industries with recent increases in layoffs also experienced increases in quits. Industries

which experienced little change in layoffs also experienced little change in quits.

The suggestion from these results is that, in a downturn year immediately following a series of expansion years, individuals may seek greener pastures when their firms begin laying off workers. Comparing the two years, the results show that in 1966 quits are increasing while layoffs are stabilizing at low levels. In the following downturn year, industries begin laying off workers and other workers decide to seek a new job rather than face layoffs.

The placement of the changes in quits and layoffs is still different in the years 1958 and 1959. In the 1958 R-analysis, reflecting the recession year, the change in quits loaded by itself on a factor, unrelated to all other variables. Hypothesis I.b stated that during unstable years, the quit rate would not be closely related to business activity. Thus, the singular loading by the change in quits aids the support for this hypothesis. It should be noted that the only variables included in the study are those of an economic nature. The singular loading by ΔQ in 1958 suggests that, while quits are low in a recession year, any changes in the level of quits that do occur cannot be explained by economic analysis.

In the recovery year, 1959, the change in the quit rate coloads (.880) with Factor I, the turnover/wage factor, in the same direction as the quit rate. This suggests that in the year immediately following a recession, a high quit rate (QR) in an industry also reflects a high change in the quit rate (ΔQ) since all industries experienced quite low quit rates in 1958. In the 1967 analysis the change in quit rates coloaded moderately with the static quit rate but in the opposite

direction. In 1967, just after the peak year, almost all changes in quit rates were negative and were small relative both to the level of quits in 1967 and to the change in quits in 1959. Apparently those industries which were experiencing highest quit rates were least affected by the dip in the economy.

The change in layoff rate in 1958 coloaded (.934) with the layoff rate (.850), suggesting roughly the same relationship as between QR and ΔQ in 1959. In 1959 ΔL loads almost by itself on a factor with only an unexplainable .549 loading by the percent non-production workers.

B.3 Summary

The purpose of the comparative R-analyses was to determine if relationships among variables remain constant through time, with particular emphasis on high and low levels of business activity. Most relationships remained quite stable across the four R-analyses, regardless of the economy level. High levels of quit rates are consistently associated with high new hire rates and low wages. The stability of the relationship suggests that these results would be found in any cross-sectional study. The negative relationship between wages and voluntary turnover should not be considered contradictory to the P-analysis, which found no relationship between levels of wages and the quit rate. The R-analysis results imply that, at any given time, high wage industries experience lower quits. The P-analysis results suggest that over time wages are unrelated to turnover.

Reflecting almost as much stability, layoffs were negatively related to production, except in the recession year when layoffs appear unrelated to all other variables. This last conclusion probably stems

from the fact that some industries were still laying off workers while others had already pared their work forces thereby reflecting lower layoff rates.

The percentage unionization was unrelated to voluntary turnover in each of the R-analyses, just as it was in all of the P-analyses. Unions apparently do have some effect on wages, production, and layoffs in some years, but not in all.

Relationships involving the incremental changes in quits and layoffs did not exhibit the stability that was desired. In 1958, the recession year, the yearly changes in quits appeared unrelated to any of the variables included in the analysis. In 1966 and 1967 the changes in quits and layoffs loaded on the same factor, but in 1966 the relationship was positive, while in 1967 it was negative.

From the comparative R-analyses the implication may be made that relationships among key variables do tend to remain stable over time, but short-run fluctuations may be the result of forces not immediately explainable.

C. T-analysis and a Regression

The previous analyses have considered the quit rate as it relates to other variables over time. The P-analyses considered how it fit in a structure of variables each reflecting a different characteristic of the manufacturing sector or economy as a whole. Both static and dynamic variables were included. As a result of these analyses, a set of comparative R-analyses were made, considering the relationship of the quit rate to other characteristics in a cross-sectional

analysis. Four of these were made comparing the structure of variables in a recession year and a downward turning year.

From all of these analyses, it is apparent that the quit rate, as well as other variables, vary considerably over time. To get a picture of the quit rate over time, a T-analysis was made of the quit rate for 23 industries over the 24-year period 1947-1970, and for 36 industries for the 21-year period 1950-1970.

The T-analysis is an analysis of a single variable, the quit rate. The results of the analysis are groups of years based on the values of the quit rate for the industries (cases) sampled. Years that coload on a factor exhibit similar variances across the industries. The purpose of the T-analysis was to demonstrate that the decision to leave a job is based upon different sets of relationships over time rather than a constant set of decision criteria.

In the 24-year analysis, three factors were developed. Each factor included a series of years as shown in Table XII. As can be seen, each series of years overlaps other series at most one year. Each series also represents distinct trends in quit rates. The first factor includes years 1947-1950. This was a period of rapidly declining quit rates throughout industries, suggesting post-war adjustments or job shopping. It also ends with the recession of 1949-1950.

Factor II begins with 1951 and includes years through 1958. Quit rates were high in 1951 and began a general decline at that time terminating in the recession of 1958. This was the time period Ross included in his analysis that caused him to question if an industrial feudalism was being created.

TABLE XII

24-YEAR T-ANALYSIS FACTOR LOADINGS

YEAR	FACTORS I	II	III
1947	(.719)	--	--
1948	(.777)	--	--
1949	(.789)	--	--
1950	(.853)	--	--
1951	--	(.729)	--
1952	--	(.827)	--
1953	--	.624	--
1954	--	(.771)	--
1955	--	.692	--
1956	--	(.792)	--
1957	--	(.818)	--
1958	--	.615	.685
1959	--	--	(.742)
1960	--	--	(.745)
1961	--	--	(.798)
1962	--	--	(.826)
1963	--	--	(.834)
1964	--	--	(.842)
1965	--	--	(.862)
1966	--	--	(.854)
1967	--	--	(.889)
1968	--	--	(.891)
1969	--	--	(.887)
1970	--	--	(.930)

Factor III would answer the question posed by Ross in a negative manner, since it begins a period of slowly increasing quit rates for the next 13 years. It is noted from raw data that a general upward trend is delineated. A slight dip in the quit rate in 1967 and 1970 does not affect the trend seriously. It is hypothesized that if 1971 and 1972 data were included, a possible fourth factor might develop.

The second factor is of particular interest. Factor I can be easily explained by post-war adjustment and the 1949 recession. Likewise, Factor III can be explained by a consistently expanding economy. In the decade reflected in Factor II, the economy could be classified as variable at best and unstable at worst. This is probably the explanation for the decreasing trend, even though six of the eight years were plus years and 1955 registered one of the higher changes in gross national product throughout the 24 years.

The 21-year, 36-industry analysis sharpens this relationship to some extent (See Table XIII). Note that the 1947-1950 factor is missing since 1947, 1948, and 1949 were omitted due to lack of data. Factor I is now made up of years 1950-1957. Factor III is basically the same as in the prior analysis. Factor II now is made up of years 1954-1963, with most moderate loadings on each end. This certainly could be called a decade of uncertainty. It began with a recession in 1954, and also included a recession in 1958, and had a very small plus year in 1961.

It will be recalled that Hypothesis I stated that the relationship between quits and business activity would be positive during the growth years (1960-1969), but that the quit rate would not be closely related to business activity in less stable years, as in the period included in

TABLE XIII

21-YEAR T-ANALYSIS FACTOR LOADINGS

YEAR	FACTORS I	II	III
1950	(.847)	--	--
1951	(.860)	--	--
1952	(.811)	--	--
1953	(.827)	--	--
1954	.667	.504	--
1955	(.710)	.510	--
1956	.591	.631	--
1957	(.717)	.574	--
1958	--	.675	.551
1959	--	.583	.626
1960	--	.653	.625
1961	--	.681	.644
1962	--	.588	(.722)
1963	--	.531	(.754)
1964	--	--	(.805)
1965	--	--	(.804)
1966	--	--	(.820)
1967	--	--	(.851)
1968	--	--	(.869)
1969	--	--	(.892)
1970	--	--	(.889)

Factor II. To test this further, a simple regression analysis was made, using business sales as the independent variable.[10] To check the hypothesis, one analysis was done for the years 1960-1969, while the second included the eight years from 1951 to 1958. The results showed that in the first analysis a correlation coefficient of .96 was obtained. The relationship was significant at the .1% level. In the 1960-1969 years business sales explained 92.3% of the variance associated with the quit rate. In the years 1951-1958, business sales accounted for only 49.6% of the variance (R = .69). The relationship was not significant at even the 5% level. From this, we accept both parts of Hypothesis I, i.e., that in growth years the quit rate will be positively related to business activity, whereas in unstable years the quit rate will not be closely related to business activity.

