PRESENT VALUES OF EXPECTED FUTURE INCOME STREAMS AND THEIR REVELANCE TO MOBILITY OF FARM WORKERS TO THE NONFARM SECTOR IN THE UNITED STATES, 1917-62

Thesis for the Degree of Ph. D.

MICHIGAN STATE UNIVERSITY

Chennareddy Venkareddy

1965

This is to certify that the

thesis entitled

Present Values of Expected Future Income Streams
and Their Revelance to Mobility of Farm Workers
to the Nonfarm Sector in the United States, 1917-62

presented by

Chennareddy Venkareddy

has been accepted towards fulfillment
of the requirements for

Ph.D. **degree in** Agricultural Economics

Glenn Johnson
Major professor

Date November 24, 1965

O-169

ABSTRACT

PRESENT VALUES OF EXPECTED FUTURE INCOME STREAMS AND THEIR RELEVANCE TO MOBILITY OF FARM WORKERS TO THE NONFARM SECTOR IN THE UNITED STATES, 1917-62

by Chennareddy Venkareddy

The major objectives in this study were

1. to estimate the present values of the expected future income stream for a 25 year old and 45 year old worker in the farm sector and in four nonfarm occupations: manufacturing, construction, laundries and retail trade.
2. To formulate a model for estimating the supply function of farm workers.
3. To formulate a model for estimating the mobility of farm operators of different ages from the farm sector to the non-farm sector.
4. To utilize the estimated relationships for projecting age composition of farm operators to 1970.
5. To estimate the number of farm workers in the future.

Among the monetary variables, the ratio of the present value of the expected future income stream of a worker in the non-farm sector to the same in the farm sector was considered to be the basis upon which farm workers decide their

occupational choice. This is a variable which has not been estimated and used in the previous studies.

Since age is one of the main factors related to mobility of farm workers, data were developed on the present values of the expected future income stream for workers, age 25 and 45.

Since unemployment in the nonfarm sector can seriously reduce the expected income stream of a potential off-farm migrant, an adjustment of the annual wage in the nonfarm sector was made for this factor.

Since annual wage data in retail trade and laundries are not available from 1917 to 1938 and from 1917 to 1933 respectively, they were estimated on the basis of the regression line with the annual wage data in the concerned occupation as the dependent variable and the annual wage data in construction as the independent variable.

Expected unemployment rates in individual years up to nine years in the future were estimated so that an average of the estimates is an estimate of the average. On and after the tenth year ahead from the current year, the estimated average in the next nine years was used.

In the case of annual wage estimates a similar procedure was used up to nine years ahead. Beyond the ninth year, and up to $(n_1-1)^{th}$ year (n_1 is the remaining life expectancy of a 45 year old worker) an estimated increment Δ_1 in the annual wage was added to the estimate of the annual wage in the ninth year ahead. From n_1 th year ahead to $(n_2-1)^{th}$ year ahead, an estimated increment Δ_2 in the annual wage was added every year to the estimate of the annual wage in the $(n_1-1)^{th}$ year ahead.

After adjustment of annual wage rates for the unemployment rate, present values of the expected future income stream from each year, 1917 to 1962, were calculated for both the 45 and 25 year old worker in each occupation.

The present values in expected future income stream seems to be consistent with the economic and political events overtime since 1917 to 1962.

The present value of the expected future income stream for a 25 year old worker increased from $19,381 in 1917 to $56,423 in 1962 in farming; from $27,278 in construction; from $13,007 to $57,271 in laundries and, finally, from $17,090 to $78,303 in retail trade. The present value for a 45 year old worker increased from $13,479 in 1917 to $43,709 in 1962 in farming; from $18,516 to $88,705 in manufacturing; from $17,747 to $112,581 in construction; from $8,888 to $44,136 in laundries and, finally, from $12,173 to $59,229 in retail trade.

As a method of testing the validity of the estimates of present values of the expected future income stream, linear and logarithmic regression lines were fitted (one in each age group) with the ratio of the number of farm operators to the number or rural survived farm males, as the dependent variable and the ratio of present value in the appropriate nonfarm occupation to the same in farming, as the independent variable. These regression lines were based on the data in four census years (1930-1960). The tests revealed that the mobility of younger farm operators are respondent to the ratio of present value of expected future wages in manufacturing to the same in farming and in the case of older farm operators, laundries, rather than manufacturing is relevant.

On the basis of the fitted regression lines and the projected present values, the number of farm operators was projected in each age group for 1970.

For the United States, the estimate of total number of farm operators for 1970 in this study is 2.607 million by linear regression method and 2.616 million by the "linear in logarithms" method as compared to the 1960 enumeration of 3.701 million.

On the basis of two different regression lines total number of agricultural workers was projected to 1980. They are 4.93 million and 4.87 million.

Most of previous studies projecting the number of farm operators in different age groups were based either directly or indirectly on the hypothesis that the mobility of farm workers to nonfarm occupations is responsive to the ratio of the current nonfarm wage rate to the current wage rate in farming. This assumption is not entirely correct. Farm workers (or anybody else) in changing occupations can be expected to think in terms of lifetime expected returns and their present values, rather than simply in terms of the current years annual wage. In this study, the mobility of farm workers was assumed to be responsive to the ratio of present value of the expected future income stream in nonfarm occupations to the same in farming.

The projected number of farm operators in each age group for 1970 indicates that the trend of aging farm operators is not going to be reversed. According to the projected number of farm operators for 1970, the number of farm operators will decrease by about 1.15 million the period 1960 to 1970.

PRESENT VALUES OF EXPECTED FUTURE INCOME STREAMS AND THEIR RELEVANCE TO MOBILITY OF FARM WORKERS TO THE NONFARM SECTOR IN THE UNITED STATES, 1917-62

By

Chennareddy Venkareddy

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1965

ACKNOWLEDGMENTS

This study is a part of a larger project concerned with the impact of government policy on resource flows in and out of agriculture. This larger project is being carried on under the auspices of a grant from Resources for the Future, Inc. The project leader is Dr. Glenn L. Johnson.

The author gratefully acknowledges the assistance of the following in making this study possible.

Dr. Glenn L. Johnson suggested the topic and guided at various phases of development of this study. The author is particularly grateful to him for the patience and confidence he displayed throughout the author's graduate program.

Dr. L. V. Manderscheid showed a great deal of patience in laboring through the earlier draft and offered several useful suggestions for improving the presentation of this thesis. His friendly attitude in helping the author throughout the graduate program was highly appreciated.

Dr. Robert L. Gustafson served as a member of the author's guidance committee and also as an alternate major professor during Dr. Johnson's absence from the U.S. His suggestions and advice throughout the author's graduate program are greatly appreciated.

Drs. Kenneth J. Arnold and Paul Straussman served as members of the author's guidance committee.

Dr. Lawrence L. Boger, the chairman of the Department of Agricultural Economics, and Resources for the Future, Inc., provided the financial assistance which made possible the author's graduate study at Michigan State University.

The author thanks all the staff in the computer pool of the Department of Agricultural Economics for their competent help in the computational work.

The author is particularly grateful to Mrs. Anne Ryan for her patience in typing the earlier draft of this thesis.

The author's heartfelt appreciation goes to his wife, Mrs. Sulochana, for the invaluable role she played in helping the author to complete his graduate work at Michigan State University.

The author assumes full responsibility for any errors in this study.

To

My Parents, My Teachers,

and My Wife

TABLE OF CONTENTS

Chapter		Page

Chapter | Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

Introduction

A conspicuous characteristic of American agriculture is the dramatic decline in farm labor input and increase in farm output. The phenomena of declining farm labor input is not new, but it is more pronounced in recent decades. Total farm labor input in the period 1910-1919 averaged 23,343.7 million man hours per year and decreased to 12,888.3 million man hours in the period 1950-1959.

TABLE 1.--Farm employment, United States 1910-19 to 1950-59.

Period	Average No. of Farm Workers		Average Farm Labor Input	
	1000's	Percent (1910-19)	Million hours	Percent (1910-19)
1910-1919	13,523.1	100.00	23,343.7	100.00
1920-1929	13,046.8	96.48	23,255.4	99.62
1930-1939	12,342.6	91.27	21,658.0	92.78
1940-1949	10,382.1	76.77	18,871.0	80.84
1950-1959	8,481.4	62.72	12,888.3	55.21

Source 1 Farm Employment U.S.D.A. Stat. Bul. No. 334.
Source 2 Changes in Farm Production and Efficiency, U.S.D.A. Stat. Bul. No. 233.

Total farm labor input in the period 1950-59 was only 55.21% of the 1910-1919 level. Total farm workers, both hired and family, decreased from 13,523.1 thousands in the period 1910-1919 to 8,481.4 thousands in the period 1950-59. However, the number of farm workers did not decrease in the same proportion as total farm labor. In 1917, labor input was 51.9 per cent of the total input used in agriculture; by 1962, it accounted for only 24.2 per cent.

The supply of and demand for labor input in the farm sector depends on, firstly, the demand for labor in the non-farm economy, secondly, the technology of farm production and, thirdly, the demand for farm products. As the nonfarm sector became more and more industrialized, an enormous increase in demand for labor in the nonfarm sector increased the wage rate in the nonfarm sector. The increased wage for labor in the nonfarm sector in turn induced further out-movement of labor from the farm sector. The increased outmovement of labor from the farm sector to the nonfarm sector caused scarcity of labor in the farm sector. The scarcity of labor in the farm sector in turn created a necessity for labor saving and capital intensive farm technology. The rapid growth in farm technology caused a further decline in the demand for labor because of the increase in the marginal productivity of capital relative to that of labor. Hence, rapid industrialization in the non-farm sector and tremendous advances in labor saving farm technology are two reasons for the decline in the use of the labor input in the farm sector. The third reason is the inelasticity of the final demand for farm products. Because of the feasibility of large scale (but still mainly family operated) farms due to the tremendous advances in labor saving as well as output increasing farm technology, farmers increased their size of operation and produced higher levels of farm output. The tremendous increase in the farm output and the existence of a highly inelastic demand for farm products caused the farm price level to fall. The decrease in prices caused a subsequent further decline in the demand for labor input.

Despite the recent unparallelled decline in farm labor input, farm output continues in excess over what is demanded at "fair prices." The farm surplus problem has continued to be a serious problem for the agricultural policy makers in the American economy. In spite of the various forms of government intervention in the free market for farm products to increase the returns to farm labor, farm labor input continues to earn less than its counterpart in the nonfarm sector after giving allowance for differences between the sectors. The gap in the labor earnings between the sectors indicates the malallocation of labor resource between the sectors.

Under the assumptions of the perfect competition model in the labor market i.e., (1) homogeneity of labor, (2) perfect mobility of labor, (3) large number of buyers and sellers of labor, (4) perfect knowledge of labor market conditions, labor moves out of agriculture in which it earns less until the returns for labor are equal in both sectors. In other words, the price system is the mechanism through which signals are transmitted for allocating production resources. In the absence of friction and transfer costs (acquisition costs in excess of salvage values), maximum efficiency can be attained.[1] But contrary to this situation of perfect competition and frictionless transfers, much evidence reveals that more labor remains in agriculture than needed, despite low returns for labor. That indicates that flows of labor between the sectors are not producing an equalization of wage rates throughout the system. This may occur for reasons mentioned by Gallaway: (1) the existence of nonprice barriers to mobility of workers, (2) the existence of positive private economic costs associated with the movement of labor from sector to sector, (3) nonhomogeniety of labor units involved, (4) a failure of workers to maximize their utility function; and/or (5) difference in workers' preference functions.[2] In addition, Hathaway explains the continuous disequilibrium in terms of the combined elements such as (1) highly inelastic demand for products, (2) a low income elasticity for products,

---

[1]Ralph Arthur Loomis, Occupational Mobility in Rural Michigan, an unpublished Ph. D. thesis. Department of Agricultural Economics, Michigan State University (1964).

[2]Lowell E. Gallaway, "Labor Mobility, Resource Allocation and Structural Unemployment," American Economic Review, Vol. LIII, No. 4 (September, 1963), pp. 694-715.

(3) rapid rate of technological change, (4) competitive structure and (5) a high degree of asset fixity.

Haver[3] believes that factor market imperfections and institutional rigidities tend to misallocate resources, impeding adjustments in agriculture. He also believes that uncertainty causes inefficient production. He further stated that price support and production control programs also have impeded adjustments to achieve optimal resource allocation.

The relative immobility of labor in agriculture with its attendant problems of surplus production and low farm prices and incomes has long been a concern to agricultural economists and rural sociologists. During recent years, a conviction has grown among these researchers that the declining economic position of agriculture is closely associated with an inadequate rate of migration from farming.[4] This judgment is succinctly expressed in Schultz's statement ". . . the hard core of the United States farm problem is a labor transfer problem."[5] The over-commitment of labor

---

[3]Cecil B. Haver, "Institutional Rigidities and Other Imperfections in the Factor Markets," Agricultural Adjustment Problems in a Growing Economy (E. O. Heady, et al., eds.) Iowa State College Press, Ames, Iowa, U.S.A. (1958).

[4]H. W. Baumgartner, "Potential Mobility in Agriculture: Some Reasons of the Existence of a Labor-transfer Problem," Journal of Farm Economics, Vol. 47 (February, 1965), p. 74.

[5]Theodore W. Schultz, "The United States Farm Problem in Relation to the Growth and Development of the United States Economy," Policy for Commercial Agriculture: Its Relation to Economic Growth and Stability, Washington Joint Economic Committee (1957), p. 4.

resource in agriculture can be avoided by impeding the labor resource flow into agriculture and by inducing labor flows from the farm sector. However transfer of farm labor resource to the nonfarm sector is not an easy and quick process. Several studies reveal that quite a few factors other than monetary incentives may influence the out mobility of farm workers. D. Gale Johnson[6] has suggested that a study of farmer mobility should include a reasonable explanation of the important motivating factors both monetary and nonmonetary. Mobility of farm workers to the nonfarm sector is not only subject to monetary influence but also to various other sociological, psychological and institutional factors. In the literature, among the variables which significantly influence the mobility of the farm workers, the important categories are economic status, age, and attitudes toward farming. As the present study does not pay much attention to nonmonetary factors other than age, time, unemployment and occupations, a brief review of literature relating to the effect of such factors on the mobility of farm workers is presented below.

Age, an important independent variable, was considered to be the most effective in influencing the mobility of

---

[6] D. Gale Johnson, "Mobility as a Field of Economic Research," Southern Economic Journal, Vol. XV (October, 1948), p. 152.

farm workers. Bowles[7] writes that migration rates were consistently lower among younger people. Roy[8] found by a chi-square test that both husbands and wives among the high aspirants, were consistently of the younger age groups. In this context aspiration is a measure of a farmer's desire to seek a better paying job and, hence, modifies the monetary pull-factor for farmers to leave agriculture. Heady[9] reports that the number of subjects indicating that "no amount" would move them out of agriculture rose sharply with the increasing age. Baumgartner[10] concludes that under a variety of personal, economic, social, and psychological conditions, age is more closely associated with migration than any other independent variable. Potential mobility was significantly greater among farmers under 45 than among those aged 45 or over. Among all the other variables, nonfarm work

---

[7] Gladys K. Bowles, "Migration Patterns of the Rural-Farm Population, Thirteen Economic Regions of the United States, 1940-50," Rural Sociology, Vol. 22 (March, 1957), p. 3, Chart 1.

[8] Roy Prodipto, "Factors Related to Leaving Farming," Journal of Farm Economics, Vol. 43 (August, 1961).

[9] E. O. Heady, W. B. Back, and G. A. Peterson, Interdependence Between the Farm Business and the Farm Houshold with Implications on Economic Efficiency, Res. Bul. 398, Iowa Ag. Expt. Sta. (1953), p. 421, N. 27.

[10] H. W. Baumgartner, "Potential Mobility in Agriculture: Some Reasons for the Existence of a Labor-Transfer Problem," Journal of Farm Economics, Vol. 47, No. 1 (Feb., 1965), pp. 74-82.

experiences also appeared to be closely associated with mobility. Nonfarm experience was associated positively with potential mobility among farmers irrespective of age.[11]

Some of the monetary factors are (a) present costs of training to fit themselves to nonfarm work, (b) costs of moving to the nonfarm centers, (c) expected returns in the nonfarm sector as compared to the expected returns in the farm sector. Institutional factors are (a) various government programs relating to farm production, (b) wars.

Need For This Study

Any policy study for labor resource transfer for farm adjustments needs knowledge of the ease or difficulty with which reductions in number of farm workers can be achieved. This achievement depends partly, if not mainly, upon the response of the farm workers to the relative monetary incentives in the nonfarm sector and the farm sector. If the response of the mobility of farm workers to relative monetary incentives in the farm and nonfarm sector is low, it is very difficult to make the necessary changes in the policies to induce transfer of labor. Hence, knowledge about the supply function of farm workers in agriculture is of immense need for better understanding of the future farm adjustment.

Agricultural workers include operator, family and hired workers. Previous studies indicated that reductions in farm operators are not easily brought about when farm operators

---

[11]Baumgartner, Op. Cit., p. 82.

are largely older persons who are less likely to shift to other employment. Not only information about the response of supply of total number of farm workers to monetary incentives but also information about the responses of different aged farm operators is needed. Projections of the total number of farm workers and farm operators would be an aid in designing programs to facilitate adjustment.

This study is intended to supply data on monetary incentives influencing the behavior of farm operators in two age groups. The data pertain to the two age groups, 25 and 45 year old operators, and to five occupations: farming, laundries, retail trade, construction and manufacturing.

Previous Studies

Schuh[12] has studied the demand and supply for hired labor. Johnson and Heady[13] have investigated the market for both hired and family labor. Recently, several studies emphasizing cohort analysis for projecting the future number of farm operators were done (Kanel, 1961; Clawson, 1963;

---

[12] G. E. Schuh, "An Econometric Investigation of the Market for Hired Labor in Agriculture," Journal of Farm Economics, 44 (2) (1962), 307-321.

[13] S. S. Johnson, and E. O. Heady, Demand for Labor in Agriculture, C.A.E./Report 13T, Center for Agricultural and Economic Adjustment, Iowa State University, Ames, Iowa (1962).

Tolley and Hjort, 1963; Kanel, 1963, Johnston, 1963). Tolley and Hjort (1963) attempted to measure directly the effect of changing farm numbers on the response of different aged farm operators. The regression model assumes that the number of farm operators in a given age group depends on the number of cohort members a decade earlier and on the ratio of the total number of farmers of all ages to total numbers 10 years previously. The regression is the logarithmic transformation of

$$\left(\frac{f_{it}}{f_{i-1,t-1}}\right) = a_i \left[\frac{\Sigma_i f_{it}}{\Sigma_i f_{i-1,t-1}}\right]^{b_i}$$

where f_{it} is the number of farm operators in the i^{th} age group for t^{th} census year. For each age group there are five observations, ie;t goes from 1 to 5 corresponding to the five censuses of 1920, 1930, 1940, 1950, 1960.