Much of the utility of the present research stems from the fact that literature does not report on time-series analyses which take the differing economy levels into account. Stoikov and Raimon studied 1963 and 1966 in a cross-sectional study. They did report that the regression coefficients were larger in 1966 than in 1963, suggesting that the variables had more effect on turnover in the good year.[11]

D. Summary

The key results of the analyses will be briefly summarized before turning to the discussion of Chapter V.

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[10]The problems of auto-correlation are acknowledged.

[11]Vladmir Stoikov and Robert L. Raimon, "Determinants of Differences in the Quit Rate Among Industries," The American Economic Review, LVIII (December, 1968), p. 1293.

The P-analyses showed that many variables do not affect turnover in their static sense. Variables exhibiting closest relationship to turnover were the accessions variables, unemployment, layoffs, and help-wanted advertising. The hypothesis that individuals react more to opportunity variables than to incentive variables was supported. Short-run changes in some variables, such as earnings and business activity, do have an effect on changes in turnover, even though their static counterparts were not related to static turnover variables. The results of the static analysis suggested that quits may be either reaction to opportunities or they may be non-opportunistic quits reflecting stimuli other than those of economic rationality.

The four comparative R-analyses suggested that most key cross-sectional relationships remain stable through time, although short-run changes in turnover may not be closely related to other variables.

The T-analysis and its related regression analysis supported the hypothesis that quits are more closely related to business activity during periods of continued growth than when the economy is fluctuating.

The next chapter will discuss the results presented here in more depth. The chapter initially addresses the relationships among the results of the separate analyses. The discussion then focuses upon the hypotheses of the study. The final section discusses overall relationships concerning turnover.

CHAPTER V

DISCUSSION OF RESULTS

A. An Overview of the Chapter

The previous chapter presented the results of the analyses with discussion focused on the delineation of factor patterns and the logic underlying those patterns. The initial P-analysis showed that voluntary turnover was related to unemployment, accessions, and layoffs. No relationship was found between the quit rate and wages, employment, or variables reflecting the level of the economy or government spending. The incremental changes in wages and business activity were related to changes in the quit rate, suggesting that short-run changes are more important decision criteria than are absolute level of the variables. The static variable analysis showed that part of the variance associated with the quit rate is explained by opportunity variables, while the remainder reflects non-opportunistic quits not explainable by variables analyzed. Comparative R-analysis of four years of different economic levels showed that most cross-sectional relationships remain stable over time although variables reflecting short-run changes in turnover do not appear related to variables analyzed. The T-analyses suggested that voluntary turnover in periods of economic growth reflect forces that are different from those affecting turnover in recessionary years.

The present chapter discusses those results in light of the hypotheses presented, the relationships between analyses, and general findings related to turnover.

B. Restatement of Hypotheses

It may be recalled from Chapter I that six operational hypotheses were submitted for analysis. For convenience in the ensuing discussion, this section will restate those hypotheses. As is common when dealing with factor analysis, hypotheses are not subject to formal statistical testing as is done when analysis of variance is the methodological tool. Instead, the hypotheses are supported through the placement of variables within specific factor patterns.

The hypotheses submitted to analysis were:

I. The relationship between the quit rate and the level of business activity will differ depending on the stability of the economy.

Ia. During years of economic expansion (1960-1969) the quit rate will be directly related to the level of economic productivity.

Ib. During recessionary years the quit rate will not be closely related to measures of productivity.

II. Layoffs will load highly on the same factor as the quit rate, but with opposite sign.

III. Gross weekly earnings, the range of wages throughout the manufacturing industry and other industries, the consumer price index, and the total employment level will be unrelated to quit rates.

IV. All classes of unemployment will be negatively related to turnover.

V. Spendable average weekly earnings will be more closely related to quit rates than will gross weekly earnings.

VI. The amount of union work stoppages will be positively related to quits while the percent of unionization will be negatively related.

C. Analysis of Hypotheses

Hypothesis I, stating that the relationship between turnover and business activity will depend upon the stability of the economy, received support from the initial P-analysis. This was the first analysis of the study, comprising 39 variables for the 24-year period. Here the results showed that the quit rate loaded on a factor which is orthogonal to the trend factor, which included variables such as gross national product, business sales, etc. The factor scores suggested that the quit rate factor was a cyclical factor. Since the quit rate does increase as the economy increases, it should be positively related to the trend variable during expansionary times. However, the trend variables increase continually over time while the quit rate fluctuates; hence, little relationship between the two should exist when all 24 years are considered.

More support was registered for Hypothesis I by the T-analysis and the regression that followed it. The T-analysis delineated three factors. To suggest that the quit rate was continually decreasing, as Ross implied, or even that a parabolic relationship with a low point in 1959 existed, would have required that one, or at most two, factors be

derived. The fact that one factor included the years 1951 through 1958 and a separate factor included years 1960 through 1970 leads one to conclude that different influences upon turnover were appearing. The regression analysis, done as a result of the two factor analyses, statistically supported the hypothesis by determining quite different levels of significance for analyses in the two periods.

It should be noted here that Hypothesis I was the only hypothesis tested via regression analysis. Since one of the purposes of the study was to determine the viability of factor analysis as a research tool, it would seem somewhat facetious to revert back to the more basic regression analysis for each set of variables. As will be seen, conclusive results were obtained for each of the hypotheses as a result of the factorization. The inclusion of the regression tests of Hypothesis I illustrates to the statistical theorist that the same result could be obtained with either method, whereas much of the other information gained from the factor analysis could not have been gleaned from a regression analysis.

The significance of Hypothesis I, whether one accepts the regression or the factor analysis approach to the conclusion, is of more importance. Publication is lacking which focuses upon the time-series relationships between turnover and economic variables while taking into consideration the different economy levels. Parker and Burton (22), for example, conducted a time-series analysis of turnover, but the shortest span of years was 1949-1966, roughly comparable to the entire data set of the present study. Yet, the regression analysis covered both expansionary and recessionary years without attempting to separate out these effects. It is of little wonder that they obtained

insignificant results for their time variable. This by itself should demonstrate the viability of factor analysis in that it does aid the discovery of relationships other methods fail to find.

Since business activity is not a good predictor of quit rates during less stable years, it is of interest to posit what might be the cause of quits during these times. A statement by Parker and Burton, taken somewhat out of context, states the situation very well.

> Even when there are no pecuniary incentives for workers to leave their firms, there is a normal level of voluntary turnover because employees become disillusioned with their jobs, exchange acrimonious words with their foremen, or because of the innumerable other reasons associated with the vagaries of being human.[1]

The second hypothesis concerning the relationship between layoffs and quits was partially supported. The initial P-analysis, as well as the static analysis, found negative relationships as posited, although the relationships were not as high as were expected. In each of the comparative R-analyses a positive relationship between layoffs and quits was obtained. This relationship was never strong, but each succeeding analysis obtained a higher loading for the layoff rate on the quit rate factor. Thus, it would appear that over time layoffs in manufacturing are, in fact, inversely related to the quit rate, although in a given time period any relationship that does occur may be positive. It is entirely possible that those industries with high quit rates may also have high layoff rates even though these vary inversely over time.

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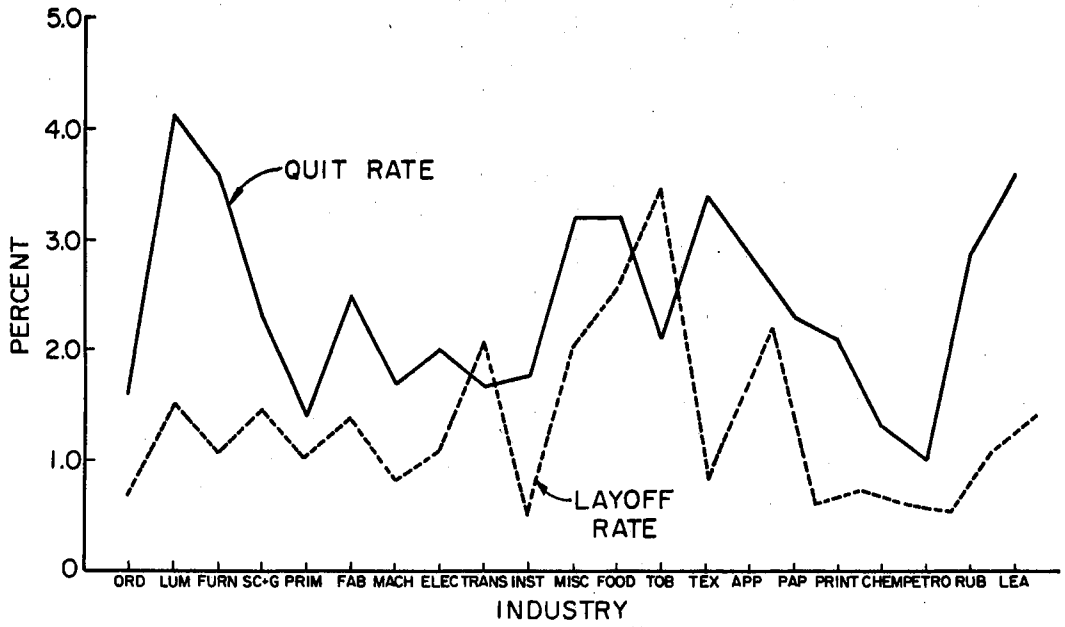
[1]John E. Parker and John F. Burton, "Voluntary Labor Mobility in the U. S. Manufacturing Sector," Proceedings of the Twentieth Annual Winter Meeting, Industrial Relations Research Association (1967), p. 62.

This paradox may be explained by looking at Figures 5 and 6. Using 1967 as an example, it can be seen in Figure 5 that, with two exceptions, the quit rate exceeds the layoff rate, but that most industries which reflect high quit rates also exhibit relatively high layoff rates, while industries with low quit rates also have low layoff rates. This explains the positive association between the quit rate and layoff rate. It is not inconceivable that a similar set of differences could be obtained across industries in other years.

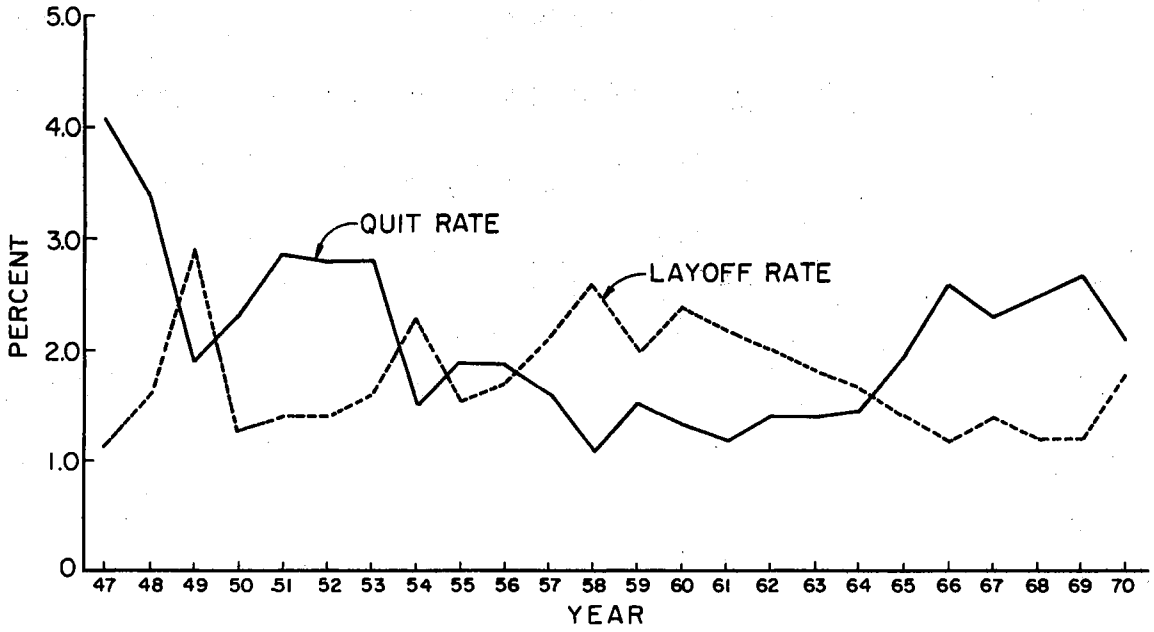
Figure 6 shows the "all manufacturing" quit rates and layoff rates over time. To illustrate the inverse relationship most clearly, the quit rate is plotted as a positive deviation from zero while the layoff rate is shown as a negative deviation. The inverse relationship is evident.

A problem concerning the relationship between layoffs and quits remains. This study and the study by Stoikov and Raimon (33) found positive cross-sectional relationships between quits and layoffs, while the Burton and Parker (5) study found negative relationships. Both of the earlier studies found statistically significant results for their conclusions. Attempting to determine which of the two relationships is correct from a logic viewpoint failed since both the above studies posit tenable reasons to substantiate their significant empirical results. A possible explanation would be difference in data sources since Burton and Parker utilized census data rather than Bureau of Labor Statistics data, but even this is a dubious explanation. Perhaps the only conclusion that can be made is that this is an area of fruitful research potential.



SOURCE NO. 40

Figure 5. 1967 Quit Rate and Layoff Rate, 21 Industries



SOURCE NO. 40

Figure 6. Quit Rate and Layoff Rate, 1947-1970

The third hypothesis was that gross weekly earnings, the range of wages throughout the manufacturing industry or throughout all industries, the consumer price index, and the total employment level will load orthogonally to the quit rate.

Support for this hypothesis was found in the initial P-analysis. None of the above variables coloaded significantly with the quit rate. Each loaded on Factor I, the trend factor, whereas the quit rate was unrelated to each of the trend variables. Thus, it can be said, at least superficially, that the hypothesis is supported.

It is of interest and somewhat more meaningful to look at the variables in Hypothesis III in the dynamic analysis to determine if any relationship between yearly changes is evident. From Table IV, the change in the consumer price index loads on a factor by itself, implying no relationship between it and the change in quit rates. In retrospect, this might be expected. Although the cost of living continues to rise and certainly is of importance to families, it would not be expected that this would be of prime importance in the decision to leave a job.

The yearly change in employment was not included in the dynamic analysis since individuals would not be expected to be aware of the magnitude of these changes. Since employment levels are a measure of opportunity, the change in business sales may serve as a proxy for the opportunity aspect of employment changes. The change in business sales did load highly on the same factor as the change in quits. This, plus the high loading for change in gross national product, suggests that individuals do, in fact, respond to changes in economic activity or

opportunity, whereas the static levels of the variables have no real effect.

The two wage variables, gross weekly earnings and range of wages throughout manufacturing and the total economy, are not related to quits in their static form. Like the previously discussed variables, the change in wages, but not the change in wage range, is associated with the change in quit rate. Here again the decision to quit a job is based not on the absolute wages of the industry but on recent changes. The lack of loading by the change in wage range in the dynamic analysis adds conclusive support to the hypothesis that wage ranges would be unrelated to quits. It should be noted again that Pencavel (24) utilized the standard deviation of wages as a measure of wage dispersion and obtained similarly insignificant results.

From considerations presented, none of the variables specified in Hypothesis III affect turnover from the static viewpoint. When short-run changes are considered, both wages (incentives) and business sales and gross national product (the proxies for opportunities) are associated with changes in turnover although inter-industry wage differentials have little effect.

Hypothesis IV stated that all classes of unemployment variables would be negatively related to turnover. Each of the variables loaded as expected, although it was not expected that they would be quite so closely interrelated as they were. The almost equally high loading by each of the unemployment variables suggested that a single concept was being measured. They were all negatively related to the quit rate in the initial P-analysis; the overall unemployment rate was negatively

related to quits in the static analysis; and the change in quits was negatively related to changes in unemployment in the dynamic analysis.

The close relationship between unemployment and voluntary turnover in all analyses suggests that this is a key variable in explaining turnover. From a behavioral viewpoint one might expect the unemployment rate to be one of the most, if not the most, important criterion to consider. Although low wages may entice one to look for a better job, a high probability of becoming unemployed should make one reluctant to quit an existing job.

The fifth hypothesis, that spendable earnings would be more closely related to quit rates than would gross weekly earnings, received no support at all. The loadings by spendable earnings were almost identical to gross weekly earnings in the initial P-analysis. The two variables appeared to be so closely related over time that they could be considered a single variable. This hypothesis was considered to be a minor hypothesis, and the spendable earnings variable was eliminated from further consideration.

Hypothesis VI, the final hypothesis, stated that the amount of union work stoppages will be positively related to quits while the percent of unionization will be negatively related to quits.