If there were no change in farm operator numbers from census to census, the independent variable would be unity and the parameter a_i would then measure the cohort pattern of net entry and withdrawal without changes in the total number of farm operators overtime. The b_i may be interpreted as the elasticity of farm operators of a given age group with respect to total number of farm operators. For all regions the regression coefficients tend to decline with age. Large b_i values for younger age groups substantiates their greater occupational mobility. For most regions and for the national aggregate, occupational mobility was not found to be significant after age group 45-54. Johnston (1963) has formulated the following supply model for projecting the future number of farm operators by age group.

$$f_{it} = \delta_i Z_t^{\beta_i} S_{it} U_{it}$$

$$\frac{f_{it}}{S_{it}} = \delta_i Z_t^{\beta_i} U_{it}$$

where f_{it} is the number of farm operators classified according to i^{th} age group in t^{th} census period.

S_{it} is the number of survived rural for males who were ten years younger in the preceding census. S_{it} is considered a supply shifter.

Z_t is the ration of farm to nonfarm earnings facing potential farm operators in year t and U_{it} is a random error.

Both farm operator numbers (f_{it}) and survived rural farm male estimates (S_{it}) are readily available. Since a suitable measure of the farm to nonfarm earnings ratio (Z_t's) is not available for the regions, (such a measure is available for the nation). Johnston adopted an iterative procedure to estimate δ_i, β_i, Z_t, simultaneously. The iterative procedure begins with the assumption that the ratio of total farm operator numbers in a given decade to the number of survived rural farm males is a crude approximation of the farm-nonfarm earnings ratio. Using these ratios for each decade as approximations of the Z_t's, the first step of the initital iteration yields a set of δ_i and β_i's. The β_i's are then used in the second step of the first iteration to yield new estimates of Z_t's. The Z_t's are then used to obtain a new set of δ_i's β_i's in the first step of the second iteration and so on until estimators are approximately identical from the K^{th} to the $K+1^{th}$ iterations.

The Objectives of This Study Are

1. To estimate the present values of the expected future income stream for a 25 year old and 45 year old worker in the farm sector and in four different occupations in the nonfarm sector.
2. To formulate a model for estimating the supply function of farm workers.
3. To formulate a model to estimate age-specific relations for farm operators in agriculture.
4. To utilize the estimated relationships for projecting age composition of farm operators to 1970.
5. To project the number of farm workers in the future.

Outline of This Study

To fulfill the above objectives the organization of this thesis is as follows.

Chapter II: Methodology. In this chapter the procedure adopted for estimating the expected annual wage and the expected unemployment rate in various occupations in the remaining years of life of a 45 year old and 25 year old worker is discussed. The method for calculating present values is also given. An explanation of the supply models for farm operators and total farm workers is also given.

Chapter III: Sources and Limitations of Data. In this chapter, sources of all the variables, i.e. annual wage per worker in various occupations, unemployment rate in various occupations, interest rate, expected remaining years of life at a specific age, and their limitations are discussed. If data on the variables were not available during the period 1917 to 1962, methods for projecting the series backwards to 1917 are also discussed. In all cases, the method of projecting the series forward to 2007 is also discussed.

Chapter IV deals with a method of estimating expected unemployment rate in the next nine years from each current year from 1917 to 1962. For the tenth year ahead onwards, the estimated average unemployment rate for the next nine years is used.

Chapter V deals with a method of estimating the expected annual wage in the next nine years. A method to estimate an average increment in annual wage from the ninth year to the 26th year ahead from the current year and an average increment from the 26th year to the 44th year ahead from the current year is also given. The expected annual wage in any year ahead up to nine years and the first and second increment are derived as a function of the current year and the past year observations.

Chapter VI deals with the present values of the expected future income stream in various occupations. It also deals with the supply models for farm operators and farm workers and empirical estimates. Projections of farm operators and the total farm workers are also given in this chapter.

Chapter VII deals with the summary and conclusions of the entire work described in the previous six chapters.

CHAPTER II

METHODOLOGY

Introduction

This chapter first specifies the supply model for farm operators and for total agricultural workers. It also specifies the method for estimating the ratio of the present value of the expected future income stream in a nonfarm occupation to the present value of the expected future income stream in farming.

The Model and An Estimating Procedure

Theoretically, a supply model for any commodity or service is specified with the quantity of the commodity or service under study as a function of price for that commodity or service. To this relationship, one usually adds one or more variables to explain shifts in the supply curve.

The supply model used in this thesis for farm operators specifies the farm operators in a specific age group as the quantity variable. The relevant "price" for farm workers making occupational decisions as to whether or not they should be farmers is assumed as the ratio of the present value of the future income stream in nonfarm occupations to the same in farming. This price is used as an independent variable in the supply model.

The supply shifter in this study is survived rural farm males. This measure takes rural farm males ten years younger in the previous decennial census and adjusts the numbers for deaths and intercensus enumeration errors by use of age-specific survival ratios. The rationale for this choice of shifter variable is that it approximates the number of potential farmers if there were no net migration.

The foregoing discussion leads to the following supply model for farm operators:

$$f_{it} = \alpha_i z_t^{\beta_i} s_{it} u_{it} \tag{1}$$

where f_{it} is the number of farm operators classified according to i^{th} age group and enumerated in the Census of Agriculture for t^{th} time period. S_{it} is the number of survived rural farm males who were ten years younger in the preceding census. Z_t is the ratio of present value in nonfarm occupation to the same in farming, expected by the potential farm operators in the census year t.

Both farm operator numbers (f_{it}'s) and survived rural farm male estimates (s_{it}'s) are readily available for quantification of the relationship expressed in equation (1). Z_t can also be treated as the ratio of opportunity price in the nonfarm sector to the price in the farm sector. U_{it} is a random term.

The supply function for the total number of farm workers is as follows.

$$N_t = f(Z_t, t) \tag{2}$$

where N_t is the total number of farm workers and Z_t is the ratio of the present value of expected future income stream in the nonfarm sector to the same in the farm sector. Though this is a general form, different forms of functions are tried. 't' is the time variable. The present values of the expected future income stream are also fitted as a function of time in different forms.

$$P_t = f(t) \tag{3}$$

Different forms of functions 1, 2, 3 will be discussed with empirical results in Chapter VI. The most important variable to be quantified is the ratio of present values of the expected future income stream in the nonfarm sector to the same in the farm sector. This is a variable not estimated and used in the previous studies. Hence, the method of calculating the present values of the future income stream is discussed in detail in this chapter.

Sources of Off-farm Employment

In the calculation of the present value of the expected future income stream in the nonfarm sector, a question arises as to what kind of jobs farm workers usually take when they move to the nonfarm sector.

Perkins found that four industries employed over three-fourths of all the farm workers who transferred to nonfarm employment. The four industries were construction, manufacturing, wholesale and retail trade, and government. Manufacturing was most important in 1957 and only slightly less important in 1958 than wholesale and retail trade.[1] A survey in 1957 of State Employment Service managers in Kansas by Schnittker and Owens reports similar types of jobs most commonly available to farmers. Managers listed jobs in order of importance as (1) construction labor, (2) machine shop and mechanical work, (3) factory work, (4) retail trade employment, and (5) wholesale trade employment.[2] Other jobs available to farm workers included: truck driving, service station attendant, custodial work, farm equipment sales, oil field work, feed milling and mixing and heavy equipment operator.

A survey of the literature indicates that the nonfarm occupations which the majority of farm workers have been taking are (1) building trades (helpers and laborers), (2) manufacturing, (3) service industries (laundries), (4) trade (retail). The sub-occupations (1) helpers and laborers in building trades, (2) laundries in service industries,

---

[1]Brian B. Perkins, The Mobility of Labor Between the Farm and Nonfarm Sector, (an unpublished Ph. D. thesis, Department of Agricultural Economics, Michigan State University, 1964).

[2]John A. Schnittker and Gerald P. Owens, Farm to City Migration: Perspective and Problems, Ag. Ec. Report No. 84, Kansas Ag. Exp. Sta. (1959), p. 28.

(3) retail trade under 'trade' are chosen in the light of availability of wage rate data for a longer period. Since age is one of the main factors which affects the mobility of farm workers, data on the present values of the expected future income stream in relation to the age of the farm workers are also constructed.

Age Classification

All workers were classified into two categories. The first category consists of all the workers belonging to the age group 15-40 with a range of 25 years. The second category consists of all workers of age 40 and above. The first category indicates a group of younger farmers and the second category represents a group of older farmers. Among the ages in each group, two typical ages were selected, 25 in the first category and 45 in the second category.

Expected Remaining Number of Years of Life of a Worker

The expected remaining years of life of a worker of a specific age increased gradually though not dramatically from 1917 to 1962. The remaining expected number of years of life of a 25 year old worker in the United States in the year 1917 was 41. It steadily increased to 46 years in the year 1962. The remaining expected number of years of life of a 45 year old worker in the United States only increased from 25 in the year 1917 to 27 in the year 1962. It is assumed in this study that workers continue to earn until their death. Briefly speaking, workers retire through death. The source and the limitations of these data and assumptions will be discussed in detail in Chapter III (p. 45 to 73).

Rate of Interest

One of the variables included in the calculation of the present value of the expected future income stream is the current rate of interest. A crucial part of the calculation of present value is the decision as to what rate of interest is to be selected among various rates of interest, charged by different agencies for various transactions. A near ideal concept of rate of interest, for our purpose, would be a weighted average of the contract interest rates on currently negotiated mortgage loans. However, in the light of paucity of the desired data over a long period of time, deviation from the ideal concept is justified. The sources and procedure for construction of interest rate series overtime are given in Chapter III.

Type of Wage Rate

An important aspect of the calculation of the expected income stream is the formulation of expectations of an annual wage in the remaining years of life of a worker. A 25 year old worker in the year 't' can expect up to n_2 (n_2 ranges from 41 to 46) remaining years of life. A 45 year old worker can formulate expectations of earnings for up to n_1 (n_1 ranges from 25 to 27) remaining years of life. In this study, it was assumed that both workers of age 25 and 45 in the year 't' have the same expectation of the future income stream for a given occupation up to n_1 years ($n_1<n_2$). In other words, the assumption in this study is that the differences between the capacities, skills and training of a 25 year old and a 45 year old worker are not significant enough to effect any difference in their expectations of future income stream up to n_1 years. This assumption was also made in the case of expectations of unemployment rate. These assumptions were made in view of the difficulties in getting better data.

In the farm sector, the earnings of farm operators and family members are different from the earnings of hired farm workers. For the purpose of comparison of earnings, workers in the farm sector as well as in the nonfarm sector, should be of the same type. Total earnings per worker in the case of farm operators and other family workers are due not only to their labor effort but also to their supervision and decision-making power, capital investment, risk and uncertainty and, lastly, to the quality of the other co-operating inputs. Though various methods are available for separating the returns for labor, none of them is very satisfactory. Therefore, the hired farm annual wage rate per worker in the farm sector was used in comparison with the annual wage rate per worker in the nonfarm occupations. The actual method of calculation, source and the limitations of this data are given in Chapter III.

The supply function depends upon relative present values. Therefore differences between ages is of little effect if the difference affects all occupations.

Definition of Price of Farm Worker

The price to the farm sector of a farm worker from the farm sector is defined as the present value of the expected future income stream in the farm sector in the remaining years of his life. In calculating the expected future income stream, it was assumed that the farm worker is fully employed throughout the year at the expected annual wage in any year ahead. The opportunity price of a farm worker is defined as the present value of his expected future earnings in the nonfarm sector if he would enter for his remaining years of life. The expected income stream of a farm worker in the nonfarm sector is made up of two components, namely (1) expected apparent income stream of an employed worker in particular occupation (2) unemployment rate in that occupation in the nonfarm sector. Sjaastad[3] writes that

---

[3]Larry Sjaastad, "Occupational Structure and Migration Patterns," Labor Mobility and Population in Agriculture, Iowa State University Press, Ames (1961), p. 12.

> High levels of unemployment in the nonfarm sector can seriously reduce the immediate income gain, the potential off-farm migrant can seriously expect. The aggregate unemployment rates are intended as proxies for the unemployment levels prevailing in the occupations which off-farm migrants move into large numbers. The latter 'effective' rates would be more relevant but cannot be constructed for a sufficiently long period.

Therefore, apparent expected wage rates in the nonfarm sector have to be adjusted for unemployment rates in the concerned occupation to obtain the expected earnings. In other words, the apparent expected earnings will have to be multiplied by the probability of not being laid off in that occupation. The probability of not being laid off in that occupation in the nonfarm sector is roughly approximated by the formula $(1-\frac{u}{100})$ where u is the percentage of unemployment in that nonfarm occupation.

Construction of Annual Wage From 1917 to 2007

Introduction

A preliminary objective of this study is to construct a series of present values of expected future income stream of 25 and 45 year old workers in the farm sector and in selected nonfarm occupations, 1917 to 1962. The nonfarm occupations are manufacturing, construction, laundries and retail trade. This objective can be achieved only when the estimates of an actual annual wage in each occupation are available from 1917 to 1962. Data on expected annual wages from 1963 to 2007 are also required for supplying more degrees of freedom in fitting the regression equations for estimating the expected average annual wage in the longer period, i.e. up to 45 years in the future. For example, in order to estimate the present value of the expected future income stream for a 25 year old worker in an occupation in the year 1962, we need to have the expected annual wage in the 45 years starting with 1963. For estimating the expected annual wage in the next 45 years, we need to estimate regressions with the average annual wage in the next, say, 45 years as the dependent variable. If we do have data only for 1917 to 1962, the number of observations for use in estimating the average annual wage in the next 45 years is only 1. Hence, it was decided to construct estimates of annual wages from 1963 to 2007 to increase the degrees of freedom for use in fitting regression line for estimating the average for larger number of years in the future.

The annual wage per worker in manufacturing, the building trades (laborers and helpers) and in the farm sector are readily available from 1917 to 1962. But in the case of laundries and retail trade, it is not available from 1917 to 1938 and from 1917 to 1933 respectively. Hence, as a first phase, it was decided that the data on annual wage per worker in laundries, retail trade back to 1917 had to be estimated.

Backward Projection of Annual Wage in Laundries and in Retail Trade

Two graphs drawn (1) with the annual wage of a worker in retail trade on vertical axis and the annual wage in building trades (helper and laborer) on the horizontal axis, and (2) with the annual wage of a worker in retail trade on vertical axis and the annual wage in building trades (helpers and laborers) on the horizontal axis, clearly indicated that both the annual wage in laundries and in retail trade are highly and linearly correlated with the annual wage in building trades (helpers and laborers) overtime. Hence, it was reasonable to fit linear regression equations with the annual wage in retail trade and in laundries as dependent variables and the annual wage in building trades (helpers and laborers) as the independent variable and then project the annual wage in retail trade and in laundries back to 1917.

Due to probable differences in the strength of the trade unions, the impact of the second world war and tremendous growth in technology, the relationships among annual earnings of a worker in retail trade, in laundries, and in building trades are quite different in the post World War II period than before. Hence, it is safer to fit relationships for the data in the period which is closer to the period for which we want to construct data. Since we want to construct data for the years in the period 1917 to 1938 for retail trade and from 1917 to 1933 for building trades and since the period before the post World War II period is closer to the period mentioned above, the period before the post World War II was used for fitting relationships. A linear regression of the form $y = a + bx + \varepsilon$ was fitted with y as the annual wage in retail trade and x as the annual wage in building trades for the period 1939-51 and secondly, with y as the annual wage in laundries and x as the annual wage in building trades for the period 1934-47.

Forward Projection of Annual Wage Rates in All the Occupations

The second phase in this study required generating data on the annual wage rate per worker in all the occupations considered from 1963 onwards to the year 2007. For this purpose, the most reasonable technique we could think of was fitting a linear regression line with the annual wage rate per worker as the dependent variable and time as the independent variable for the data in the period 1950-62. The reason for the selection of this method and the time period is that it is very clear from graphs drawn with the annual wage per worker on the Y axis and the time variable on the X axis, that the annual wage rate per worker in all the occupations has steeply increased from 1950 to 1962 and is highly correlated linearly with the time variable. After fitting a linear regression line of the form $Y = \beta_0 + \beta_1 t + \varepsilon$ to the annual wage per worker in all the occupations, the annual wage rate per worker in each occupation was projected to 2007.

Construction of Unemployment Rates in the Nonfarm Occupations from 1917 to 1962

The third phase required construction of data on unemployment rate in each occupation. Published unemployment rates in the concerned occupations are available only for the period 1948 to 1962. Since data on unemployment rate were required for each occupation from the year 1917 to 1962, a method had to be found for estimating the unemployment rate in each occupation from 1917 to 1947. The general unemployment rate, defined as the percentage of unemployed to the civilian labor force in the whole economy is available from 1917 to 1962. But the unemployment rate in the nonfarm sector is not available because it is very difficult to classify labor force by nonfarm and farm sector. However, Stanley Leborgott, in the appendix of his book "Manpower and Economic Growth" has given the series on unemployment rate as defined by the percentage of unemployed to nonfarm employees. This series is available from 1917 to 1960. It was decided to use this series instead of the general unemployment rate as a basis for projecting unemployment rates backwards in each nonfarm occupation.

From the graphs drawn with the unemployment rate in each nonfarm occupation on the Y axis and unemployment rate given by Leborgott on the X axis for the period 1948-1960, it is very clear that the unemployment rate in each nonfarm occupation is highly linearly correlated with the unemployment as a percentage of nonfarm employees. Therefore, it was decided that a linear regression line should be fitted and backward projections of the unemployment rate to 1917 in each nonfarm occupation should be made.

Expectation Models

It is not known how farm workers (or anyone else, for that matter) formulate expectations. Furthermore, expectations are probably not single valued but tend to have a distribution. In this case, an estimate of the central tendency and the variance would be desired.

The importance of price expectations as a variable in business planning was well established even by the earlier writings of Marshall,[4] Keynes,[5] and Hicks[6] in the area of dynamic economics.

The present study deals with the role that farmer's expectations of future wages in farming and in the nonfarm occupations plays in shaping their decisions as to move out

---

[4]Alfred Marshall, Principles of Economics (8th ed., London: Macmillan Co., 1949), p. 311.

[5]J. M. Keynes, The General Theory of Employment, Interest and Money (London: Macmillan Co., 1936).

[6]J. A. Hicks, Value and Capital (2nd ed., Oxford: Clarendon Press, 1946), p. 119.

of farming or not. Bishop[7] writes that farm workers will be inclined to transfer to nonagricultural employment if they find the present value of the expected future income stream in the nonagricultural employment exceeds the same in farming more than the costs of transferring to nonagricultural employment. Estimation of the present values of the expected future income stream is based partly on the estimation of expected future income stream. In the context of estimation of expected future income stream, annual wage expectations and unemployment rate expectations are to be discussed in this section.

If more specific information is not available it seems reasonable to assume that the wages or unemployment rate expected to prevail at some future date depends in some way on what wages or unemployment rate have been in the past. Nerlove[8] writes as "Price expectations are, of course, shaped by multitude of influences so that representation of expected price as a function of past price may merely be a convenient way to summarize the effects of these many and diverse influences." Phillip Cagan[9] developed a weighting pattern to

---

[7]C. E. Bishop, Geographic and Occupational Mobility of Rural Manpower, Preliminary 14/03 (1964), O.E.C.D., Paris.