The first part of this hypothesis received moderate support. In the initial analysis, the work stoppages variable loaded .667 on the quit rate factor. In the static analysis, the loading was .621, with a loading of .543 on a separate factor. From this we may conclude that work stoppages may affect turnover to some extent, although they measure other unrelated concepts too. It may be recalled that work stoppages may measure discontent with a company but may also represent

opportunities to look for new jobs. It is somewhat ironic that the work stoppages, looked upon with disdain by many, may in actuality be a catalyst to the labor allocation process. March and Simon include the "propensity to search" for alternative jobs when discussing an individual's perceived ease of movement.[2] It would seem appropriate that they also include "opportunities to search" in their model. Thus, it is hypothesized that the work stoppages discussed above, vacations, days off, and even sick leave may serve as opportunities to search for new jobs.

The last part of Hypothesis VI was stated in a negative fashion since that is the popular notion held by many theoretical economists and many laymen. It was with some interest, then, that no support whatsoever could be found for the hypothesis. In none of the three time-series analyses nor in any of the cross-sectional analyses did either unionization or changes in unionization coload negatively with the quit rate or change in quit rate. The only analysis for which relationships were obtained was a computer run of 50 variables including both static and dynamic variables. In this analysis the change in unionization loaded .510 with the quit rate factor, not with the change in quit rates as might be expected, and this loading was positive rather than negative.[3] Hence, there appears to be no support at all for the hypothesis that unions impede voluntary mobility.

A few other key variables should be mentioned briefly before leaving this section. Neither expenditures for new plant nor

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[2]March and Simon, p. 105.

[3]This analysis did not add anything significant to the study and is omitted from further discussion.

government spending had an effect on turnover in either the dynamic or static form. In later analyses, lagged government spending and lagged changes in government spending were added, but these were also unrelated to turnover.

The help-wanted index appeared to be moderately related to turnover in both the dynamic and static analyses. In the static analysis it loaded on the factor reflecting reaction to opportunities. In the dynamic analysis it shared the turnover factor with the changes in business sales, etc., again suggesting an opportunity factor.

No relationship between the percentage of female workers and turnover was found in either the time-series nor the cross-sectional analyses. Other variables, such as the amount of unfair labor practices filed, the labor force participation rate, the inventory/sales ratio, durables purchases, and the Dow-Jones Stock Averages were included only in the time-series analyses; and each loaded orthogonally to the quit rate.

D. The Relationships Among Analyses

The second of the two objectives stated for the study was to determine the feasibility of utilizing factor analysis to study labor turnover through time. In achieving this goal it is of importance to discuss the three types of analysis used in the study. This section will discuss the relationships between the P-analysis, the R-analysis, and the T-analysis, emphasizing the contribution of each to the study.

Three P-analyses were made. The first of these, called the <u>initial P-analysis</u>, included 39 variables. Four of these were dynamic or change variables. The contribution of this analysis was the separation

of variables related to the quit rate over time from those not related to it. It was not unexpected that the separation would occur. Rummel suggested that one could:

> orthogonally rotate the factor solution so that the first factor defines the serial correlation, or trend in the data. The subsequent factors may then be interpreted as defining interrelationships in data with the influence of serial correlation removed.[4]

The loadings of the dynamic variables lead to the addition of other change variables and the analysis of the new data set in the dynamic analysis. This analysis considered the relationships between annual incremental changes in variables. Since changes in variables are less likely to reflect trends than are static variables, the results of the analysis were important. The analysis considered short-run changes over time rather than the static or aggregate variables. In addition to analyzing relationships within the dynamic analysis, the results could be compared with those of the initial P-analysis. It was shown that some of the key variables did relate to turnover in the dynamic case although they were a part of the trend factor in the earlier analysis.

The static analysis considered a smaller data set than the P-analysis with the four change variables and selected static variables removed. From a content viewpoint the major utility of the analysis was the delineation of two factors involving the quit rate rather than a single factor. From a methodological viewpoint the utility was in the stability of factors. Very little change in the factor patterns occurred, even though several variables were removed.

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[4]Rummel, p. 244.

Four R-analyses were made comparing the factor patterns for the years 1958, 1959, 1966, and 1967. Most of the relationships were stable over time although some variables, including the changes in the quit rate and layoff rate, did not remain stable throughout the four analyses. The effect of unions appeared to be more effective during change years (1959, 1967) than in either the low or peak years (1958, 1966).

Some of the relationships found in the R-analyses seemed contradictory to those found in the P-analyses. This may be explained by recalling the fact that the R-analyses were cross-sectional while the P-analyses were time-series studies. The R-analyses considered patterns at a single time period across several industries, while the P-analyses considered several time periods but a single entity, the economy as a whole.

It is difficult to determine in the R-analyses whether long-run or short-run relationships are being measured since a single time period is studied. Limited evidence suggests that short-run relationships are being studied. This comes from the difference in loadings for some of the variables, particularly the effect of unions, layoffs, and changes in wages. In some cases, the long-run relationships appear to be the same as the short-run, but this is not the case for all variables.

The T-analysis is related to the P-analysis in that a time dimension is included in both. The major difference in the two is that the T-analysis considers a single characteristic, the quit rate based upon several industries, rather than a large group of characteristics including the quit rate with economy-wide or manufacturing-wide data.

Although the results of the T-analysis supported the P-analyses and R-analyses, the major contribution was the delineation of the factor pattern reflecting different types of years based on the quit rate. It was from this set of analyses that support was gained for the hypothesis that different forces affect the quit rate decision in poor years than affect it in growth years.

E. Turnover Relationships

The discussion of part C of this chapter as well as the discussion of Chapter IV suggests that the turnover is a function of several variables but certainly not all of those included in the data set. In many cases individuals react to recent changes in variables rather than to the variables themselves. This is particularly the case concerning wages and the state of the economy. Some support was gained for positing that individuals react more to opportunity than to incentives to change jobs. The opposite effect would have required a stronger relationship between wages and turnover, particularly in regard to the wage dispersion. Further support for the opportunity hypothesis was gained from the static hypothesis when the quit rate loaded on two factors. One of these was interpreted to be a short-term employee turnover, irrespective of opportunity, while the other was determined to reflect opportunistic turnover. Opportunity suggests a relationship between quits and help-wanted advertising, new hires, and lack of unemployment. Again, the incentive hypothesis would posit a stronger relationship between turnover and the wage variables.

The relationship between the change variables and their static counterparts may be given a behavioral interpretation. Chapter I

stated that variables would be included that reflected both actual and perceived ease or desirability of moving from one job to another. Opportunities for movement are measured by the level of economic activity or the lack of unemployment. Incentives to move are reflected by the level of wages or the difference between one's own wage and other wages in the area. However, neither the level of economic activity nor the level of wages were related to the quit rate. The results of the dynamic analysis suggested that changes in wages, business sales, and gross national product were related to changes in the quit rate. But from above, opportunities and incentives to move are measured by the static variables, not dynamic variables. Changes in the variables are not the variables themselves. This leads to the conclusion that individuals, in reacting to changes in variables, respond to perceived opportunities and incentives rather than actual opportunities or incentives.

From the testing of Hypothesis I, we have that individuals appear to react in more nearly an economically rational manner in times of economic growth than when the economy is fluctuating. Even in the comparative R-analyses the relationship between turnover and wages was far stronger in the 1966 and 1967 analyses than in the 1958 and 1959 analyses. This does not imply that individuals react to non-economic stimuli only under poor economic conditions. In fact, quits for non-opportunistic reasons should increase with the economy since the chances of picking up a new job are better. Yet, when the economy is vacillating, the quits continue in spite of the economy.

This discussion leads back to the Reynolds and Shister statement that "Worker behavior is in general a rational adaptation to the

circumstances as the worker sees them."[5] It is suggested that Reynolds and Shister's statement is incorrect unless one considers only the economics discipline. From a sociological viewpoint, individual rationality need not be, and in fact normally is not, the same concept as administrative or economic rationality. Individual rationality suggests that one may "rationalize" any act to himself. However, many of these acts which the individual considers rational are in no way rational using the economic definition of the concept. From the viewpoint of the individual, worker behavior is certainly a rational adaptation to the circumstances since all his acts are rational adaptations to circumstances. To say that he reacts in an economically rational manner during periods of vacillating economy cannot be accepted.

From the partially inconclusive discussion of layoff rates, we can say that, in general, layoffs are inversely related to quits over time. We cannot say that layoffs are the antithesis of quits in that some industries may have both high layoffs and high rates of quits, while in others the opposite relationship may be obtained.