[8]Marc Nerlove, "Estimates of Elasticities of Supply of Selected Agricultural Commodities," Journal of Farm Economics, Vol. 38 (1956).

[9]Phillip Cagan, The Monetary Dynamics of Hyperinflations, studies in the quantity theory of money, ed. Milton Friedman (Chicago: University of Chicago Press, 1956).

estimate rates of change of prices during hyperinflations from the time series of past rates of change. The model that led to this weighting pattern was used by Friedman in studying consumption functions, to estimate permanent income from the incomes of prior years. The weighting pattern gives most weight to income of immediate past period and successively declining weights to the earlier incomes.

Nerlove[10] derived a set of weights for past years prices on the basis of an hypothesis that each year farmers revise the price they expect to prevail in the coming year in proportion to the error they made in predicting price this period. Let us denote the price expected this year by P_t^*, the price expected last year by P_{t-1}^*, the actual price last year by P_{t-1}. Let the proportion of error by which farmers revise their expectations be a constant β which lies between 0 and 1. The hypothesis just stated can be expressed mathematically as follows.

$$P_t^* - P_{t-1}^* = \beta[P_{t-1} - P_{t-1}^*], \quad 0 < \beta \leq 1$$

It can be shown that the hypothesis that farmers revise the price they expect in proportion to the error they have made in prediction is equivalent to one in which expected price is represented as a weighted moving average of past prices where the weights are function of solely of the coefficient of expectation. The above equation can be written as

$$P_t^* = \beta\ P_{t-1} + \beta(1-\beta)\ P_{t-2} + \beta(1-\beta)^2 P_{t-3} + \ldots$$

---

[10]<u>Ibid</u>.

since $\beta < 1$ the weights attached to prices prevailed in the recent past years are higher than to the prices in the less recent years. The coefficient of expectation is constant from year to year because of unchanged behavior of farmers in predicting the future prices.

Johnson[11] is critical of Nerlove's hypothesis on the behavior of farmers in anticipating prices. Johnson writes that wars, price support activities, inflations, economic collapse, changing foreign demand, strikes and institutional adjustments were all important in the 1909-32 period studied by Nerlove.

The objective of estimating the expected wage series and unemployment rate series in this study is to approximate the wages and unemployment rates which farm workers did in fact expect rather than to formulate a model which they should have used. Nerlove and other investigators provided evidence that the present and the past are relied upon in planning for the future. The hypothesis in this study is similar to Nerlove's hypothesis and is that farm workers with an imperfect knowledge about the future use a set of constant weights for current and past years observations in predicting the future observations. The immediate questions about this hypothesis are (1) how to determine these weights,

---

[11]Glenn L. Johnson, Review of The Dynamics of Supply, by Marc Nerlove, Agricultural Economics Research, Vol. 12 (Jan., 1960), p. 26.

(2) how many past years should be taken for estimating the future observations. Friedman[12] writes

> One alternative is to construct a weighted average of a longer series of years, allowing both the weights and the number of years to be determined by the data; the weights by multiple correlation, the number of years by adding years until an additional year produces no significant increase in the correlation.

This form of the distributed lag model provides a very general form of the relationship between the expected wage or unemployment rate and past years actual wages or unemployment rates. If the estimation of the coefficients in the general form of distributed lag model is not a major concern but the concern is with obtaining estimates of expected wage or unemployment rate, a general distributed lag model may provide adequate estimates of expected wage or unemployment rate.

The statistical models considered in this study will be fully discussed in the following section. The basic idea implied in the models considered in this study is that farm workers have a set of constant weights attached to the current and the past year's observations to predict each average of observations in the next n (n=1,2,3. . .) years in the future. Let X_n^A be the average of actual observed figures in the next n years ahead. The hypothesis in terms of a model is $X_n^E = \partial_o^n + \beta_o^n X_t + \beta_1^n X_{t-1} + \beta_2^n X_{t-2} + \ldots$

---

[12]Milton Friedman, A Theory of Consumption Function, National Bureau of Economic Research, Number 62, Princeton University Press (1957), p. 142.

where $X_n^E = \frac{1}{n} \sum_{i=1}^{n} X_{t+i}^E$

and X_{t+i}^E is the expected figure in the i^{th} year ahead in the future, n in the right hand side of the equation is a superscript but not a Power. Statistically, it is difficult to estimate the coefficients in the model since the left hand side quantities are unobservable. Hence it is further assumed that, on the basis of current and past observations, farm workers conclude on the average that

$$X_n^A = \partial_o^n + \beta_o^n X_t + \beta_1^n X_{t-1} + \beta_2^n X_{t-2} + \ldots$$

where $$X_n^A = \frac{1}{n} \sum_{i=1}^{n} X_{t+i}^A$$

and X_{t+i}^A is the actual observation in the i^{th} year ahead in the future. On the basis of the above assumption, the left hand side quantities are observable. However, we do not know what these coefficients are. Ideally, we should probably estimate the coefficients using only those observations (current and past) already available to the farmers at the time they formulate each specific expectation. However, we do not have data going back far enough in time to permit doing this for the entire period. Hence, we have to introduce still another assumption that the coefficients are sufficiently stable overtime (both past and future at any given point in time) to permit using both past and future observations in estimating them. On the basis of the above mentioned assumptions, an ordinary least squares fit over the time period 1917-1962 (except in two cases) with the actual future average of observations as the dependent variable was used to estimate the coefficients attached to the current and past observations used in predicting the future average of observations. The weights attached to the current and past year observation for estimating X_{t-j} (for a given j), an observation in the jth years ahead in the future, are derived on the basis of an hypothesis that the estimates of X_{t+i} (i=1,2. . . j) up to j years ahead in the future, are consistent with the estimate of the average of all X_{t+i} (i =1,2. . . j) in the next j years ahead. The weights attached to the current and past years observations in estimating X_{t+j} (for a given j) are constant for all t throughout the time period considered. However, the weights are different for each j. Explanation of further particulars of the statistical models will be discussed in the following section.

Expectations of Unemployment Rate and Annual Wage

The last but one phase of this study is the formulation of the method of estimating unemployment rates and annual wage expectations held by farmers. It was assumed that farmers form their expectations of annual wage as well as unemployment rates in each occupation in the future years on the basis of the observations for the current year and for recent past years. More specifically, it was assumed in this study that their estimates for the future are a linear function of current and past observations. In other words, the expected annual wage per worker in an occupation for the next year is estimated from the following equation.

$$W_{t+1} = \partial_o + \beta_o W_t + \beta_1 W_{t-1} + \beta_2 W_{t-2} \cdot \cdot \cdot \beta_k W_{t-k} + \varepsilon^W_{t+1}$$

where W_t is the annual wage per worker in the current year in an occupation

W_{t+1} is the annual wage per worker in the next year

W_{t-k} is the annual wage per worker in k years lagged (k=0,1. . .)

ε^W_{t+1} is the random error

Similarly

$$U_{t+1} = \Pi_o + \gamma_o U_{t-1} \cdot \cdot \cdot + \gamma_k U_{t-k} + \varepsilon^u_{t+1}$$

where U_{t+1} is the unemployment rate in the next year in an occupation

U_t is the unemployment rate in the current year in that specified occupation

U_{t-k} is the unemployment rate in the same specified occupation k years lagged

ε^U_{t+1} is the random error

The general models used in estimating both the annual wage and unemployment rate in the future are discussed below.

$$\begin{aligned}
X_1 &= \delta^1_o + \beta^1_o X_t + \beta^1_1 X_{t-1}, \ . \ . \ . + \beta^1_k X_{t-k} + \varepsilon^1 \\
X_2 &= \delta^1_o + \beta^2_o X_t + \beta^2_1 X_{t-1}, \ . \ . \ . + \beta^2_k X_{t-k} + \varepsilon^2 \\
&\vdots \\
X_n &= \delta^n_o + \beta^n_o X_t + \beta^n_1 X_{t-1}, \ . \ . \ . + \beta^n_k X_{t-k} + \varepsilon^n
\end{aligned}$$

where $X_{t+\ell}$ applies to both $W_{t+\ell}$ and $U_{t+\ell}$

$W_{t+\ell}$ is the annual wage in the ℓ^{th} year ahead

$U_{t+\ell}$ is the unemployment rate in the ℓ^{th} year ahead

ℓ ranges from o to k

δ_o^j is the constant term in the j^{th} regression equation

β^j_m is the regression coefficient of X_{t-m} in the j^{th} regression equation $(m = 0,1,2. . .k)$

$$X_j = \frac{1}{j}\sum_{i=1}^{j} X_{t+i} \qquad j = 1,2. . .n$$

X_j is the average of the observations (W or U) in the next j years

From the first equation, the expected figure for the next year is estimated. From the second equation, the average figure in the next two years is estimated. Similarly, from the jth equation (j=1,2. . .n) the expected average in the next j years is estimated. The number n represents the equation such that from $(n+1)^{th}$ equation onwards, $\bar{R}^2$ is very low.

The estimate of the expected figure in any jth year ahead is derived from the estimate of the expected average figure in the next j years as well as the estimates of the expected figures in all the individual years up to $(j-1)^{th}$ year in the future. In other words, $\hat{X}_{t+j}$ is derived from the following formula.

$$\hat{X}_{t+j} = j\hat{X}_j - \sum_{s=1}^{j-1}\hat{X}_{t+s} \qquad j = 1,2, . . .$$

The above formula can also be expressed as a recurring formula as follows.

$$\hat{X}_{t+j} = j\hat{X}_j - (j-1)\ \hat{X}_{j-1}$$

The assumption in the above formula is that the estimate of the average figure in the next j years is the average of the estimates of the figures in individual years up to jth year in the future. Because of the unbiasedness of the estimates this assumption is not unreasonable for the purpose in this study. This procedure for estimating the expected figures for the individual years in the future was adopted because the expected figures for the individual years in the future should be consistent with the expected average figures in the future.

In the case of unemployment rates, n was determined as 9 in all the occupations considered. The number 9 was determined on the basis of $\bar{R}^2$. The percentage of variation in the dependent variable explained by the independent variables is lower than 18 beyond the ninth equation. But in the case of annual wage per worker, even beyond ninth regression equation, $\bar{R}^2$ is greater than 0.80 in all the occupations considered. However, for the sake of uniformity, the procedure adopted in the case of unemployment rate was used in the case of estimating annual wage up to ninth year. For unemployment rates beyond the ninth year i.e. from the tenth year ahead to the (n_2-1)th year ahead, the estimate of the expected average in the next nine years was used.

The same procedure was carried through all the years in the period 1917-61.

For 1962, the estimate of the expected unemployment rate beyond the ninth year to the (n_2-1)th year ahead is the average unemployment rate for the past fifteen years. This completes the explanation of estimating the expectations of unemployment rate up to n_2th year ahead for all the years 1917 to 1962.

The procedure adopted in estimating the expected annual wage from the ninth year ahead in all the occupations considered is yet to be explained.

Unlike unemployment rates, there is a trend factor in the annual wage rate series. Hence, a different method (making use of the trend factor in the annual wage rate) was used. Two years (26 and 44), were selected for estimating the future long-run averages. These two numbers were selected on the basis of the expected remaining years of life of a 45 year and a 25 year old worker (i.e. n_1 and n_2) being approximately 26 and 44 during the 1917 to 1962 period. The method was designed essentially to estimate the average increments in the annual wage from the ninth to the 26th year and from the 27th to the 44th year ahead. These two increments Δ_1 and Δ_2 were used to estimate the expected annual wage per worker from the tenth year to the (n_1-1)th year ahead and from the n_1th year to the (n_2-1)th year ahead. The procedure adopted to estimate these two increments for each year in the period 1917-1962 is as follows.

First, a regression of the following form was fitted to the data for the period 1917 to 2007.

$$W_{26} = \alpha_o^{26} + \beta_o^{26}\, W_t + \beta_1^{26}\, W_{t-1}, \;.\;.\;.\; + \beta_k^{26}\, W_{t-k} + \varepsilon^{26}$$

where W_{26} is the average annual wage in the next 26 years. The estimating regression is

$$\hat{W}_{26} = \hat{\alpha}_o^{26} + \hat{\beta}_o^{26} W_t + \hat{\beta}_1^{26} W_{t-1}, \;.\;.\;.\; + \hat{\beta}_k^{26} W_{t-k}$$

The number 26 in the coefficients is only a superscript, not a power. We already have an estimate of average annual wage in the next nine years.

$$\hat{W}_9 = \hat{\alpha}_o^{9} + \hat{\beta}_o^{9} W_t + \hat{\beta}_1^{9} W_{t-1}, \;.\;.\;.\; + \beta_k^{9} W_{t-k}$$

From these two equations we get an estimate of the average of the expected annual wage during the period from the tenth to the 26th (including 26th) year in the future. Let us denote this by $\hat{W}_{26-9}$.

$$\hat{W}_{26-9} = \frac{1}{17}[26\; \hat{W}_{26} - 9\; \hat{W}_9]$$

$$\hat{W}_{26-9} = \hat{\alpha}_o^{\overline{26-9}} + \hat{\beta}_o^{\overline{26-9}} W_t + \hat{\beta}_1^{\overline{26-9}} W_{t-1}, \;.\;.\;.\; + \beta_k^{\overline{26-9}} W_{t-k}$$

$\overline{26-9}$ in the coefficient is a superscript to denote the regression equation fitted to estimate an average annual wage from the tenth to the 26th year ahead. In other words, the estimate of the expected average annual wage from the tenth to the 26th year ahead is expressed as a function of the current and the past annual wages. Since we assumed a trend factor in the annual wage per worker, the difference between the estimate of the expected average annual wage from the 10th to the 26th year ahead and the estimate of the expected annual wage in the ninth year ahead is 8 1/2 times the average increment in the annual wage from the tenth year to the 26th year ahead. The reason for this is that the estimate of the average of the expected values for the years between the ninth to the 26th year ahead, lies in the middle of the period of 17 years. Therefore, the estimate of the average increment per year is $\hat{\Delta}_1$.

$$\hat{\Delta}_1 = \frac{2}{17} [\hat{W}_{26-9} - \hat{W}_{t+9}]$$
$$= \hat{\delta}_{o\Delta 1} + \hat{\beta}_{o\Delta 1} W_t + \hat{\beta}_{1\Delta 1} W_{t-1} \; . \; . \; . + \hat{\beta}_{k\Delta 1} W_{t-k}$$

where $\hat{\delta}_{o\Delta 1}$ is constant and $\hat{\beta}_{m\Delta 1}$ is the regression coefficient of the independent variable W_{t-m} $(m=0,1,2. \; . \; .k)$. Δ_1 is a function of the current year as well as the past year annual wage. $\hat{\Delta}_1$ is added, in each year, to $\hat{W}_{t+9}$ to estimate the expected annual wage per worker from the ninth year ahead to generate a series of estimates of the expected annual wage per worker to the (n_1-1)th year ahead. There remains the task of estimating the expected annual wage stream beyond the (n_1-1)th year up to the (n_2-1)th year ahead.

In the first place, an estimate of the average expected annual wage for 44 years ahead is derived from the following equation which was fitted to the data 1917 to 2007.

$$\hat{W}_{44} = \hat{\partial}_o^{44} + \hat{\beta}_o^{44} W_t + \hat{\beta}_1^{44} W_{t-1}, \; . \; . \; . + \hat{\beta}_k^{44} W_{t-k}$$

W_{44} is the average annual wage in the next 44 years. From this estimate and an estimate of an average expected annual wage in the next 26 years (W_{26}), an estimate of the average expected annual wage for the period beyond 26th year up to 44th year (44th year inclusive) is derived as follows. Let us denote this by W_{44-26}

$$\hat{W}_{44-26} = \frac{1}{18} [44 \hat{W}_{44} - 26 \hat{W}_{26}]$$

$$\hat{W}_{44-26} = \hat{\partial}_0^{\overline{44-26}} + \hat{\beta}_0^{\overline{44-26}} W_t + \hat{\beta}_1^{\overline{44-26}} W_{t-1}, \ . \ . \ . + \hat{\beta}_k^{\overline{44-26}} W_{t-k}$$

where $\overline{44-26}$ is a superscript. If there is a trend with an average increment of $\hat{\Delta}_2$, then $\hat{W}_{44-26}$ being an average, does represent a point in the middle of the period of 18 years duration. Hence, if we subtract $\hat{W}_{t+26}$ the estimate of the expected annual wage for the 26th year ahead from $\hat{W}_{44-26}$, we will get the difference as $9\hat{\Delta}_{2W}$, nine times the average increment in that period i.e. from the 26th to the 44th year ahead. But $\hat{W}_{t+26}$ is not directly available as a function of the current as well as the past annual wage. $\hat{W}_{t+26}$ is derived as follows.

$$\hat{W}_{t+26} = \hat{W}_{t+9} + 17\hat{\Delta}_1$$

$$\hat{\Delta}_2 = \frac{1}{9}[\hat{W}_{44-26} - \hat{W}_{t+26}]$$

$$= \frac{1}{9}[\hat{W}_{44-26} - \hat{W}_{t+9} - 17\hat{\Delta}_1]$$

$$= \hat{\delta}_{o\Delta 2} + \hat{\beta}_{o\Delta 2} W_t, \ . \ . \ . + \hat{\beta}_{k\Delta 2} W_{t-k}$$

where $\hat{\delta}_{o\Delta 2}$ is constant

$\hat{\beta}_{m\Delta 2}$ is the regression coefficient of W_{t-m} (m =o,1,2, . . .k)

$\hat{\Delta}_2$ is a function of the current year as well as the past year annual wage per worker. $\hat{\Delta}_2$ is added on to the estimate of the expected annual wage in the nth year ahead, each year, to generate a series of estimates of the expected annual wage up to the (n_2-1)th year ahead.

Present Values

Now we have two series of estimates of the expectations, i.e., one on annual wage per worker denoted by $\hat{W}_{t+k}$ and another on the unemployment rate in an occupation denoted by $\hat{U}_{t+k}$. (k ranges from 0 to (n_2-1) for each year in the period 1917 to 1962.) For each year in the period 1917 to 1962, we can calculate the value of a farm worker in the nonfarm sector as well as value of a worker in farming as follows. The value of a worker of a given age from an occupation in the nonfarm sector is as follows.

$$_{45}P_{ti} = \sum_{k=0}^{(n_{1t}-1)} \frac{\hat{W}_{(t+k)i}\left[1-\frac{\hat{U}_{(t+k)i}}{100}\right]}{\left[1+\frac{\gamma_t}{100}\right]^k}$$

$$_{25}P_{ti} = \sum_{k=0}^{(n_{2t}-1)} \frac{\hat{W}_{(t+k)i}\left[1-\frac{\hat{U}_{(t+k)i}}{100}\right]}{\left[1+\frac{\gamma_t}{100}\right]^k}$$

Where ${}_{45}P_{ti}$ is the present value of the expected future income stream in the ith occupation for a 45 year old worker in the remaining years of his life in the year 't'. ${}_{25}P_{ti}$ is the present value of the expected future income stream in the occupation i for a 25 year old worker in the remaining years of his life in the year 't'. $\hat{W}_{(t+k)i}$ is the estimate of the expected annual wage in the kth year ahead from the current year 't', in the ith occupation. $\hat{U}_{(t+k)i}$ is the estimate of the expected unemployment rate in kth year ahead from the current year 't' in the ith occupation. γ_t is the rate of interest in the year 't'.

n_{1t} is the expected number of years of remaining life of a 45 year old worker in the year 't'. n_{2t} is the expected number of years of remaining life of a 25 year old worker in the year 't'.

The value of a farm worker in farming is calculated as follows:

$$ {}_{45}P_{tf} = \sum_{k=0}^{(n_{it}-1)} \left[\frac{\hat{W}_{(t+k)f}}{\left(1 + \frac{\gamma_t}{100}\right)^k} \right] $$

$$ {}_{25}P_{tf} = \sum_{k=0}^{(n_{2t}-1)} \left[\frac{W_{(t+k)f}}{\left(1+\frac{\gamma_t}{100}\right)^k} \right] $$

Where $_{45}P_{tf}$ is the present value of the expected future income stream for a 45 year old worker in the year 't' in farming during the remaining years of his life.

$_{25}P_{tf}$ is the present value of the expected future income stream for a 25 year old worker in the year 't' in farming during the remaining expected number of years of his life.

$\hat{W}_{(t+k)f}$ is the estimate of the expected annual wage in the kth year ahead from the current year 't' in farming.

CHAPTER III

SOURCES AND LIMITATIONS OF THE DATA

Introduction

The data for this study are largely taken from published sources. But some of the series, which are not available throughout the period from 1917 to 1962, were generated by fitting regression lines and making backward projections. All the annual wage series were projected to 2007 by fitting a linear regression with time as an independent variable for the period 1950-1962.

Interest Rate

In the published reports, a distinction is made between the average rate of interest on currently negotiated farm mortgage loans and the average rate on farm mortgage loans outstanding. The former is used in this study. An ideal interest rate should be an average of the contract rates on currently negotiated loans weighted by the total quantity for all the farm mortgage loans closed during the year.

A project conducted during 1936 and 1937 under the joint sponsorship of the Bureau of Agricultural Economics and the Work Projects Administration provided estimates of the annual average rates of interest charged on farm mortgage recordings in the United States for the period 1910 to 1935.[1] The estimates are weighted averages for each year, based on a sample of about 20 per cent of the counties in the United States.

The U.S.D.A. has published bienniel estimates from 1941 to 1959.[2] The estimates are weighted averages based on a sample of 1,000 to 1,200 counties which contain 38 to 45 per cent of the farms in the United States. The data are from farm mortgage recordings for these counties during the month of March on alternate years from 1941 to 1953 and for the first quarter of each alternate year from 1955 to 1957. Thus, the rates are based on a sampling of each year, and particularly the month of March, which represents the time of heaviest activity in the farm mortgage market. While it would be better to have estimates based on activity for the entire year, any difference in the average rates would be small. No estimates were available for the years from 1936 to 1940 and for the even numbered years thereafter.[3] Leon

---

[1]Bureau of Agricultural Economics, <u>Average Rates of Interest Charged on Farm Mortgage Recordings of Selected Lender Groups</u> (Washington, D.C., 1940), 60 pp.

[2]U. S. Department of Agriculture, <u>Major Statistical Series of the U.S. Department of Agriculture</u>, Land Values and Farm Finance, Agricultural Handbook No. 118, Vol. 6 (1957).

[3]The U.S.D.A. has published quarterly estimates of average contract rates beginning in 1960.

F. Hesser in an econometric study[4] felt it necessary to estimate average rates of interest on farm mortgage loans in those years for which published data were not available. Detailed procedure of estimation of interest rates for the interim years adopted by Hesser can be seen in his bulletin. A continuous series of average annual interest rates for the 40 year period was constructed for all lenders as follows. The available published series was used to 1935. The biennial rates after 1940 were used as benchmarks. Interest rates on farm mortgage loans by all lenders for the interim years were calculated by making the change for the interim year proportional to the percentage change in the rates charged on mortgage loans by insurance companies for the same year. This was done because major portions of mortgaged loan amounts were lent by insurance companies.

Though these interest rate series are not an ideal series, they still serve our purpose, in view of a paucity of published data. The following table gives the estimated rate of interest from 1917 to 1962.

---

[4]Leon F. Hesser, The Market for Farm Mortgage Credit - An Econometric Study, Research Bulletin No. 770 (December, 1963). Purdue University Agricultural Experiment Station, Lafayette, Indiana.

Table 2.--Average interest rates charged on mortgage loans for farmers by all lenders in the U.S., 1917-62

Year	Rate of Interest	Year	Rate of Interest	Year	Rate of Interest
	Per cent		Per cent		Per cent
1917	6.22	1932	6.38	1947	4.48
1918	6.31	1933	5.84	1948	4.56
1919	6.36	1934	5.33	1949	4.73
1920	6.40	1935	5.43	1950	4.73
1921	6.95	1936	5.15	1951	4.74
1922	6.67	1937	5.11	1952	4.92
1923	6.33	1938	5.08	1953	4.97
1924	6.34	1939	5.06	1954	5.00
1925	6.29	1940	4.99	1955	4.87
1926	6.26	1941	4.94	1956	4.92
1927	6.22	1942	4.90	1957	5.19
1928	6.23	1943	4.83	1958	5.36
1929	6.30	1944	4.74	1959	5.41
1930	6.36	1945	4.69	1960	5.60
1931	6.38	1946	4.52	1961	5.79
				1962	5.72

Source: Research Bulletin No. 770, Purdue Agr. Expt. Sta., 1963, Lafayette, Indiana and Finance Review, U.S.D.A., 1959, 1961, 1963.

Expectancy of Life

The most relevant data for our study would be the data on the number of expected remaining years of life of a rural male worker and an urban male worker of 25 years of age from 1917 to 1962. Due to lack of availability of this type of data, we have to resort to 'life tables' - vital statistics of the United States.[5] This source gives the life expectancy at each age, for white and nonwhite and for

[5]United States Department of Health and Education and Welfare, Vital Statistics of the United States - Life Tables Vol. II, Section 2 (1960), p. 11

both sexes. It does not give the breakdown by rural and urban. In addition to the coverage not being uniform throughout the period 1910 to 1962, this source gives the data only at an interval of ten years. During the period 1900-1902 to 1919-1921, only death registration states were covered. Only in the period 1929-31 to 1962 were all the states covered. For our purpose, we used the expected number of years of remaining life of white male workers in the United States as a whole at ages 25 and 45. Since life tables give the data at an interval of ten years, the difference was distributed evenly over ten years. The results are presented in the following table.

The expected number of years of remaining life of a 45 year old worker did not change much from 1917 to 1962. It increased from 25 in the year 1917 to 27 in the year 1962. The expected number of years of remaining life of a 25 year old worker increased from 41 in the year 1917 to 46 in the year 1962.

Annual Wage Rate Per Worker

Source and Estimation of Annual Wage

Farming

Wage rate statistics for agriculture in the United States date back to 1866 when the U. S. Department of Agriculture first surveyed average rates paid to hired farm workers. From 1866 to 1908, 19 surveys were made at

TABLE 3.--Expected number of years of remaining life of white male worker at the age of 45 and 25 in the U.S., 1917-62.

Year	45 years (n_1)	25 years (n_2)	Year	45 years n_1	25 years n_2
	Number	Number		Number	Number
1917	25	41	1941	26	44
1918	25	41	1942	26	44
1919	25	41	1943	26	44
1920	26	42	1944	26	44
1921	26	42	1945	26	44
1922	26	42	1946	26	44
1923	25	42	1947	26	45
1924	25	42	1948	26	45
1925	25	42	1949	26	45
1926	25	42	1950	26	45
1927	25	42	1951	26	45
1928	25	42	1952	26	45
1929	25	42	1953	26	45
1930	25	42	1954	26	45
1931	25	42	1955	26	45
1932	25	42	1956	26	45
1933	25	42	1957	27	46
1934	25	42	1958	27	46
1935	25	42	1959	27	46
1936	25	42	1960	27	46
1937	26	43	1961	27	46
1938	26	43	1962	27	46
1939	26	43			
1940	26	43			

Source: Life Tables - Vital Statistics of the United States, 1960, Vol. II, Section 2, p. 11. U.S.D. Health and Education and Welfare.

irregular intervals, followed by annual surveys for the period 1909-22. From 1923 to date, wage rate information has been collected quarterly on about January 1, April 1, July 1, and October 1.

Wage rate data are collected on a questionnaire, and farmers are asked to report "average rates being paid to hired farm labor in your locality." Wage rates reported by farmers are summarized in the offices of the state agricultural statisticians and are forwarded to Washington together with the statistical evaluation of the reported average. State averages are reviewed and adjusted whenever necessary, on the basis of related data, in Washington. For an extended discussion of the construction of the farm wage series, Major Statistical Series[6] may be seen.

The farm wage rate series is subject to three principal limitations. First, it is a composite of averages reported by farmers for their localities rather than of actual rates paid by the individuals reporting. Second, piece wage rates, which are particularly important in some agricultural areas, are not included. Third, in relation to the probable importance of hired farm employment, certain types of farms are over-represented, and others are under represented in the series.

---

[6]U.S. Department of Agriculture, Major Statistical Series of the U.S.D.A. How They are Constructed and Used. Vol. 7. Farm Population, Employment and Levels of Living, Ag. Handbook No. 118 (1957).

Even though farm wage series before 1948 and after 1948 are not strictly comparable, farm wage rate per month without board (without board or room) constructed before 1948 and farm wage rates per week without board or room constructed after 1948, when converted to annual basis are more comparable than any other series. Therefore, the series of farm wage rate per month without board before 1948 is multiplied by 12, and the series of farm wage rate per week without board or room after 1948 is multiplied by 52, to arrive at an annual farm wage rate throughout the period 1917 to 1962. Annual farm wage rate per hired worker is given in the appendix.

Manufacturing, Laundries, and Retail Trade

The Bureau of Labor Statistics publishes each month average weekly hours, average hourly earnings and average weekly earnings relating to production or non-supervisory workers. The hours and earnings data are based upon monthly mail reports provided by cooperating establishments. The coverage of employees in cooperating establishments in manufacturing is 65 per cent of the total number of employees. The percentage coverages in trade and services are 20 and 18 respectively. The sample design used in the B.L.S. establishment employment and labor turnover statistics programs is that of a modified cut-off sample. In a cut-off design, all establishments in a category are listed in sequence by number of employees. A cut-off point is selected in terms of the number of employees in an establishment, and only establishments above the cut-off point are included in the design. At present, sample selections are made by the co-operating state agencies at the area level.

The state agencies mail the forms to the establishments and examine the returns for consistency, accuracy and completeness. The state offices use the information to prepare state and area series and then send the establishment data to the B.L.S. for use in preparing the national series. In general, the establishment reports contain information on (1) the number of all full and part time production workers or nonsupervisory employees who worked during or received pay for any part of the period reported, (2) total gross payrolls for such workers, (3) total man-hours actually worked by the full or part time workers, necessary for the computation of the hours and earnings averages.

> Average hourly earnings for manufacturing and non-manufacturing industries are on a 'gross' basis, reflecting not only changes in basic hourly and incentive wage rates, but also such variable factors as premium pay for overtime and late shift work, and changes in output of workers paid on an incentive plan.[7]

Averages or hourly earnings differ from wage rates. Earnings are the actual return to the worker for a stated period of time, while rates are the amounts stipulated for a given unit of work or time.

The work week information relates to the average hours for which pay was received and is different from standard or

---

[7]U. S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for the United States, 1909-62, Bulletin No. 1312-1 (1963), p. 626.

schedule hours. Gross average weekly earnings are derived by multiplying average weekly hours by average hourly earnings. Therefore, weekly earnings are affected not only by changes in the length of the work week caused by part time work stoppages for varying causes, labor turnover and absenteeism. The annual wage per worker is derived by multiplying the average weekly earnings by 52.

The payroll figures exclude payment in kind, contributions to welfare funds and insurance or pension plans, and bonuses, unless earned and paid regularly each pay period. In calculating the annual wage rate, it was assumed that the worker is fully employed throughout 52 weeks.

The sources and limitations are applicable to all the annual wage series in manufacturing, laundries, and retail trade. In the following sections, we discuss the backward and forward extrapolation of the data in each occupation.

Backward Extrapolation in Laundries and Retail Trade

The data on annual earnings of a nonsupervisory worker in ratail trade and in laundries are available only from 1939 and 1934 respectively. Since the present study required data from 1917, a backward extrapolation of the respective series was essential.

From the graphs drawn (Fig. 1, Fig. 2) it is reasonably clear that the relationship between the annual earnings of a

Figure 1.--The relationship between annual wage (in current dollars) per worker in retail trade and annual wage (in current dollars) per worker in construction in the U. S., 1939-51.

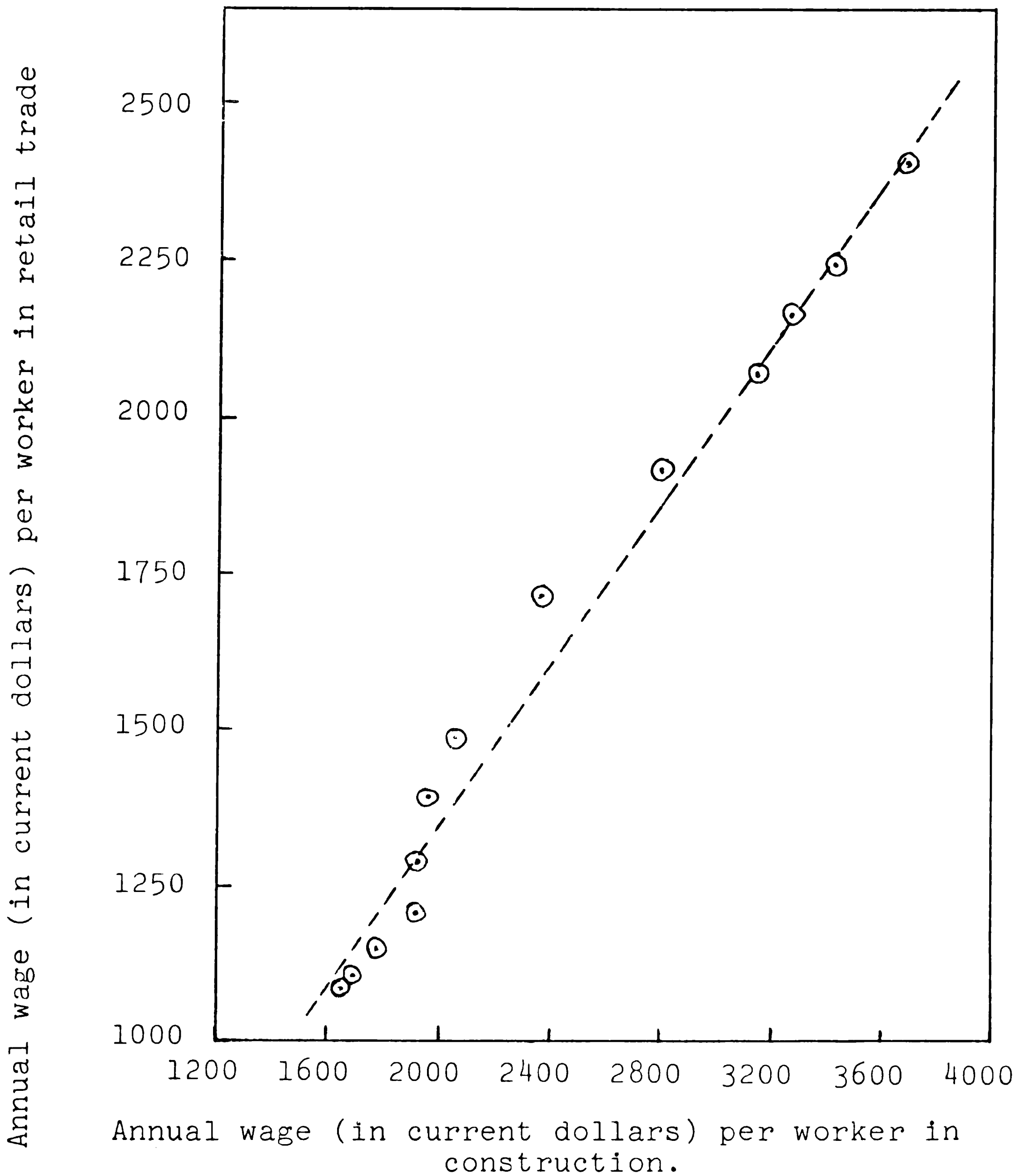
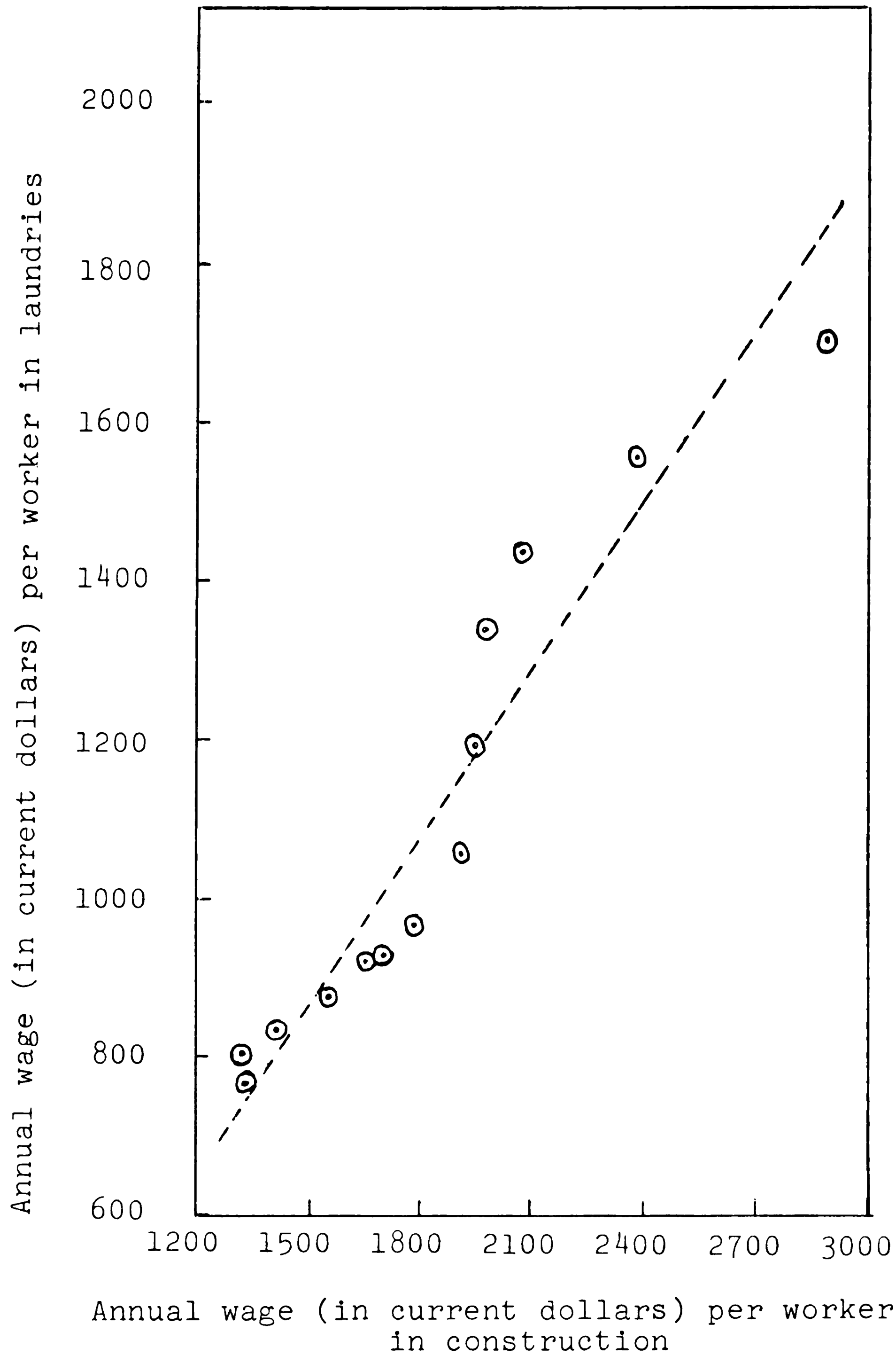


Figure 2.--The relationship between annual wage (in current dollars) per worker in laundries and annual wage (in current dollars) per worker in construction in the U. S., 1934-47.



worker in retail trade and in laundries are linearly related to the annual earnings of a worker in building trades for the periods 1939-51 and 1934-1947 respectively. Hence a straight line of the form Y = a + bX was fitted for both the series. X is the annual wage in building trades.