The study has supported the institutionalist's viewpoint in that conclusive evidence was found that unions do not impede voluntary turnover and may, in fact, increase turnover through the unlikely mechanism of the work stoppage. Any relationship between unions and involuntary turnover is weak at best. Thus, it would appear that any anti-union arguments tendered must be on some basis other than impediments to

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[5]Reynolds and Shister, p. 81.

labor allocation. Further, any relationship between unions and wages was very weak at best.

This chapter has discussed the results of the analysis with emphasis on the hypotheses presented, relationships among the analyses, and general relationships concerning turnover. Of the six hypotheses only Hypothesis V concerning spendable earnings was not supported as expected. The final hypothesis, dealing with the relationship between unions and turnover, was rejected. The general hypothesis for the study was supported. This was that individuals react more to opportunities than incentives, and they will act in an economically rational manner only in periods of economic growth when many jobs are available.

CHAPTER VI

SUMMARY AND IMPLICATIONS

A. Summary

A.1 The Problem

Labor turnover is an area of concern for those primarily interested in the firm as well as those interested in the workings of the labor market. Rates of turnover may be either too high or too low, depending on the viewpoint of the researcher. Excessive turnover increases the firm's labor cost disproportionately. On the other hand, low turnover rates may indicate inefficient operation of the labor market.

Researchers seek to find the causes of turnover in order that the causal variables may be manipulated to affect turnover in a desired direction. The more general question is whether individuals react in an economically rational manner when changing jobs rather than reacting to psychological stimuli outside the domain of the labor market.

The analytical tool utilized in almost all of the previous research on labor turnover has been regression analysis. This method is beset with problems when considering a phenomenon as complex as the decision process underlying turnover. One problem is that the number of variables must be limited unless a very large number of cases is available. A second problem is that intercorrelations among supposedly

independent variables are probable when more than a very small number of variables is included. If the number of variables is limited to truly independent variables, then the probability of omitting a key explanatory variable increases. A third problem associated with regression analysis is the inclusion of time-series data. A need exists for an analytical tool that can include a large number of variables, measuring relationships over time.

A.2 The Purpose

The purpose of this study was to utilize factor analysis to study labor turnover as it relates to selected variables over time. Factor analysis is a multivariate analytical tool based upon the correlation matrix. It considers the interrelationships among a large set of variables regardless of the interdependence among the variables rather than attempting to predict the value of a dependent variable based upon a limited number of independent variables.

The study was designed to achieve two objectives. The first was to determine variables which enter into the decision process underlying turnover. In achieving this goal, the results of previous studies were re-evaluated to determine if relationships derived through regression analyses of small data sets continue to hold when variables were included in large data sets that were factor analyzed. The interrelationships among variables affecting turnover were analyzed over time to determine if the decision to change jobs is based upon the same set of relationships throughout time. Of particular interest was the stability of relationships in periods of economic growth compared to periods when the economy is fluctuating. Although macro data were

used, the study maintained a behavioral focus emphasizing individual responses to information of a macro nature.

The second objective of the study was the demonstration of factor analysis to be a viable tool for use in labor and manpower economics. In particular, the purpose was the determination of the feasibility of time-related factor analysis to extend the methodological coverage that cannot be met by other methods. This was to be done by showing results that confirm, clarify, or extend results of earlier studies. Earlier research may be considered a control group for which results are compared to the results of the present study.

A.3 The Hypotheses and Data

The general hypothesis for the study was that individuals would react more to opportunities than to incentives to move; and that they would act in an economically rational manner only in periods of economic growth when jobs are plentiful. Operational hypotheses were submitted concerning the relationship between the quit rate and key variables. These variables included the level of business activity, the layoff rate, wages, prices, unemployment, unions, and work stoppages. In addition, each of the 52 variables entered the analysis with a hypothesized relationship to turnover.

Data used in the study were secondary, published by the Department of Labor's Bureau of Labor Statistics and the Department of Commerce's Office of Business Economics. Variables could be categorized as labor market variables, economic activity variables, and institutional/ organizational variables. Each was hypothesized to affect turnover

either directly or through the individual's perceived ease or desirability of changing jobs.

A.4 The Method

Variables were initially submitted to a P-analysis to determine relationships over a 24-year time period. The factor patterns that were derived reflected groups of variables over time. Variables reflecting annual incremental changes in key variables were analyzed. Further, a smaller set of static variables was analyzed in order to check for stability of factors.

Four R-analyses were made of cross-industry data. Each of these determined relationships among variables for a single year based upon the industries sampled. The years selected were 1958, a recession year, 1966, an expansion year, and 1959 and 1967, the two years immediately following a recession and an expansion. The purpose of these analyses was to determine differences in the structure of relationships in a recession year, an expansion year, and the two change years.

Finally, measurements of the quit rates for selected industries in the years 1947-1970 were submitted to factor analysis. The T-analysis gave groups of years based upon the quit rates for the industries. A simple regression of quit rates on business sales was made to verify the results of the T-analysis.

A.5 The Results

The analysis of data showed that the decision to change jobs may be based upon several variables but is not dependent upon all the variables included in the analysis. Support was evidenced for the

general hypothesis that individuals respond more to opportunity variables than to incentive variables. This was shown by a relationship between quits and unemployment, help-wanted advertisements, layoffs, and accessions. Supporting this further was the limited relationship between all wage variables and the quit rate, with no relationship at all evidenced between the quit rate and wage dispersion. If incentives to move were of primary importance, then a strong relationship between the dispersion of wages and the quit rate would have been obtained since a larger dispersion of wages would indicate greater incentives to improve one's economic position by changing jobs.

The results of the dynamic analysis indicated that individuals may respond to short-run changes in some variables even though they do not respond to the static counterparts. Thus, changes in the quit rate are related to changes in wages and business sales, gross national product, and the percent of non-production workers. Some variables, such as the unemployment rate and the new hire rate, are related to the quit rate in both the dynamic and static cases, while others, such as the wage range and government spending, are unrelated in both cases.

No evidence supported Hypothesis VI that unions were related in any way to voluntary turnover. In all P-analyses and the comparative R-analyses, the percentage unionization loaded orthogonally to the quit rate. The factor loadings also showed little or no relationship between unions and layoffs or unemployment, suggesting that unions have little effect on either voluntary or involuntary turnover.

Results of both the P-analyses and the T-analyses supported Hypothesis I that quit rates would be more closely related to business activity in growth years than in periods when the economy is

vacillating. In the poorer years quits are non-opportunistic in nature and reflect movement based upon dissatisfactions with the job itself rather than opportunities for better jobs. During these times the decision to change jobs does not appear to be based on an economically rational decision process.

The utility of factor analysis was demonstrated in the study. In particular, it was shown to be a viable tool for the study of a large amount of time-series data. The utility of the P-analyses and the comparative R-analyses to investigate changes in the structure of relationships over time was demonstrated in that different types of relationships were determined for the growth years as opposed to the less stable years. Other studies did not appear to treat this concept adequately, and part of this failure may be attributed to the analytical tools used.

B. Implications for Further Research

One of the frequent uses of factor analysis is as an exploratory tool. Factor analysis may be used to uncover relationships which may then be investigated in depth. The present study was not designed as an exploratory exercise; the tool was used to complete an extensive study of the subject area. Yet, some implications for future research did result from the study; three are noteworthy.

The first research implication concerns the layoff rate. In most studies, as in the present one, the layoff rate is included as an explanatory variable rather than being the target of the research. This variable measures involuntary turnover rather than voluntary turnover. Previous studies found conflicting results when the layoff

rate was included (5) (33). The present study showed that the cross-sectional relationship between quits and layoffs is opposite that of the time-series relationship. The static layoff variable loaded negatively with the quit rate in the P-analysis but positively in the R-analyses. Further, the annual change in layoffs did not load as expected, and its placement in the factor patterns could not always be explained. Thus, there is a need for an intensive study of the layoff variable rather than simply including it in an extensive study of some other concept. Peter S. Barth (2) has attacked the problem in a recent study using time-series regression analysis; there is still room for further research in the area.

A second implication for further research concerns the comparative R-analyses. Although some factors exhibited stability across the four analyses, some variables, especially the change in quits and layoffs, loaded differently in the separate analyses. An area for further research would be the analysis of a select group of variable in R-analyses for several different time periods to see if the changes in the structure can be traced through time more closely. One might make, say, ten successive R-analyses using annual data or perhaps refine the analysis by using quarterly or monthly data. This would be of particular interest to follow moves into and out of a recession period.