<u>Results</u>

	'a'	'b'	d.f.	$\bar{R}^2$	Period
Retail trade:	44.25 (67.2075)	0.6509 (0.0265)	11	0.9805	1939-51
Laundries	-200.9561 (123.6148)	0.7106 (0.0663)	12	0.8976	1934-47

The independent variable in annual wage per worker in building trades explains about 98 per cent of the variation in the annual wage in retail trade during the period 1939-51 and 89.8 per cent of the variation in the annual wage in laundries during the period 1934-47. The regression coefficient of the time variable is significantly different from zero at the one per cent level in both the regression equations. Annual wage in retail trade and laundries increases by 0.6509 and 0.7106 dollars for a dollar increase in the annual wage in building trades respectively. The extrapolated annual wage per worker in retail trade and in laundries are given in Table 4.

TABLE 4.--Estimated annual wage rate (in current dollars) in retail trade and in laundries in the U.S., 1917-38.

Year	Annual wage in Retail trade	Annual wage in Laundries
	Current dollars	Current dollars
1938	1129.72	
1937	1050.85	
1936	964.54	
1935	906.67	
1934	911.07	
1933	911.40	745.66
1932	959.13	797.76
1931	1143.93	999.50
1930	1151.38	1007.63
1929	1091.53	970.68
1928	1123.28	976.96
1927	1123.28	976.96
1926	1091.81	942.60
1925	1015.99	859.83
1924	986.54	827.69
1923	908.15	742.11
1922	859.28	688.76
1921	939.50	776.33
1920	908.15	742.11
1919	661.95	473.35
1918	587.49	392.07
1917	509.64	307.08

Construction

The suboccupation considered for this study under construction is "Helpers and Laborers." Annual wage per worker data in this occupation are not as readily available as they are in some of the other occupations. However, information on the union scales and hours prevailing in each city is available through Bureau of Labor Statistics.[8]

[8] U.S. Department of Labor, Bureau of Labor Statistics, Union Wages and Hours: Building Trades, July 1, 1963 and Trend 1907-63. Bull. No. 1397, 1963.

Union scales are those agreed on through collective bargaining between trade unions and employers and defined as (1) the basic wage (minimum) scale (excluding holiday, vacation, or other benefit payments regularly made or credited to the worker each pay period), and (2) the maximum schedules of hours at straight time rates. Data are obtained by the USDL primarily from local union officials by mail questionnaire. In some instances, economists of the Bureau of Labor Statistics visit local union officials to obtain the desired information. Average hourly scales as well as working hours are weighted by the number of union members at each rate.

The indexes of union hourly wage rates as well as the indexes of union weekly hours for the helpers and laborers with the base period 57-59 are given for the period 1907-63 in bulletin no. 1397 of the Bureau of Labor Statistics. From these indexes, actual union average wage rate and average weekly hours are calculated for the period 1917 to 1962. The average weekly wage per worker in the occupation "Helpers and Laborers" was derived by multiplying the average weekly hours by the average hourly wage rate. The annual wage per worker was estimated by multiplying the average weekly wage by 52.

The annual wage derived by the method explained above does not indicate the actual annual wage earned by all the workers. The averages calculated by the Bureau of Labor

Statistics are not designed for precise year to year comparisons because of fluctuations in union membership.

The estimated annual average wage per worker who comes under "helpers and laborers," in construction for the period 1917 to 1962 is given in the appendix.

Forward Projection of Annual Wage

As pointed out in the methodology chapter this study required annual wage data in each occupation from 1963 to 2007. Hence projection of annual wage data was done on the basis of regression lines fitted with annual wage in the concerned occupation as the dependent variable and time as the independent variable. The period considered is 1950-62. The explanation for the choice of the functional form and time period were given in the Methodology Chapter. The following are the regression equations fitted for annual wage data in farming, manufacturing, construction, retail trade and laundries. (See Figures 3, 4, 5, 6, and 7 respectively.)

	d.f.	$\bar{R}^2$
$\hat{W}_t^F = \underset{(24.12)}{1695.99} + \underset{(3.41)}{66.00}\, t$	11	0.9689
$\hat{W}_t^M = \underset{(30.81)}{3121.65} + \underset{(4.36)}{156.69}\, t$	11	0.9908
$\hat{W}_t^C = \underset{(33.31)}{3374.30} + \underset{(4.71)}{254.49}\, t$	11	0.9959
$\hat{W}_t^T = \underset{(8.66)}{2282.70} + \underset{(1.23)}{96.05}\, t$	11	0.9981
$\hat{W}_t^L = \underset{(16.22)}{1855.25} + \underset{(2.29)}{62.64}\, t$	11	0.9841

FIGURE 3.--Trend in annual wage (in current dollars) per farm worker in the U.S., 1950-62.

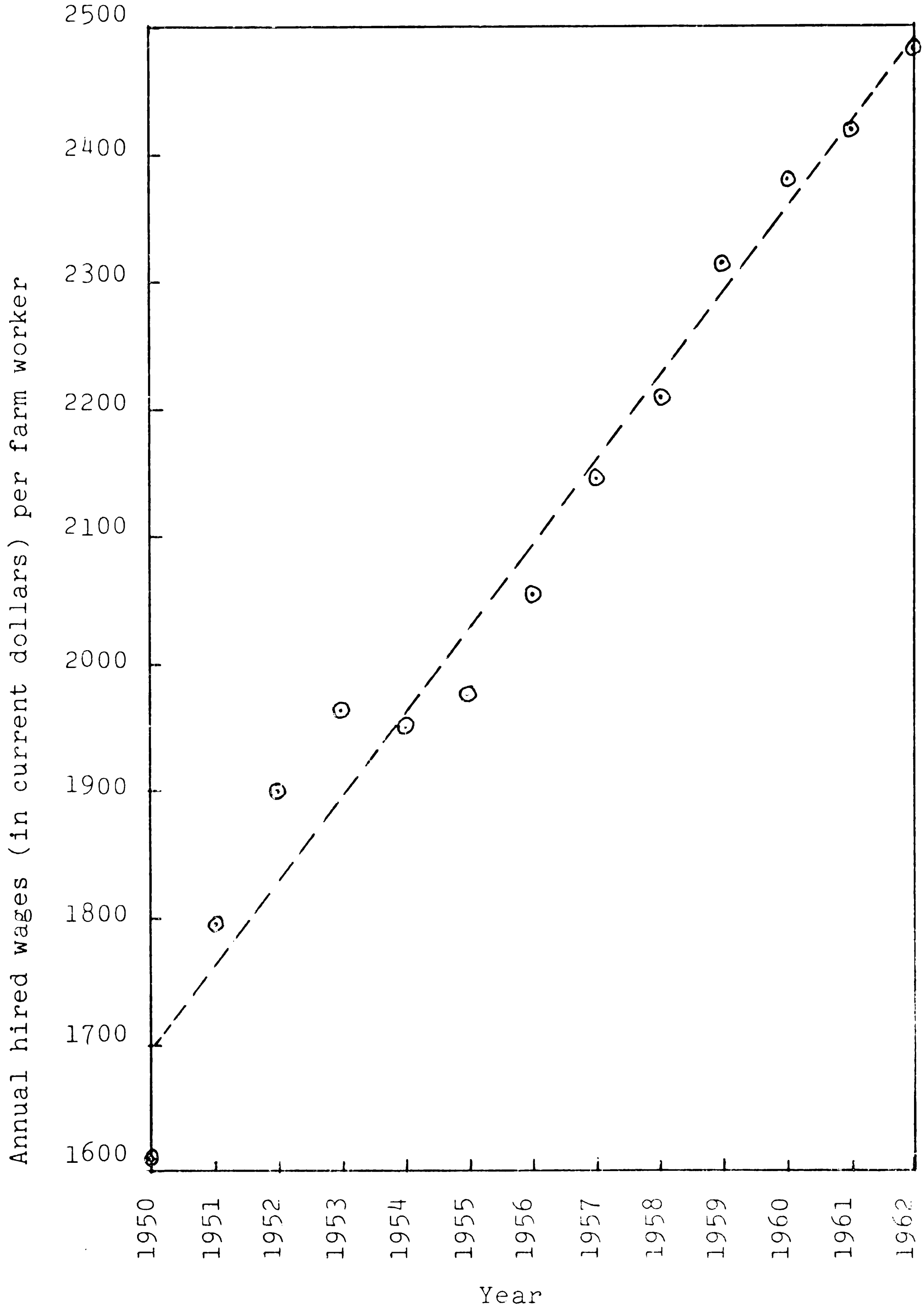


FIGURE 4.--Trend in annual wage (in current dollars) per worker in manufacturing in the U.S., 1950-62.

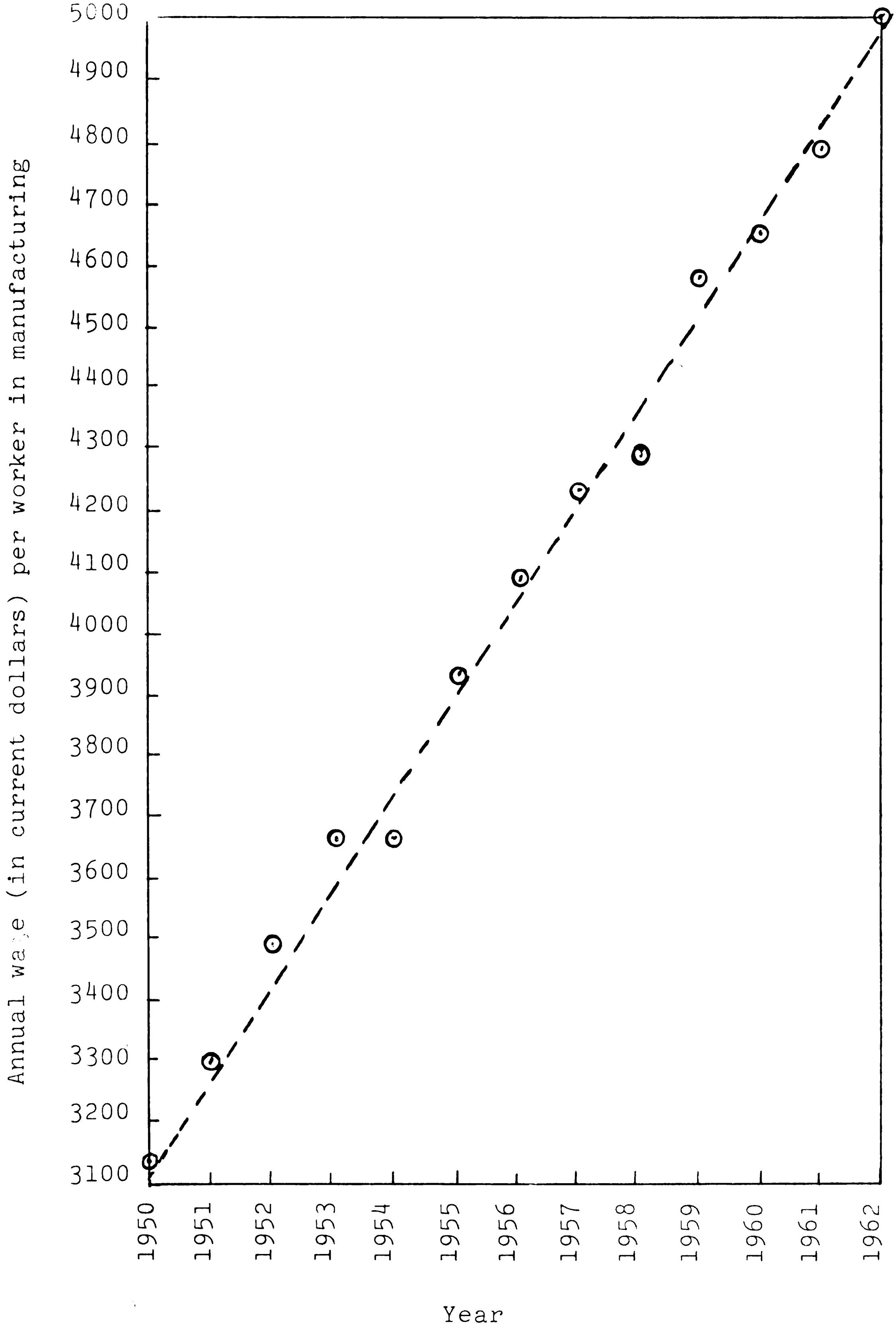


FIGURE 5.--Trend in annual wage (in current dollars) per worker in construction in the U.S., 1950-62.

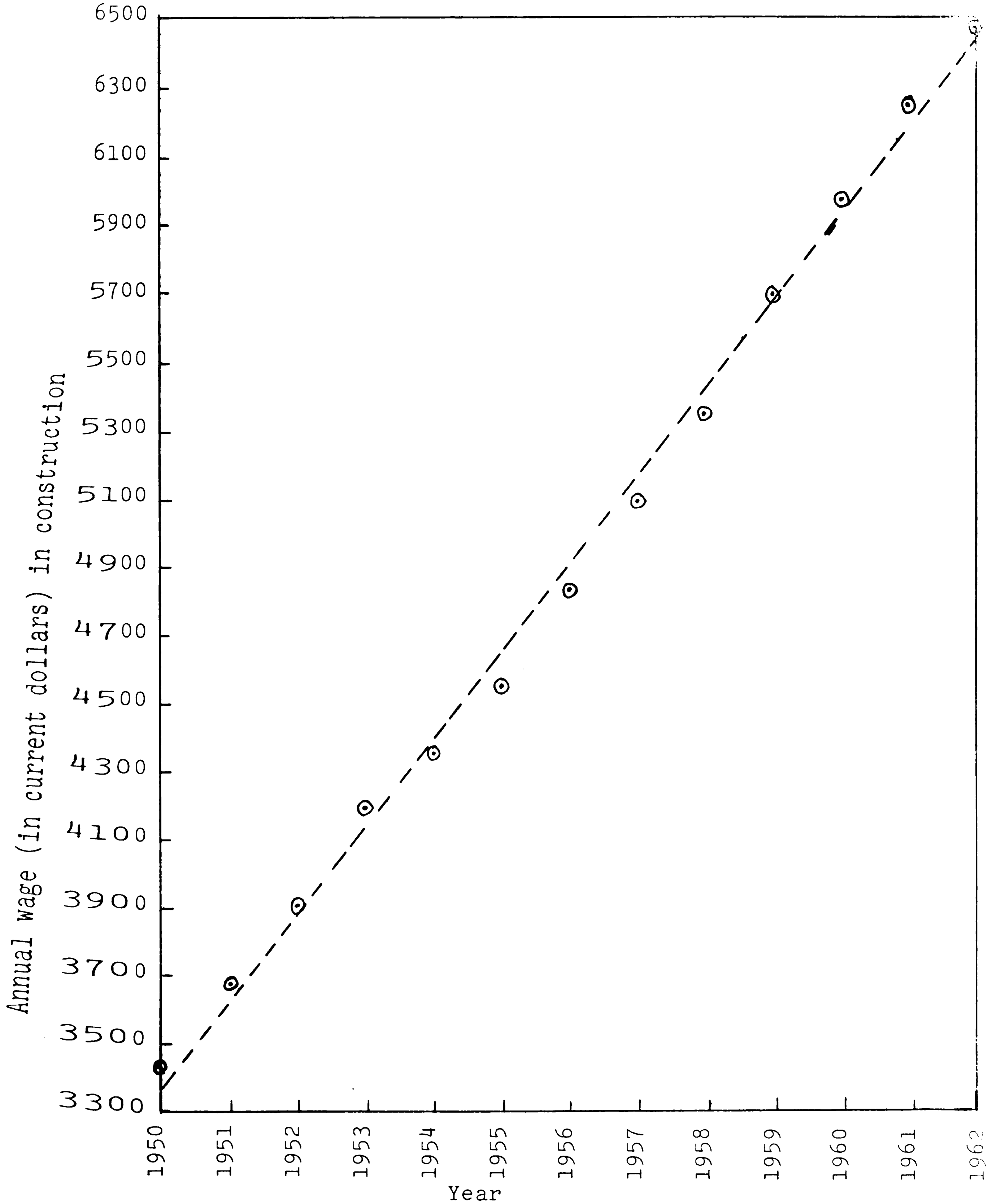
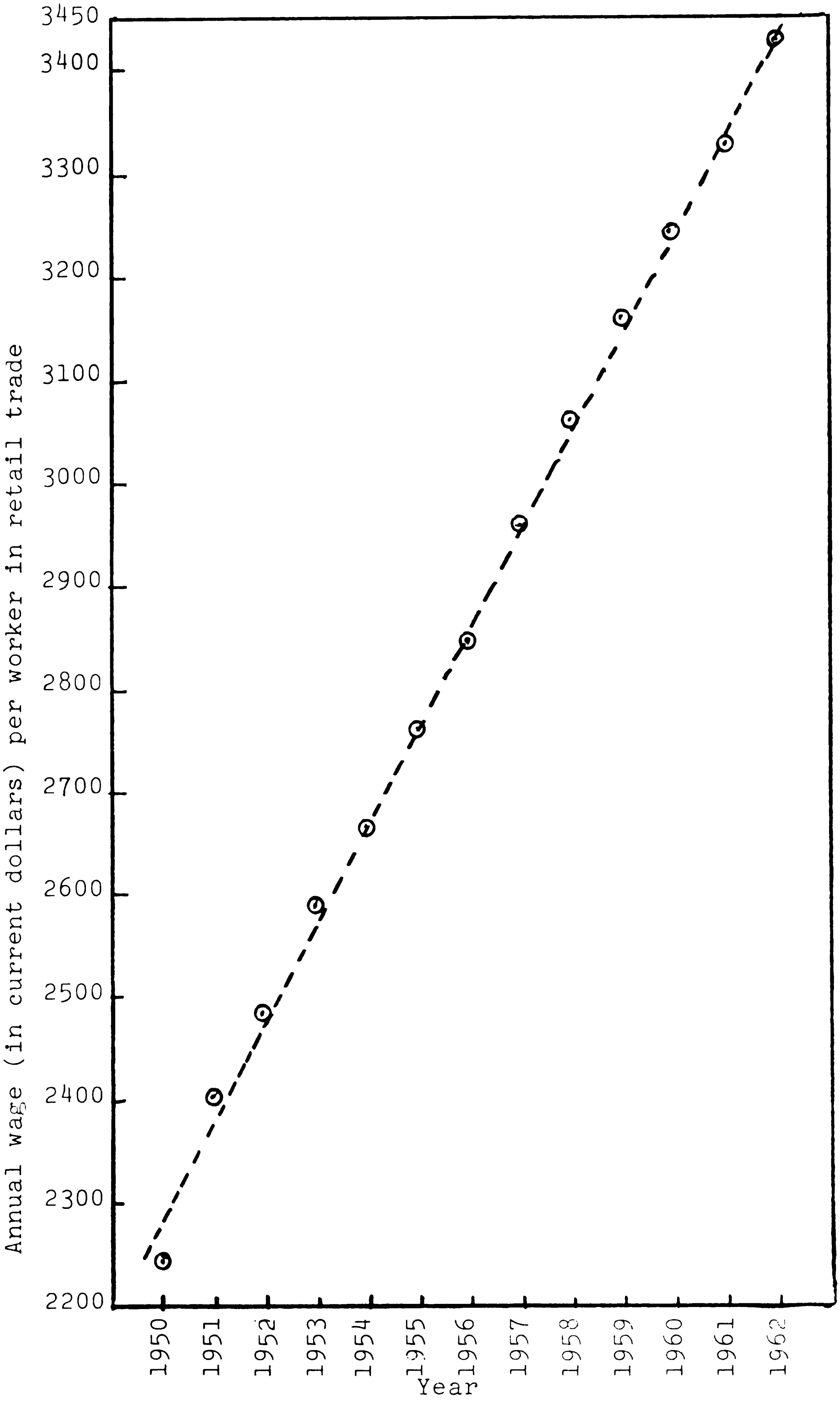


FIGURE 6.--Trend in annual wage (in current dollars) per worker in retail trade in the U.S., 1950-62.



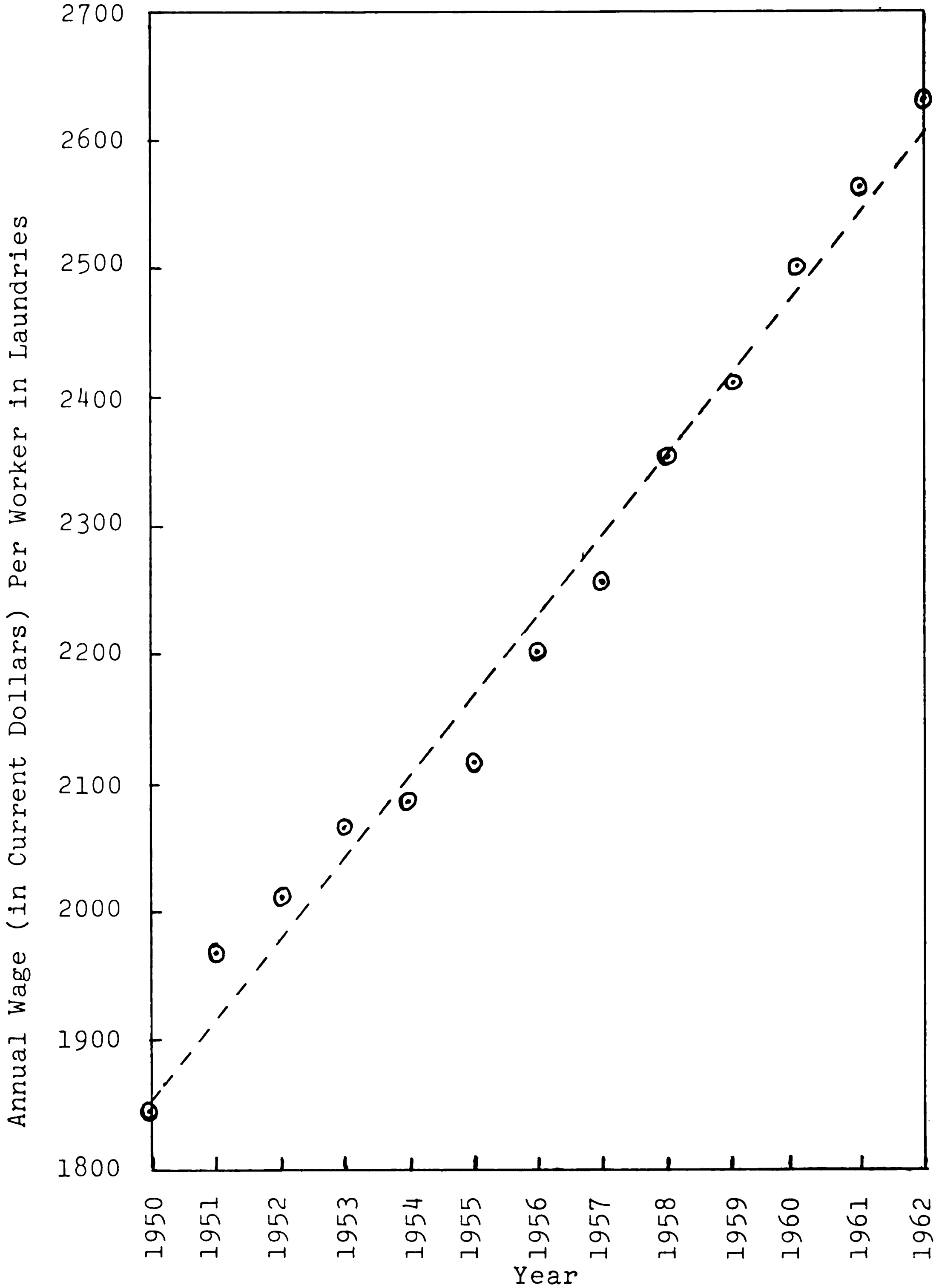


FIGURE 7.--Trend in annual wage (in current dollars) per worker in laundries in the U. S., 1950-62.

$\hat{W}_t^F$ = annual wage per worker in farming

$\hat{W}_t^M$ = annual wage per worker in manufacturing

$\hat{W}_t^C$ = annual wage per worker in construction

$\hat{W}_t^T$ = annual wage per worker in retail trade

$\hat{W}_t^L$ = annual wage per worker in laundries

t = time variable

The constant and the regression coefficient in the regression equation in each occupation are significantly different from zero even at the one per cent level. The time variable explains about 98 per cent of the variation in annual wage per worker in each occupation during the period 1950-62. The annual wage rate per worker increases from 1950 by an average of 66 dollars per year in farming; 156.7 dollars per year in manufacturing; 254.49 dollars per year in construction; 96.05 dollars per year in retail trade; and 62.64 dollars per year in laundries. Table 2 in Appendix A gives projected annual wages per worker in farming; in manufacturing, in construction, in retail trade, and in laundries from 1963 to 2007.

Source and Estimation of Unemployment Rate

Unemployment rates[9] in the concerned nonfarm occupations are only available from 1948. As pointed out in the Methodology Chapter, data on unemployment rates were

---

[9] U. S. Department of Labor, Bureau of Labor Statistics, Labor Force Employment and Unemployment Statistics, 1947-61 (1962), Table 16.

required for each occupation from 1917 to 1962. Hence, backward projection of the unemployment rate to 1917 in each nonfarm occupation was done on the basis of fitted regression equations. The dependent variable is the unemployment rate in the concerned nonfarm occupation, and the independent variable is the unemployment as a percentage of nonfarm employees. The explanation for the method and the time period used in fitting these regression equations was given in the Methodology Chapter.

The following table presents the unemployment rates given by Lebergott for the period 1917 to 1960.

TABLE 5.--Unemployment as a percentage of nonfarm employees in the U. S., 1917-60.

Year	Unemployment rate	Year	Unemployment rate	Year	Unemployment rate
	per cent		per cent		per cent
1917	8.2	1932	36.3	1947	5.4
1918	2.4	1933	37.6	1948	5.1
1919	2.4	1934	32.6	1949	8.0
1920	8.6	1935	30.2	1950	7.1
1921	19.5	1936	25.4	1951	4.4
1922	11.4	1937	21.3	1952	4.0
1923	4.1	1938	27.9	1953	3.8
1924	8.3	1939	25.2	1954	7.1
1925	5.4	1940	21.3	1955	5.7
1926	2.9	1941	14.4	1956	5.4
1927	5.4	1942	6.8	1957	5.6
1928	5.9	1943	2.7	1958	8.7
1929	5.3	1944	1.7	1959	7.0
1930	14.2	1945	2.7	1960	7.1
1931	25.2	1946	2.7		

Source: Stanley Lebergott, Manpower in Economic Growth; the American Record Since 1800 (New York: McGraw-Hill, 1964), Appendix.

The following are the regression equations fitted for unemployment rate data in manufacturing, construction, retail trade and laundries. (Also see Figures 8, 9, 10, and 11.)

	d.f.	$\bar{R}^2$
$\hat{U}_M = \underset{(0.5325)}{-2.2653} + \underset{(0.0851)}{1.2057}\, U_{N.F.E.}$	11	0.9433
$\hat{U}_C = \underset{(0.8389)}{-0.5727} + \underset{(0.1341)}{1.6575}\, U_{N.F.E.}$	11	0.9267
$\hat{U}_T = \underset{(0.3117)}{0.2994} + \underset{(0.0498)}{0.7381}\, U_{N.F.E.}$	11	0.9479
$\hat{U}_L = \underset{(0.3961)}{0.6936} + \underset{(0.0633)}{0.5074}\, U_{N.F.E.}$	11	0.8404

U_M is the unemployment rate in manufacturing

U_C is the unemployment rate in construction

U_T is the unemployment rate in retail trade

U_L is the unemployment rate in laundries

$U_{N.F.E.}$ is the unemployment as a percentage of nonfarm employees

The regression coefficient of the independent variable in each occupation is significantly different from zero even at the one per cent level. A one per cent increase in the unemployment as a percentage of nonfarm employees is associated with an increase in the unemployment rate of 1.2057 in manufacturing; 1.6575 per cent in construction; 0.7381 per cent in retail trade and of 0.5074 per cent in laundries.

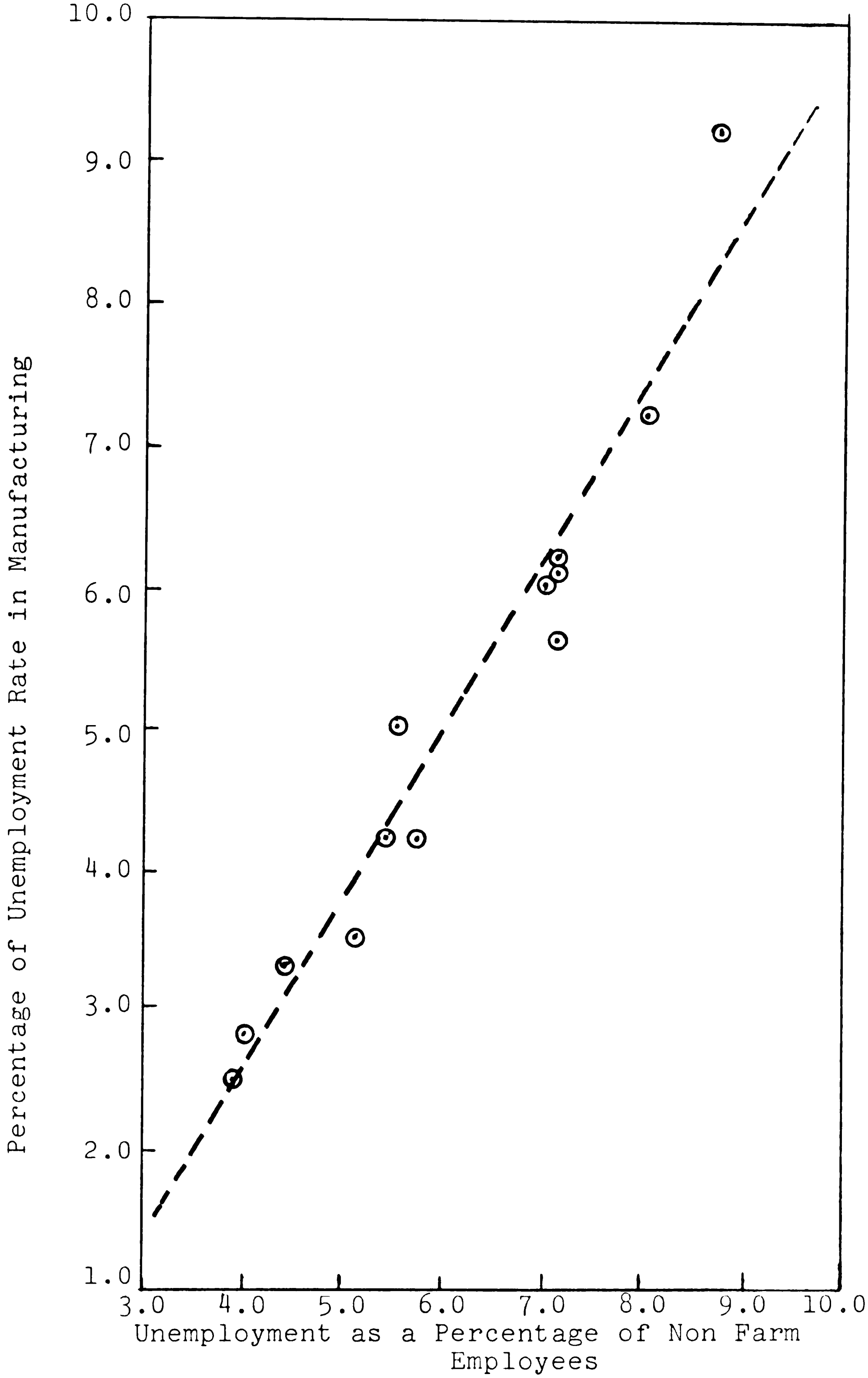


Figure 8.--The relationship between unemployment in manufacturing and unemployment as a percentage of nonfarm employees U. S., 1948-60.

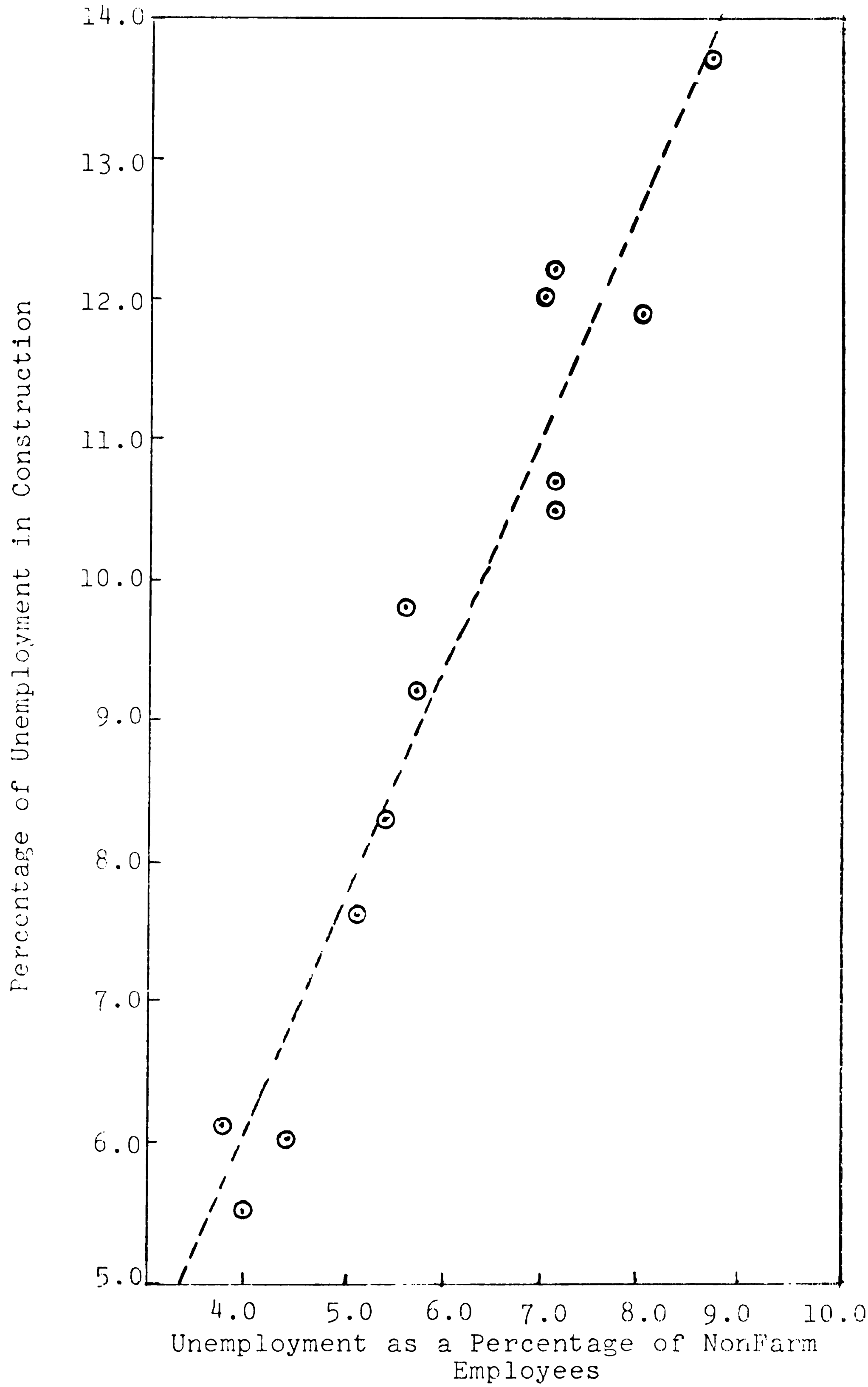


Figure 9.--The relationship between unemployment rate in construction and unemployment as a percentage of nonfarm employees in the U. S., 1948-60.