A third implication concerns further use of the analytical tool. The present study used factor analysis to analyze labor turnover. The implication is that the tool may now be applied to other more complex areas within manpower economics or organizational analysis where a dominant methodological need is for a tool that can handle many variables. Examples would include an intensive study of unions and their

effects, analysis of specific manpower programs, studies of organizational climate, or comparative organization studies. The tool should be quite appropriate for either intensive or extensive studies in these and other areas.

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APPENDIXES

APPENDIX A

INDUSTRIES INCLUDED IN STUDY

TABLE XIV

INDUSTRIES INCLUDED IN STUDY

Industry or Group	SIC
Manufacturing[1]	--
Durable Goods[1]	--
Ordnance and Accessories	19
Lumber and Wood Products	24
Furniture and Fixtures	25
Stone, Clay, and Glass	32
Primary Metal Industries	33
Fabricated Metal Products	34
Machinery, except Electrical	35
Electrical Equipment and Supplies	36
Transportation Equipment	37
Instruments	38
Miscellaneous Manufacturing	39
Non-Durable Goods[1]	--
Food and Kindred Products	20
Tobacco Manufactures	21
Textile Mill Products	22
Apparel and Other Textile Products	23
Paper and Allied Products	26
Printing and Publishing[2]	27

TABLE XIV (Continued)

Industry or Group	SIC
Chemicals and Allied Products	28
Petroleum and Coal Products	29
Rubber and Plastics	30
Leather and Leather Products	31
Motor Vehicles and Equipment[3]	371
Aircraft and Parts[3]	372
Ship and Boat Building and Repairs[3]	373
Railroad Equipment[3]	374
Radio and Television Equipment[3]	365 (3661)[4]
Telephone and Telegraph Equipment[3]	3661 (3664-69)[4]
Floor Covering Mills (Carpets)[3]	227
Plastics Materials and Synthetics[3]	282[5]
Drugs and Medicines[3]	283
Footwear, except Rubber[3]	314
Cement, Hydraulic[3]	324
Tires and Inner Tubes[3]	301
Agricultural Machinery[3]	352

[1]Not included in R-analyses.

[2]Included only in R-analyses.

[3]Included only in T-analysis of quit rate for 1950-1970.

[4]Changed SIC Codes in 1958.

[5]Prior to 1958, included in Industrial Organic Chemicals with the same SIC code.

APPENDIX B

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR THE ANALYSES IN THE STUDY[1]

[1]Factor loadings greater than ±.250 are included. Loadings less than ±.250 are assumed to be equal to zero.

TABLE XV

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR INITIAL P-ANALYSIS

Factor	I	II	III	IV	V
Variable			Factor Loadings		
SEP	--	.819	-.351	--	--
QR	--	.917	--	--	--
LR	--	-.723	-.566	--	--
Δ^Q	.275	--	.886	--	--
Δ^L	--	--	-.905	--	--
AR	-.397	.753	.272	.308	--
LAR	-.432	.699	-.389	.282	--
NH	-.262	.850	--	.308	--
NAW	.990	--	--	--	--
PW	.584	.727	--	-.264	--
%NP	.904	-.372	--	--	--
GWE	.991	--	--	--	--
Δ^{WE}	.316	.386	.696	--	--
HE	.992	--	--	--	--
SE	.991	--	--	--	--
U	--	-.930	--	.253	--
U_{ad}	--	-.895	.251	--	--
LFPR	.570	--	--	-.655	.360
CPI	.990	--	--	--	--
WPI	.959	--	--	--	--
GNP	.990	--	--	--	--
ΔGNP	--	--	.878	--	--
DJSA	.905	--	--	--	--
G	.956	--	--	--	--
ENP	.977	--	--	--	--
BS	.989	--	--	--	--
I/S	.324	--	-.607	-.655	--
DP	.974	--	--	--	--
WR_I	.993	--	--	--	--
WR_M	.958	--	--	--	--
HWI	.499	.471	.419	--	-.258
Un	-.458	--	--	-.805	--
ULP	.576	--	--	.647	--
WS	.413	.589	--	-.252	.507
TLWS	--	--	--	--	.818
%FE	.989	--	--	--	--
%MFE	.969	--	--	--	--
U_{20}	--	-.893	-.302	--	--
U_B	--	-.964	--	--	--

TABLE XV (Continued)

Factor	I	II	III	IV	V
Year			Factor Scores		
47	-1.642	1.536	-0.684	1.460	-0.306
48	-1.203	1.174	-0.633	1.802	-0.193
49	-1.096	-0.411	-1.956	1.161	1.048
50	-1.329	-0.413	2.048	0.910	1.660
51	-0.861	1.224	0.565	-0.830	-0.238
52	-0.700	1.104	0.122	-0.947	1.375
53	-0.618	1.324	-0.174	-1.555	-0.543
54	-0.584	-0.731	-1.639	-1.007	-0.742
55	-0.664	-0.431	1.739	-1.136	0.260
56	-0.373	-0.012	0.051	-1.613	-0.285
57	-0.196	-0.219	-0.524	-1.609	-0.994
58	-0.142	-1.700	-1.048	-0.675	0.312
59	-0.160	-1.184	1.139	-0.235	1.643
60	0.084	-0.862	-0.614	-0.206	-0.763
61	0.126	-1.595	-0.112	0.531	-0.211
62	0.207	-1.020	0.626	0.612	-0.563
63	0.336	-1.016	0.234	0.896	-1.021
64	0.520	-0.721	0.422	0.964	-0.970
65	0.727	0.057	0.886	0.822	-1.121
66	0.998	0.881	0.810	0.535	-1.258
67	1.294	0.859	-0.512	0.111	-0.513
68	1.485	0.961	0.776	-0.013	0.210
69	1.763	1.063	-0.087	-0.118	0.882
70	2.029	0.131	-1.432	0.139	2.330

TABLE XVI

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR DYNAMIC ANALYSIS

Factor	I	II	III	IV	V	VI
Variable			Factor Loadings			
ΔQ	.872	--	--	--	--	--
ΔL	-.870	--	--	--	--	--
ΔW	.807	.373	--	--	--	--
ΔGNP	.930	--	--	--	--	.253
ΔBS	.848	.266	--	--	--	.340
ΔG	--	--	.926	--	--	--
ΔNH	.715	--	.340	--	.367	--
ΔU	-.748	.260	-.292	--	--	--
ΔWR	--	--	--	--	.962	--
$\Delta \%NP$	-.872	--	--	--	--	--
ΔCPI	--	.953	--	--	--	--
ΔUn	--	--	--	--	--	.890
ΔHWI	.644	-.406	.331	--	--	--
ΔENP	.459	.336	--	.335	--	.599
$L\Delta G$	--	--	--	-.925	--	--
Year			Factor Scores			
48	-0.394	0.754	1.462	1.545	-1.041	-0.779
49	-1.521	-2.346	-0.072	-0.248	-0.872	0.048
50	1.427	-0.728	-1.152	-0.300	1.099	-1.119
51	0.268	1.170	1.805	-0.278	-0.795	2.097
52	0.101	0.228	1.035	-2.707	0.391	-0.693
53	-0.160	-1.025	-0.869	-1.355	-1.009	1.650
54	-2.086	-0.448	-0.959	-0.505	1.531	0.049
55	1.583	-0.749	-0.737	1.456	-0.744	-1.336
56	-0.395	-0.767	-0.232	1.210	0.024	1.271
57	-0.860	0.643	-0.405	0.613	-0.158	-0.129
58	-1.477	0.235	0.126	-0.606	0.792	-1.447
59	1.188	-0.567	-0.408	-0.056	-0.028	-0.362
60	-0.624	-0.203	0.615	0.896	-0.880	-0.075
61	0.035	-0.052	1.913	-0.081	-0.048	-2.063
62	0.608	-0.703	-0.178	0.205	-0.924	0.535
63	0.173	-0.485	-0.112	0.122	-0.584	-0.172
64	0.459	-0.387	0.776	0.445	1.125	0.520
65	0.931	-0.359	-0.430	0.721	1.606	0.910
66	0.813	0.314	1.356	0.269	2.163	1.088
67	-0.529	0.338	0.079	-0.587	-0.925	0.151
68	1.312	1.038	-0.644	-1.581	-0.450	-0.108
69	0.328	2.070	-1.632	-0.217	-1.136	-0.017
70	-1.191	2.038	-1.338	1.041	0.863	-0.020