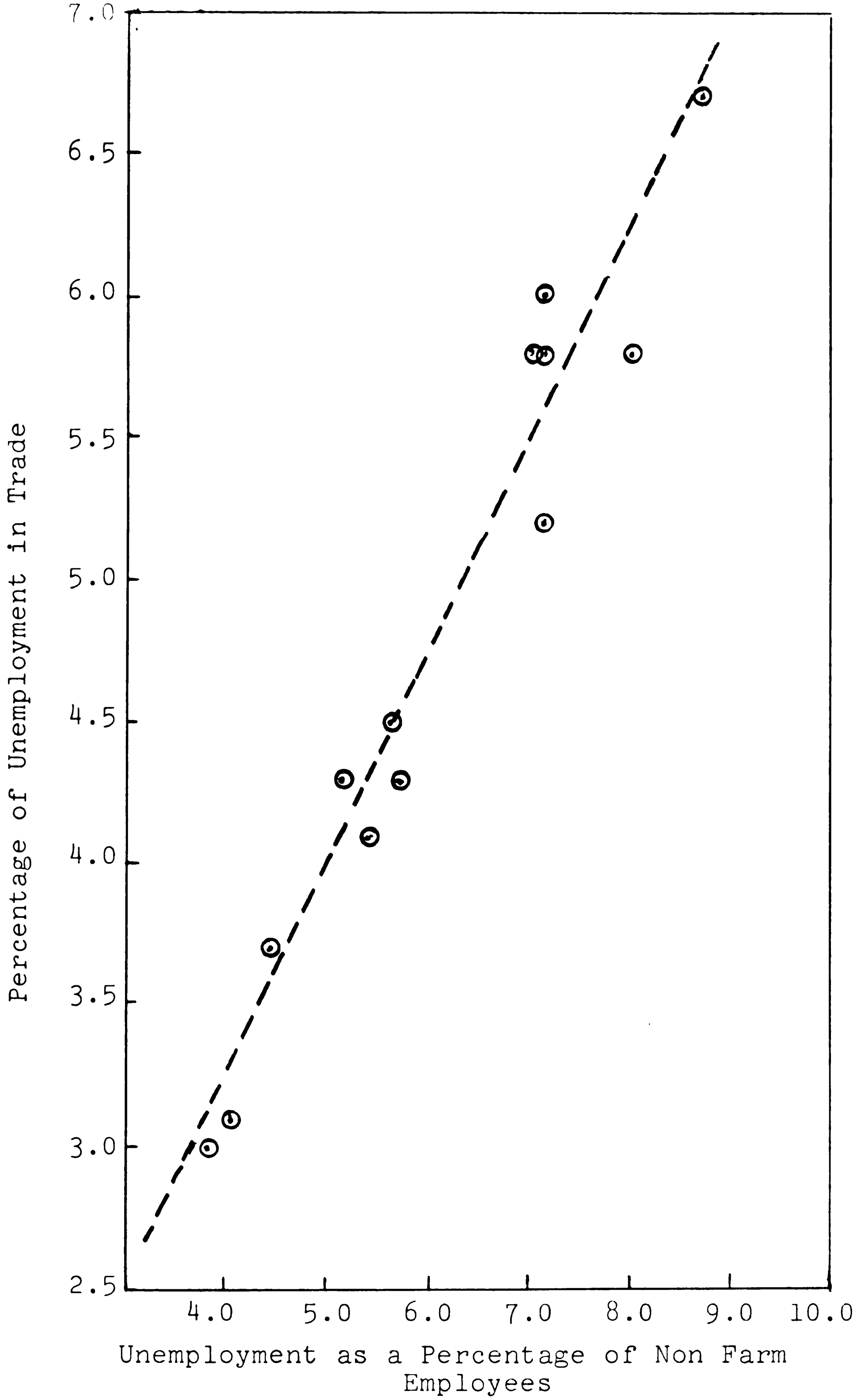


Figure 10.--The relationship between unemployment rate in trade and unemployment as a percentage of nonfarm employees in the U. S., 1948-60.

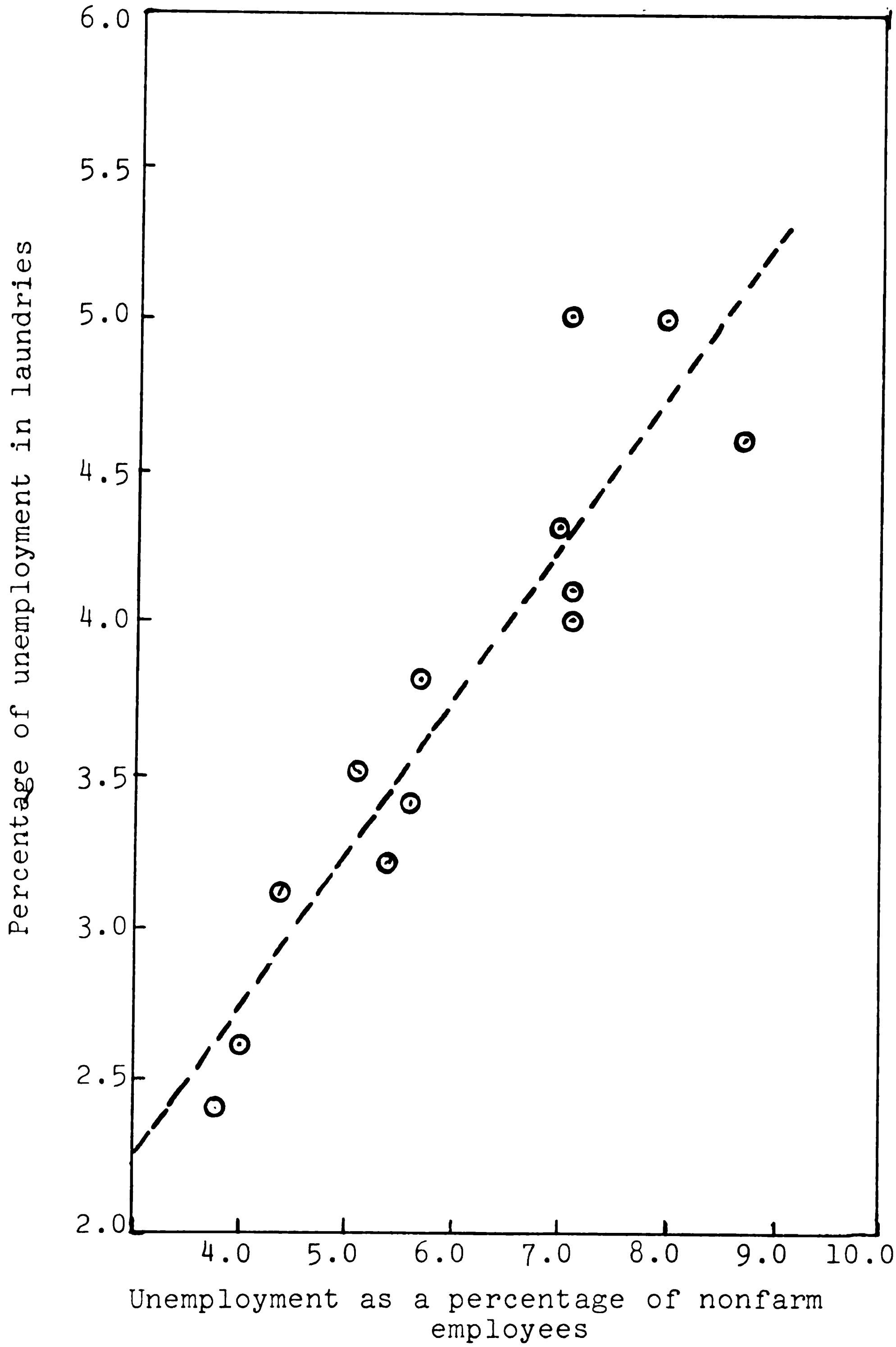


Figure 11.--The relationship between the unemployment rate in laundries and unemployment as a percentage of nonfarm employees in the U. S., 1848-60.

The percentages of unemployment (estimated for the period 1917 to 1947 and actual for the period 1948-1962) in manufacturing, construction, retail trade and in laundries are given in Table 3 in Appendix A.

CHAPTER IV

UNEMPLOYMENT RATE EXPECTATIONS

The procedure for estimating expected unemployment rates in the next n years ahead was discussed in the chapter on "Methodology." However, a brief explanation is given in this chapter.

Introduction

In this study it was assumed that the expected future unemployment rates in each nonfarm occupation are a linear function of current and past unemployment rates.

An indirect method was used for estimating expected unemployment rates in the 1st, 2nd. . .$(n_2-1)^{th}$ year ahead. The number n_2 is the expected remaining number of years of life of a 25 year old worker. The general formula is as follows. The following regression equation gives an estimate of an average unemployment rate in the next n years ahead.

$$U_n = \delta_o^n + \sum_{i=o}^{k} \beta_i^n U_{t-i} + \varepsilon^n . \; . \; . 1$$

ε^n is the random error in the n^{th} equation

$U_n = \frac{1}{n} \sum_{\ell=1}^{n} U_{t+\ell}$ = an average unemployment rate in the next n years ahead.

$n=1,2,3 . . . 9$.

After estimating these n regression equations, an estimate of the expected unemployment rate in any j^{th} year ahead was derived as follows.

$$\hat{U}_{t+j} = j\hat{U}_j - (j-1)\ \hat{U}_{(j-1)} . . . 2$$

The assumption in the above formula is that an estimate of the average unemployment rate in the next n years ahead is the average of the estimates of unemployment rate for the individual years up to the nth year ahead. This procedure was designed to ensure that the average of all the estimates of the expected unemployment rate up to the n^{th} year ahead from the current year is equal to the estimate of the average of all the expected unemployment rates in the n years ahead from the current year.

Discussion of Results

In this section, empirical results for all the non-farm occupations considered are discussed. For each non-farm occupation, the following decisions were made. On the basis of $\bar{R}^2$, n was determined as 9 because, beyond n=9, the regression equation explains less than 18 per cent of the variance in the expected average unemployment rate. In all the regression equations, k was determined as 1, because the regression coefficients of U_{t-k} where $k \geq 2$ were not significantly different from zero even at the 10 per cent level. Hence, all the regression equations were fitted only with the two independent variables U_t, U_{t-1}.

The fitted regression equations for estimating the average unemployment rate in the next n years ahead (n=1, 2,. . .9) for each nonfarm occupation are given in the following pages.

The constants for the regression equations for laundries, retail trade were significantly different from zero even at the one per cent level. The regression coefficients of the current year unemployment rate in all the regression equations in each nonfarm occupation considered were significantly different from zero at the one per cent level. The regression coefficient of the past year unemployment rate is significantly different from zero at the five per cent level in the first four regression equations in manufacturing, construction, trade and in the first five regression equations in trade and at the ten per cent level in the rest of the regression equations in all the nonfarm occupations considered. The percentage of variation of the dependent variable explained by the independent variables in each nonfarm occupation decreases from about 82 per cent in the first regression equation to about 18 per cent in the ninth regression equation.

The following are the estimated regression equations used to derive an estimate of the average unemployment rate in the n years ahead (n=1,2,. . .9)

Manufacturing

	d.f.	$\bar{R}^2$
$\hat{U}_1 = 1.8067 + 1.2387\ U_t - 0.3953\ U_{t-1}$ (1.0814) (0.1374) (0.1373)	43	0.8139
$\hat{U}_2 = 2.9756 + 1.1636\ U_t - 0.4168\ U_{t-1}$ (1.3708) (0.1723) (0.1724)	42	0.6959
$\hat{U}_3 = 4.0846 + 1.0931\ U_t - 0.4358\ U_{t-1}$ (1.5577) (0.1934) (0.1935)	41	0.5974
$\hat{U}_4 = 5.1019 + 1.0041\ U_t - 0.4284\ U_{t-1}$ (1.7024) (0.2100) (0.2098)	40	0.5022
$\hat{U}_5 = 6.1686 + 0.9173\ U_t - 0.4180\ U_{t-1}$ (1.8121) (0.2219) (0.2224)	39	0.4182
$\hat{U}_6 = 7.0065 + 0.8498\ U_t - 0.4194\ U_{t-1}$ (1.9025) (0.2292) (0.2300)	38	0.3472
$\hat{U}_7 = 7.8562 + 0.8061\ U_t - 0.4441\ U_{t-1}$ (1.9672) (0.2330) (0.2340)	37	0.2899
$\hat{U}_8 = 8.7284 + 0.7535\ U_t - 0.4587\ U_{t-1}$ (2.0182) (0.2358) (0.2363)	36	0.2341
$\hat{U}_9 = 9.7495 + 0.7020\ U_t - 0.4768\ U_{t-1}$ (2.0562) (0.2363) (0.2381)	35	0.1868

The following are the estimated regression equations used to derive an estimate of the average unemployment rate in the n years ahead (n=1,2,. . .9)

Construction

Equation	d.f.	$\bar{R}^2$
$\hat{U}_1 = \underset{(1.5855)}{2.9289} + \underset{(0.1359)}{1.2559}\ U_t - \underset{(0.1358)}{0.4132}\ U_{t-1}$	43	0.8195
$\hat{U}_2 = \underset{(2.0292)}{4.7850} + \underset{(0.1724)}{1.1764}\ U_t - \underset{(0.1724)}{0.4306}\ U_{t-1}$	42	0.6986
$\hat{U}_3 = \underset{(2.3056)}{6.5400} + \underset{(0.1939)}{1.1037}\ U_t - \underset{(0.1939)}{0.4473}\ U_{t-1}$	41	0.5997
$\hat{U}_4 = \underset{(2.5189)}{8.1859} + \underset{(0.2099)}{1.0136}\ U_t - \underset{(0.2098)}{0.4393}\ U_{t-1}$	40	0.5052
$\hat{U}_5 = \underset{(2.6903)}{9.7687} + \underset{(0.2220)}{0.9168}\ U_t - \underset{(0.2224)}{0.4179}\ U_{t-1}$	39	0.4178
$\hat{U}_6 = \underset{(2.8211)}{11.0956} + \underset{(0.2293)}{0.8496}\ U_t - \underset{(0.2301)}{0.4194}\ U_{t-1}$	38	0.3473
$\hat{U}_7 = \underset{(2.9135)}{12.4026} + \underset{(0.2332)}{0.8057}\ U_t - \underset{(0.2339)}{0.4428}\ U_{t-1}$	37	0.2901
$\hat{U}_8 = \underset{(2.9844)}{13.7988} + \underset{(0.2355)}{0.7552}\ U_t - \underset{(0.2360)}{0.4600}\ U_{t-1}$	36	0.2358
$\hat{U}_9 = \underset{(3.0427)}{15.3474} + \underset{(0.2361)}{0.7007}\ U_t - \underset{(0.2379)}{0.4745}\ U_{t-1}$	35	0.1870

The following are the estimated regression equations used to derive an estimate of the average unemployment rate in the n years ahead (n=1,2,. . .9)

<u>Laundries</u>

Equation	d.f.	$\bar{R}^2$
$\hat{U}_1 = 1.0349 + 1.2699\ U_t - 0.4292\ U_{t-1}$ $(0.5269)\ (0.1351)\ (0.1346)$	43	0.8210
$\hat{U}_2 = 1.7025 + 1.1991\ U_t - 0.4575\ U_{t-1}$ $(0.6738)\ (0.1712)\ (0.1709)$	42	0.7016
$\hat{U}_3 = 2.3172 + 1.1318\ U_t - 0.4807\ U_{t-1}$ $(0.7652)\ (0.1923)\ (0.1920)$	41	0.6041
$\hat{U}_4 = 2.9055 + 1.0452\ U_t - 0.4775\ U_{t-1}$ $(0.8352)\ (0.2078)\ (0.2074)$	40	0.5113
$\hat{U}_5 = 3.4650 + 0.9501\ U_t - 0.4589\ U_{t-1}$ $(0.8926)\ (0.2197)\ (0.2198)$	39	0.4245
$\hat{U}_6 = 3.9325 + 0.8801\ U_t - 0.4580\ U_{t-1}$ $(0.9370)\ (0.2270)\ (0.2274)$	38	0.3534
$\hat{U}_7 = 4.3900 + 0.8301\ U_t - 0.4750\ U_{t-1}$ $(0.9674)\ (0.2311)\ (0.2311)$	37	0.2954
$\hat{U}_8 = 4.8852 + 0.7740\ U_t - 0.4865\ U_{t-1}$ $(0.9893)\ (0.2331)\ (0.2330)$	36	0.2414
$\hat{U}_9 = 5.4333 + 0.7219\ U_t - 0.5038\ U_{t-1}$ $(1.0062)\ (0.2332)\ (0.2346)$	35	0.1961

The following are the estimated regression equations used to derive an estimate of the average unemployment rate in the n years ahead (n=1,2,. . .9)

Retail Trade

Equation	d.f.	$\bar{R}^2$
$\hat{U}_1 = 1.4013 + 1.2507\ U_t - 0.4085\ U_{t-1}$ (0.7370) (0.1360) (0.1360)	43	0.8178
$\hat{U}_2 = 2.2909 + 1.1749\ U_t - 0.4300\ U_{t-1}$ (0.9391) (0.1723) (0.1723)	42	0.6981
$\hat{U}_3 = 3.1147 + 1.1020\ U_t - 0.4463\ U_{t-1}$ (1.0672 (0.1938) (0.1939)	41	0.5988
$\hat{U}_4 = 3.8895 + 1.0138\ U_t - 0.4404\ U_{t-1}$ (1.1649) (0.2098) (0.2096)	40	0.5047
$\hat{U}_5 = 4.6092 + 0.9192\ U_t - 0.4220\ U_{t-1}$ (1.2442) (0.2221) (0.2227)	39	0.4174
$\hat{U}_6 = 5.2678 + 0.8505\ U_t - 0.4217\ U_{t-1}$ (1.3058) (0.2295) (0.2304)	38	0.3462
$\hat{U}_7 = 5.8940 + 0.8062\ U_t - 0.4452\ U_{t-1}$ (1.3489) (0.2333) (0.2342)	37	0.2890
$\hat{U}_8 = 6.5469 + 0.7541\ U_t - 0.4606\ U_{t-1}$ (1.3821) (0.2357) (0.2363)	36	0.2339
$\hat{U}_9 = 7.2868 + 0.7002\ U_t - 0.4763\ U_{t-1}$ (1.4086) (0.2364) (0.2383)	35	0.1856

The increase in the expected average unemployment rate associated with a one per cent increase in the current year unemployment rate decreases from 1.2387 per cent in the next year to 0.7020 in the next nine years, in manufacturing; from 1.2559 per cent in the next year to 0.7007 per cent in the next nine years in construction; 1.2699 in the next year to 0.7219 in the next nine years in laundries; from 1.2507 per cent to 0.7002 per cent in the next nine years in retail trade.

The decrease in the expected average unemployment rate due to a one per cent increase in the past year unemployment rate increases from 0.3953 per cent in the next year to 0.4768 per cent in the next nine years in manufacturing; from 0.4132 per cent in the next year to 0.4745 per cent in the next nine years in construction; from 0.4292 per cent in the next year to 0.5038 per cent in the next nine years in laundries; from 0.4085 per cent in the next year to 0.4763 per cent in the next nine years in retail trade.