TABLE XVII

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR STATIC ANALYSIS

Factor	I	II	III	IV	V
Variable			Factor Loadings		
SEP	--	.303	--	.901	--
QR	--	.744	--	.640	--
LR	-.288	-.920	--	--	--
AR	-.286	.791	.275	.375	--
LAR	-.277	.209	--	.919	--
NH	--	.813	.262	.472	--
LNH	--	.262	--	.909	--
NAW	.988	--	--	--	--
PW	.596	.667	-.310	.271	--
%NP	.901	--	--	-.324	--
GWE	.989	--	--	--	--
U	--	-.807	.315	-.430	--
LFPR	.470	--	.610	--	.514
CPI	.983	--	--	--	--
GNP	.986	--	--	--	--
DJSA	.906	--	--	-.282	-.251
G	.955	--	--	--	--
ENP	.975	--	--	--	--
BS	.988	--	--	--	--
I/S	.284	-.382	.787	.275	--
WRI	.989	--	--	--	--
HWI	.495	.650	--	--	-.457
Un	-.455	--	.850	--	--
ULP	.532	--	-.675	.463	--
WS	.361	.621	--	.279	.543
%FE	.988	--	--	--	--
Year			Factor Scores		
48	-1.346	0.301	1.703	2.184	-0.640
49	-1.197	-1.613	0.868	1.663	-0.087
50	-1.588	1.330	1.825	-1.156	1.705
51	-0.970	0.951	-0.479	1.020	0.527
52	-0.822	1.136	-0.785	0.717	0.490
53	-0.683	0.869	-1.581	0.936	-0.236
54	-0.627	-1.277	-1.372	0.239	-0.723
55	-0.824	1.063	-0.520	-1.863	0.618
56	-0.450	0.411	-1.515	-0.590	-0.275
57	-0.246	-0.475	-1.589	-0.412	-0.503
58	-0.226	-1.654	-0.637	-0.729	0.814
59	-0.233	-0.188	0.053	-1.260	0.174
60	0.066	-1.200	-0.261	-0.141	-0.397

TABLE XVII (Continued)

Factor	I	II	III	IV	V
Year			Factor Scores		
61	0.092	-1.197	0.667	-0.774	0.463
62	0.184	-0.694	0.712	-0.577	-0.362
63	0.324	-0.711	0.961	-0.637	-0.734
64	0.463	-0.277	1.067	-0.817	-0.817
65	0.674	0.425	0.947	-0.383	-1.377
66	0.940	1.342	0.523	-0.116	-1.147
67	1.375	0.411	-0.313	0.829	-1.104
68	1.499	1.146	-0.165	0.134	-0.671
69	1.672	0.746	-0.097	0.627	1.685
70	1.923	-0.846	-0.013	1.109	2.598

TABLE XVIII

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR 1958 R-ANALYSIS

Factor	I	II	III	IV	V	VI
Variable			Factor Loadings			
QR	-.965	--	--	--	--	--
LR	-.296	.319	--	--	.850	--
NH	-.891	--	.349	--	--	--
Δ^Q	--	--	--	--	--	.875
Δ^L	--	--	--	--	.934	--
NAW	--	.973	--	--	--	--
PW	--	.977	--	--	--	--
%NP	.470	--	.458	--	-.489	.364
GWE	.796	--	.323	--	-.356	--
Δ^{WE}	--	--	.776	--	--	.457
HE	.802	--	.309	--	-.360	--
Un	--	.280	.838	--	--	-.259
WS	--	.850	--	.297	--	--
%FE	--	-.227	--	-.884	--	--
ENP	.644	--	--	-.565	--	--
IPI	--	-.305	--	-.557	--	.425
Industry			Factor Scores			
ORD	-0.374	-1.242	2.754	0.947	-1.789	0.622
LUM	-1.703	-0.116	-0.042	0.673	-0.620	0.001
FURN	-0.727	-0.535	-1.097	0.867	-0.169	0.033
SC&G	0.069	-0.220	-0.624	0.827	0.330	0.992
PRIM	1.797	0.761	0.022	0.770	0.421	-0.889
FAB	0.300	0.934	-0.491	0.762	0.407	-0.019
MACH	1.067	1.363	-0.808	0.749	-0.053	-0.201
ELEC	0.182	0.688	0.807	-0.273	-0.615	-1.405
TRANS	0.763	1.439	1.361	0.854	0.709	-0.586
INST	0.465	-1.071	-1.068	0.456	-0.606	0.259
MISC	-0.580	-0.669	0.105	0.072	0.464	-0.838
FOOD	-1.150	1.912	0.550	-0.480	0.653	3.021
TOB	-0.124	-1.829	0.642	-0.384	3.205	0.424
TEX	-1.063	0.440	-2.029	-0.544	-0.810	0.058
APP	-1.234	1.155	0.703	-2.066	0.603	-1.601
PAP	0.033	-0.530	0.365	0.103	-0.308	-0.483
PRINT	-0.190	-0.084	0.157	-0.198	-1.204	0.061
CHEM	0.957	-0.066	0.034	-0.432	-0.389	0.828
PETRO	2.023	-0.767	-0.140	-2.844	-0.840	0.859
RUB	0.644	-0.878	-0.647	0.824	0.568	-0.059
LEA	-1.157	-0.686	-0.564	-0.671	0.051	-1.079

TABLE XIX

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR 1959 R-ANALYSIS

Factor	I	II	III	IV	V	VI
Variable			Factor Loadings			
QR	-.953	--	--	--	--	--
LR	-.435	.286	--	--	--	.642
NH	-.950	--	--	--	--	--
ΔQ	-.880	--	--	--	--	--
ΔL	--	--	--	.921	--	--
NAW	--	.934	--	--	--	--
PW	--	.948	--	--	--	--
%NP	.591	--	.379	.549	--	--
GWE	.690	--	.596	--	.332	--
ΔWE	.327	.307	.674	-.431	.289	--
HE	.762	--	.471	--	.309	--
Un	--	--	--	--	-.263	.827
WS	--	.790	.306	-.315	--	--
%FE	--	--	-.881	--	--	--
ENP	--	--	--	--	.864	--
IPI	-.371	-.282	--	--	-.405	-.601
Industry			Factor Scores			
ORD	0.683	-1.839	1.425	1.403	0.066	1.293
LUM	-2.379	-0.370	1.189	0.254	0.989	-0.244
FURN	-1.234	-0.656	0.620	-0.171	0.458	-0.808
SC&G	0.006	0.021	0.679	-0.603	-0.414	-0.459
PRIM	1.142	0.945	1.021	-2.640	0.906	0.629
FAB	-0.285	1.362	0.186	0.051	1.468	-0.081
MACH	0.587	1.292	0.899	-1.058	0.168	-0.475
ELEC	0.359	0.556	0.446	-0.087	-1.284	-0.070
TRANS	0.839	1.158	0.525	1.046	-0.547	1.847
INST	0.141	-0.762	0.410	-0.042	0.441	-1.831
MISC	-1.152	-0.872	-0.148	-0.217	0.918	0.681
FOOD	-0.855	1.665	-0.338	1.336	0.241	1.087
TOB	0.271	-1.641	-1.531	-1.721	-0.653	1.687
TEX	-0.156	0.779	-1.632	0.072	-1.204	-1.720
APP	-1.109	0.880	-1.666	-0.150	-0.629	0.662
PAP	0.321	-0.556	0.246	0.294	-0.910	0.207
PRINT	0.588	0.147	-0.094	1.499	-0.405	-0.184
CHEM	1.068	-0.062	0.312	0.625	-0.662	-1.208
PETRO	1.972	-0.621	-1.765	0.780	2.554	-0.509
RUB	0.127	-0.876	0.520	-0.335	-1.534	-0.564
LEA	-0.937	-0.549	-1.304	-0.334	0.033	0.057

TABLE XX

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR 1966 R-ANALYSIS

Factor	I	II	III	IV	V	VI
Variable			Factor Loadings			
QR	-.799	--	--	--	--	-.332
LR	-.488	--	-.427	--	--	-.520
NH	-.857	--	--	--	--	--
Δ^{Q}	--	--	.800	--	.343	.247
Δ^{L}	--	--	.888	--	--	--
NAW	--	.971	--	--	--	--
PW	--	.979	--	--	--	--
%NP	.753	--	--	--	--	.302
GWE	.938	--	--	--	--	--
ΔWE	.371	--	--	-.820	--	--
HE	.949	--	--	--	--	--
Un	--	--	-.278	.801	--	-.255
WS	--	.865	--	--	.308	--
%FE	--	--	--	--	-.921	--
ENP	.455	.626	.252	--	--	--
IPI	.253	--	--	--	--	.873
Industry			Factor Scores			
ORD	1.331	-1.603	-0.747	1.463	0.243	1.382
LUM	-0.985	-0.611	0.887	0.572	1.253	-1.157
FURN	-1.250	-0.782	0.526	-0.092	0.832	1.204
SC&G	0.223	-0.282	0.087	-0.037	0.804	-0.631
PRIM	1.039	0.956	-0.508	0.521	1.155	-0.761
FAB	-0.104	0.983	-0.100	-1.077	0.754	0.136
MACH	0.608	1.755	-0.235	-1.985	0.236	0.550
ELEC	0.023	1.383	-0.402	0.457	-0.881	1.631
TRANS	0.926	1.395	-0.154	1.231	0.512	-0.531
INST	0.456	-0.974	-0.142	-2.266	-0.313	1.098
MISC	-0.905	-0.726	0.190	0.640	0.052	0.299
FOOD	-0.652	1.290	0.364	0.301	0.142	-1.463
TOB	-0.792	-1.058	-3.189	-0.851	0.391	-1.250
TEX	-1.163	0.096	1.121	-1.128	-0.823	-0.000
APP	-1.393	1.073	-0.904	1.375	-2.387	0.456
PAP	0.487	-0.227	-0.204	0.536	0.516	-0.409
PRINT	0.762	-0.306	-0.010	-0.251	-0.430	-0.132
CHEM	0.847	0.007	1.831	0.264	0.825	0.770
PETRO	2.166	-1.000	0.621	-0.237	-2.368	-1.461
RUB	-0.363	-0.547	-0.283	0.646	0.248	1.340
LEA	-1.261	-0.822	1.252	-0.082	-0.762	-1.070

TABLE XXI

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR 1967 R-ANALYSIS

Factor	I	II	III	IV	V	VI
Variable			Factor Loadings			
QR	-.926	--	--	--	--	--
LR	-.509	--	.535	--	.561	--
NH	-.853	--	--	--	.316	--
Δ^Q	.567	-.299	--	--	.615	--
Δ^L	--	.296	--	--	-.789	-.348
NAW	--	.929	--	--	--	--
PW	--	.928	--	--	--	--
%NP	.799	--	-.269	--	--	--
GWE	.940	--	--	--	--	--
Δ^{WE}	--	--	--	--	--	.833
HE	.942	--	--	--	--	--
Un	--	--	.669	--	--	--
WS	--	.910	--	--	--	--
%FE	--	--	--	-.863	--	--
ENP	--	--	--	.838	--	--
IPI	--	--	-.881	--	--	--
Industry			Factor Scores			
ORD	1.176	-1.198	-0.403	-0.420	0.289	-1.374
LUM	-1.259	0.159	-0.460	2.021	0.591	1.210
FURN	-1.253	-0.422	-0.873	0.008	-1.335	0.707
SC&G	-0.004	-0.120	-0.215	-1.104	0.042	0.049
PRIM	1.022	0.584	1.792	1.420	-1.371	-0.734
FAB	-0.139	1.360	-0.763	0.144	-0.091	-0.508
MACH	0.768	1.727	-1.092	1.446	-0.176	-1.218
ELEC	0.230	1.025	0.635	-1.186	-1.625	-0.254
TRANS	0.811	1.577	0.964	-0.067	0.808	-0.013
INST	0.619	-1.171	-1.427	0.194	-0.198	-0.473
MISC	-1.021	-0.348	-0.315	-0.415	0.392	1.069
FOOD	-0.521	1.592	0.066	-0.300	2.399	0.928
TOB	-0.607	-1.540	1.773	0.251	2.138	-1.804
TEX	-1.152	-0.270	-1.489	-0.062	0.034	-0.925
APP	-1.323	0.462	1.589	-1.102	-0.761	0.405
PAP	0.355	-0.299	0.215	-1.452	-0.276	0.980
PRINT	0.755	-0.511	0.200	-1.157	0.036	0.230
CHEM	1.080	0.008	-1.245	-0.571	0.296	0.168
PETRO	2.064	-1.217	0.448	1.234	0.148	2.386
RUB	-0.283	-0.436	-0.177	-0.301	-0.237	-0.742
LEA	-1.320	-0.960	0.775	1.419	-1.106	-0.088

TABLE XXII

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR T-ANALYSIS OF THE QUIT RATE, 1947-1970

Factor	I	II	III
Variable	Factor Loadings		
47	.298	.719	.540
48	.388	.777	.342
49	.405	.789	.344
50	.329	.853	.275
51	--	.492	.729
52	.265	.443	.827
53	.302	.666	.624
54	.474	.347	.770
55	.469	.473	.692
56	.501	.272	.792
57	.499	--	.818
58	.685	.350	.615
59	.742	.405	.486
60	.745	.279	.589
61	.798	.264	.525
62	.826	.246	.460
63	.833	.255	.455
64	.842	.337	.406
65	.861	.269	.102
66	.854	.330	.357
67	.889	.329	.286
68	.891	.264	.304
69	.887	.273	.265
70	.930	.234	.218
Industry	Factor Scores		
MFG	0.218	0.396	-0.188
DUR	-0.228	0.649	-0.163
ORD	0.496	-0.160	-0.828
LUM	-0.394	-0.358	-0.249
FURN	-0.018	-0.645	0.429
SC&G	0.737	0.103	-0.165
PRIM	1.221	1.131	-0.838
FAB	-0.214	0.656	-0.437
MACH	1.659	-0.214	-0.530
ELEC	0.484	0.952	1.619
TRANS	0.165	-0.605	0.019
INST	-0.366	-1.669	-0.248
MISC	-0.218	-2.158	-1.051
N-DUR	0.998	0.104	-1.246

TABLE XXII (Continued)

Factor	I	II	III
Industry		Factor Scores	
FOOD	1.691	0.033	0.595
TOB	-1.668	2.437	-1.066
TEX	-1.520	0.201	1.293
APP	-0.286	0.166	2.979
PAP	-0.800	-1.584	0.732
CHEM	1.430	0.319	0.960
PETRO	-1.646	0.383	-0.289
RUB	-1.217	-0.955	-0.654
LEA	-0.524	0.817	-0.674

TABLE XXIII

ROTATED FACTOR LOADINGS AND FACTOR SCORES FOR T-ANALYSIS OF THE QUIT RATE, 1950-1970

Factor	I	II	III
Variable		Factor Loadings	
50	--	.846	.449
51	.269	.860	.265
52	.454	.810	.270
53	.360	.827	.296
54	.504	.667	.438
55	.510	.710	.419
56	.631	.591	.442
57	.717	.574	.347
58	.675	.442	.550
59	.583	.461	.626
60	.654	.406	.625
61	.680	.308	.645
62	.588	.321	.722
63	.530	.340	.754
64	.441	.366	.805
65	--	.401	.804
66	.357	.425	.820
67	.363	.359	.851
68	.333	.310	.869
69	.247	.328	.892
70	.328	.233	.889
Industry		Factor Scores	
MFG	-0.082	0.163	0.209
DUR	-0.609	0.649	-0.088
ORD	1.199	-0.807	-0.957
LUM	0.641	1.367	1.521
FURN	-1.334	1.858	1.788
SC&G	-0.576	-0.539	0.613
PRIM	-1.507	0.273	-0.414
FAB	-1.063	0.632	0.560
MACH	-0.545	-0.026	-0.400
ELEC	0.448	-0.002	-0.363
TRANS	-0.929	1.384	-0.810
INST	0.294	-1.300	-0.003
MISC	0.553	0.687	0.784
N-DUR	0.402	-0.289	0.603
FOOD	-0.290	-0.108	1.496
TOB	-0.360	0.109	-0.126
TEX	0.351	-0.905	1.633
APP	2.082	1.101	-0.114
PAP	-0.273	0.012	0.077
CHEM	-0.268	-0.899	-0.597

TABLE XXIII (Continued)

Factor	I	II	III
Industry		Factor Scores	
PETRO	-0.553	-1.750	-0.457
RUB	-1.486	-0.198	1.414
LEA	1.443	-0.135	1.305
AUTO	-1.934	1.604	-1.083
AIR	0.767	0.945	-1.845
SHIP	1.611	2.078	-0.679
RR	-0.621	-0.425	-0.546
R-TV	1.404	0.668	-0.333
T&T	0.905	-0.720	-1.306
CARP	-0.245	-1.915	1.809
PLAST	-0.482	-1.495	-0.681
DRUGS	0.963	-1.530	-0.829
FTWR	1.861	0.088	0.978
CEM	-0.605	0.155	-1.525
TIRE	-0.828	-0.686	-1.221
AGRI	-0.336	-0.045	-0.414

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