The expected unemployment rate in each nonfarm occupation considered in any n^{th} year ahead up to the 9th year ahead and also in the 10th year ahead from each current year during the period 1917-62 are given in the appendix. The unemployment rate from the 10th year ahead was estimated as the expected average unemployment rate in the next nine years ($\hat{U}_{t+n} = \hat{U}_9$ for all $n \geq 10$). However, the expected unemployment rate from the 10th year ahead onwards from the current year 1962, was taken as the average unemployment rate in the last 15 years (1948-62).

A brief explanation of the expected unemployment rates in the years ahead from four current years, 1917, 1933, 1944, 1962 in each occupation is presented here. (For data, see next page.) These four current years are selected to represent end years of the time period (1917-62) considered in this study and the years of the highest (year 1933) and the lowest (year 1944) current unemployment recorded in the data.

The percentage of unemployment in manufacturing fluctuates from the lowest figure 0 in 1944 to the highest 43.10 in 1933; it fluctuates from 2.30 to 61.20 in construction, from 1.60 to 19.80 in laundries, and from 1.60 to 28.10 in retail trade. The fluctuations in unemployment rate in manufacturing and in construction are higher than those in laundries and retail trade. The expected unemployment rates for the next year, 5th year ahead, and the 9th year ahead from the current year 1944 (year lowest unemployment recorded) are higher than the unemployment rate recorded in 1944. The expected unemployment rates in the next year, 5th year ahead, and the 9th year ahead, from the current year 1933 (year of highest unemployment recorded) are lower than the unemployment rate recorded in 1933. These two statements are true in each nonfarm

TABLE 6.--Current and expected unemployment rate in the future years in various occupations, U. S., selected years.

Year	Percentage of unemployment in the Current year	Next year	5th year ahead	9th year ahead	10th year ahead and onwards
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
			Manufacturing		
1917	7.60	7.78	11.49	14.72	10.94
1933a	43.10	38.79	19.39	4.63	20.22
1944b	0.00	1.41	10.06	17.30	9.27
1962	5.80	5.95	10.84	14.82	5.29c
			Construction		
1917	13.00	13.26	18.17	22.62	17.58
1933a	61.20	55.92	29.02	8.90	30.37
1944b	2.30	4.21	16.02	26.04	15.11
1962	12.00	12.17	17.77	22.59	9.97c
			Laundries		
1917	4.90	4.98	6.46	7.91	6.30
1933a	19.80	17.98	9.64	3.59	10.10
1944b	1.60	2.17	5.81	8.96	5.53
1962	4.30	4.39	6.27	7.98	3.89c
			Retail Trade		
1917	6.40	6.55	8.51	10.71	8.43
1933a	28.10	25.48	13.24	4.45	14.05
1944b	1.60	2.46	7.55	12.25	7.31
1962	6.30	6.34	8.39	10.57	5.05c

a Year of highest unemployment rate recorded in data.
b Year of lowest unemployment rate recorded in data.
c Average unemployment rate during the period 1948-62.

Source: These figures are taken from the Appendix.

occupation considered. Extending these two statements, two generalizations with some exceptions can be made for all the nonfarm occupations considered. The expected unemployment rate in any year in the future (up to 9th year ahead) is lower than the current unemployment rate when the current unemployment rate is high. The expected unemployment rate in any year in the future (up to 9th year ahead) is higher than the current year unemployment rate when the current unemployment rate is low.

CHAPTER V

ANNUAL WAGE EXPECTATIONS IN VARIOUS OCCUPATIONS

The general procedure for estimating the expected annual wage in the remaining years of life of a 45 year old and a 25 year old worker in both the farm and nonfarm sectors that applies to all the occupations was discussed in the chapter on "Methodology." However, a brief outline of the method adopted is given in this chapter.

Introduction

Firstly, the following regression equations were fitted to annual wage data:

$$\hat{W}_n = \hat{\delta}_0^n + \hat{\beta}_0^n W_t + \hat{\beta}_1^n W_{t-1}, \ . \ . \ . + \hat{\beta}_k^n W_{t-k}$$

where n=1, 2, . . . , 9 and $\hat{\beta}_i^n$ represents the coefficient of the annual wage with lag i (i=0,1, . . .,k) in the equation fitted for estimating the average annual wage in the next n years ahead. From these fitted equations, $\hat{W}_{t+j}$ estimated expected annual wage in the nth year ahead, is derived. Two other regression equations

$$\hat{W}_{26} = \hat{\delta}_o^{26} + \hat{\beta}_o^{26} W_t, \ . \ . \ . + \hat{\beta}_k^{26} W_{t-k}$$

$$\hat{W}_{44} = \hat{\delta}_o^{44} + \hat{\beta}_o^{44} W_t, \ . \ . \ . + \hat{\beta}_k^{44} W_{t-k}$$

are also fitted to give an estimate of the average annual wage in the next 26 years ahead and 44 years ahead. From these two and other previous equations, the following two equations are derived.

$$\hat{W}_{26-9} = \hat{\delta}_o^{26-9} + \hat{\beta}_o^{26-9} W_{t-1}, \ . \ . \ . + \hat{\beta}_k^{26-9} W_{t-k}$$

where $\hat{W}_{26-9}$ is the estimate of the average annual wage from the ninth to the 26th year ahead.

Similarly

$$\hat{W}_{44-26} = \hat{\delta}_o^{44-26} + \hat{\beta}_o^{44-26} W_t + \hat{\beta}_o^{44-26} W_{t-1}, \ . \ . \ . + \hat{\beta}_k^{44-26} W_{t-k}$$

where $\hat{W}_{44-26}$ gives an estimate of the average annual wage in the period from the 26th year to the 44th year ahead.

From the regression equations for $\hat{W}_{26-9}$, $\hat{W}_{44-26}$, $\hat{W}_{t+9}$ and $\hat{W}_{t+26}$, two average annual wage increments (Δ_1 and Δ_2) are derived as follows:

$$\hat{\Delta}_1 = \frac{2}{17} [\hat{W}_{26-9} - \hat{W}_{t+9}]$$

$$\hat{\Delta}_1 = \frac{1}{9} [\hat{W}_{44-26} - \hat{W}_{t+26}]$$

$\hat{\Delta}_1$ is added to $\hat{W}_{t+9}$, 17 times to arrive at $\hat{W}_{t+26}$. $\hat{\Delta}_2$ is added to $\hat{W}_{t+26}$ 18 times to arrive at $\hat{W}_{t+44}$, which gives an estimate of the expected annual wage in the 44th year ahead. Thus, W_{t+i} for all $i=0,1,2,\ldots(n_2-1)$ are derived for each year from 1917 to 1962 in each of the five occupations. The number n_2 is the expected number of years of remaining life of a 25 year old worker.

Discussion of Results

In this section, empirical results for all the occupations considered are discussed. For each occupation the following decisions were made.

In all the regression equations for each occupation, k was determined as 1, because the regression coefficients of W_{t-k} where $k \geq 2$ were not significantly different from zero, even at the ten per cent level. Hence, all the regression equations were fitted only with the two independent variables, W_t and W_{t-1}. The number n was determined as nine even though $\bar{R}^2$ in the (n+1)th regression equation where $n>9$ is as high as .80. This was done for two reasons; firstly, to make this procedure consistent with the procedure adopted in the case of unemployment rate expectations; secondly, to reduce the computations.

The fitted regression equations to estimate the average annual wage rate in the next n years ahead (n=1,2, . . .9) for each occupation (farming, manufacturing, construction, laundries, retail trade) are given in the following pages.

The constant in all the first nine regression equations is not significantly different from zero even at the ten per cent level in all the occupations. But it is significantly different from zero even at the one per cent in the regression equations estimating the average annual wage in the next 26 and 44 years.

The regression coefficient of the current year annual wage is significantly different from zero even at the one per cent level in all the regression equations except the one for estimating the average annual wage in the next 44 years. This is true in each occupation.

The regression coefficient of the past year annual wage is significantly different from zero at the one per cent level only in the first three regression equations in farming; in the first regression equation in manufacturing; at the one per cent level in the first regression equation, and at the five per cent level in the second regression equation in construction; at the five per cent level in the first regression equation in laundries; at the one per cent level in the first regression equation, and at the five per cent level in the second, third, fourth and fifth regression equation in retail trade.

All the regression equations in each occupation except the one for estimating average annual wage in the next 44 years in farming explain over 80 per cent of the variation in the dependent variable. The regression equation for estimating the average annual wage in the next 44 years in the farming occupation explains about 78.5 per cent of the variation in the dependent variable.

The increase in the expected average annual wage in the future years, due to a one dollar increase in the current year annual wage, increases from 1.4857 dollars in the next year to 2.2878 dollars in the next nine years ahead in farming; from 1.3478 dollars in the next year to 1.7078 dollars in the next nine years in manufacturing; from 1.4589 dollars in the next year to 1.9438 dollars in the next nine years in construction; from 1.3465 dollars in the next year to 1.6380 dollars in the next nine years in laundries; from 1.4271 dollars in the next year to 1.9523 dollars in the next nine years in retail trade.

The decrease in the expected average annual wage due to a one dollar increase in the past year annual wage increases from 0.4761 dollars in the next year to 1.2412 dollars in the next nine years in farming; from 0.3213 dollars in the next year to 0.4831 in the next nine years in manufacturing; from 0.4325 dollars in the next year to 0.6324 dollars in the next nine years in construction; from 0.3436 dollars in the next year to 0.6190 dollars in the next nine years in laundries; from 0.4133 dollars in the next year to 0.7997 dollars in the next nine years in retail trade.

Expected annual wages in any nth year ahead (up to n=9) and the expected first and second increment in the annual wage from each current year during the period 1917-62 in each occupation are given in the Appendix. However,

Farming

The following are the estimated regression equations to derive an estimate of the average annual wage in the n years ahead (n=1,2, . . .9)

Equation	d.f.	$\bar{R}^2$
$\hat{W}_1 = \underset{(19.1412)}{14.1347} + \underset{(0.13561)}{1.4857}\,W_t - \underset{(0.1407)}{0.4761}\,W_{t-1}$	43	0.9902
$\hat{W}_2 = \underset{(26.1966)}{23.6702} + \underset{(0.1850)}{1.6024}\,W_t - \underset{(0.1928)}{0.5853}\,W_{t-1}$	42	0.9813
$\hat{W}_3 = \underset{(33.2712)}{30.8440} + \underset{(0.2312)}{1.6887}\,W_t - \underset{(0.2416)}{0.6594}\,W_{t-1}$	41	0.9699
$\hat{W}_4 = \underset{(40.1684)}{35.8971} + \underset{(0.2740)}{1.7739}\,W_t - \underset{(0.2863)}{0.7291}\,W_{t-1}$	40	0.9564
$\hat{W}_5 = \underset{(47.1397)}{43.7789} + \underset{(0.3157)}{1.8583}\,W_t - \underset{(0.3309)}{0.8030}\,W_{t-1}$	39	0.9403
$\hat{W}_6 = \underset{(54.6230)}{52.5094} + \underset{(0.3583)}{1.9471}\,W_t - \underset{(0.3758)}{0.8807}\,W_{t-1}$	38	0.9203
$\hat{W}_7 = \underset{(62.6687)}{66.8818} + \underset{(0.4023)}{2.0357}\,W_t - \underset{(0.4228)}{0.9639}\,W_{t-1}$	37	0.8956
$\hat{W}_8 = \underset{(71.3010)}{88.3503} + \underset{(0.4495)}{2.1452}\,W_t - \underset{(0.4765)}{1.0801}\,W_{t-1}$	36	0.8664
$\hat{W}_9 = \underset{(81.3444)}{116.6466} + \underset{(0.5078)}{2.2878}\,W_t - \underset{(0.5478)}{1.2412}\,W_{t-1}$	35	0.8318
$\hat{W}_{26} = \underset{(79.6285)}{601.1184} + \underset{(0.6728)}{2.13215}\,W_t - \underset{(0.6841)}{1.05668}\,W_{t-1}$	63	0.92432
$\hat{W}_{44} = \underset{(113.2449)}{1213.3940} + \underset{(0.8294)}{1.86532}\,W_t - \underset{(0.8575)}{0.76793}\,W_{t-1}$	45	0.7852

Manufacturing

The following are the estimated regression equations used to derive an estimate of the average annual wage in the n years ahead (n=1,2, . . .9).

Equation	d.f.	$\bar{R}^2$
$\hat{W}_1 = 4.8116 + 1.3478\ W_t - 0.3213\ W_{t-1}$ $(37.3683)\ (0.1451)\quad (0.1512)$	43	0.9912
$\hat{W}_2 = 33.0029 + 1.3925\ W_t - 0.3562\ W_{t-1}$ $(47.5911)\ (0.1893)\quad (0.1972)$	42	0.9842
$\hat{W}_3 = 41.6270 + 1.3912\ W_t - 0.3354\ W_{t-1}$ $(58.7884)\ (0.2303)\quad (0.2415)$	41	0.9760
$\hat{W}_4 = 33.4594 + 1.4250\ W_t - 0.3399\ W_{t-1}$ $(68.4557)\ (0.2631)\quad (0.2747)$	40	0.9677
$\hat{W}_5 = 36.8249 + 1.4558\ W_t - 0.3502\ W_{t-1}$ $(78.3267)\ (0.2960)\quad (0.3114)$	39	0.9583
$\hat{W}_6 = 27.8930 + 1.4876\ W_t - 0.3511\ W_{t-1}$ $(89.0997)\ (0.3261)\quad (0.3444)$	38	0.9472
$\hat{W}_7 = 16.5045 + 1.5296\ W_t - 0.3593\ W_{t-1}$ $(101.3050)(0.3574)\quad (0.3789)$	37	0.9336
$\hat{W}_8 = 0.1016 + 1.6312\ W_t - 0.4247\ W_{t-1}$ $(114.2754)(0.3914)\quad (0.4128)$	36	0.9174
$\hat{W}_9 = 10.0147 + 1.7078\ W_t - 0.4831\ W_{t-1}$ $(131.3263)(0.4397)\quad (0.4714)$	35	0.8957
$\hat{W}_{26} = 1069.4624 + 2.0384 - 0.8816\ W_{t-1}$ $(130.6944)\quad (0.6635)\ (0.6764)$	63	0.9574
$\hat{W}_{44} = 2037.5675 + 1.5903\ W_t - 0.2181\ W_{t-1}$ $(207.8165)\quad (0.8760)\quad (0.9089)$	45	0.8642

Construction

The following are the estimated regression equations used to derive an estimate of the average annual wage in the next n years ahead (n=1,2, . . .9).

Equation	d.f.	$\bar{R}^2$
$\hat{W}_1 = \underset{(31.5310)}{9.0837} + \underset{(0.1405)}{1.4589}\, W_t - \underset{(0.1490)}{0.4325}\, W_{t-1}$	43	0.9953
$\hat{W}_2 = \underset{(44.5387)}{4.8787} + \underset{(0.1923)}{1.4998}\, W_t - \underset{(0.2042)}{0.4447}\, W_{t-1}$	42	0.9906
$\hat{W}_3 = \underset{(56.6682)}{-1.0518} + \underset{(0.2363)}{1.5473}\, W_t - \underset{(0.2517)}{0.4624}\, W_{t-1}$	41	0.9849
$\hat{W}_4 = \underset{(68.6042)}{-15.1982} + \underset{(0.2766)}{1.6183}\, W_t - \underset{(0.2942)}{0.4991}\, W_{t-1}$	40	0.9780
$\hat{W}_5 = \underset{(81.6169)}{-26.3325} + \underset{(0.3162)}{1.6868}\, W_t - \underset{(0.3373)}{0.5357}\, W_{t-1}$	39	0.9693
$\hat{W}_6 = \underset{(95.6797)}{-46.2414} + \underset{(0.3550)}{1.7646}\, W_t - \underset{(0.3792)}{0.5763}\, W_{t-1}$	38	0.9588
$\hat{W}_7 = \underset{(111.5680)}{-69.4649} + \underset{(0.3962)}{1.8401}\, W_t - \underset{(0.4229)}{0.6109}\, W_{t-1}$	37	0.9452
$\hat{W}_8 = \underset{(130.5273)}{-83.5469} + \underset{(0.4408)}{1.8991}\, W_t - \underset{(0.4733)}{0.6332}\, W_{t-1}$	36	0.9279
$\hat{W}_9 = \underset{(153.2137)}{-108.1538} + \underset{(0.4879)}{1.9438}\, W_t - \underset{(0.5290)}{0.6324}\, W_{t-1}$	35	0.9067
$\hat{W}_{26} = \underset{(177.9759)}{1284.79016} + \underset{(0.9567)}{3.92312}\, W_t - \underset{(0.9808)}{2.74090}\, W_{t-1}$	63	0.9615
$\hat{W}_{44} = \underset{(301.9383)}{2441.2619} + \underset{(1.4004)}{2.32940}\, W_t - \underset{(1.4719)}{0.69526}\, W_{t-1}$	45	0.8644

Laundries

The following are the estimated regression equations used to derive an estimate of the average annual wage in the next n years ahead (n=1,2,3, . . .9).

	d.f.	$\bar{R}^2$
$\hat{W}_1 = 30.7954 + 1.3465\ W_t - 0.3436\ W_{t-1}$	43	0.9894
(22.4460) (0.1430) (0.1458)		
$\hat{W}_2 = 51.9897 + 1.3660\ W_t - 03603\ W_{t-1}$	42	0.9810
(29.9190) (0.1868) (0.1907)		
$\hat{W}_3 = 70.7593 + 1.4177\ W_t - 0.4083\ W_{t-1}$	41	0.9714
(36.5246) (0.2232) (0.2276)		
$\hat{W}_4 = 92.0853 + 1.4676\ W_t - 0.4577\ W_{t-1}$	40	0.9594
(43.2329) (0.2585) (0.2639)		
$\hat{W}_5 = 106.4602 + 1.5078\ W_t - 0.4915\ W_{t-1}$	39	0.9450
(50.2942) (0.2941) (0.2995)		
$\hat{W}_6 = 123.4582 + 1.5503\ W_t - 0.5315\ W_{t-1}$	38	0.9288
(57.1658) (0.3267) (0.3331)		
$\hat{W}_7 = 139.8237 + 1.5824\ W_t - 0.5595\ W_{t-1}$	37	0.9091
(64.6691) (0.3607) (0.3671)		
$\hat{W}_8 = 161.9980 + 1.6141\ W_t - 0.5939\ W_{t-1}$	36	0.8862
(72.2606) 0.3940) (0.4025)		
$\hat{W}_9 = 183.2212 + 1.6380\ W_t - 0.6190\ W_{t-1}$	35	0.8596
(80.5335) (0.4283) (0.4402)		
$\hat{W}_{26} = 571.71970 + 1.05970\ W_t + 0.03757\ W_{t-1}$	63	0.96435
(58.1184) (0.47039) (0.47482)		
$\hat{W}_{44} = 1040.8409 + 0.87423\ W_t + 0.31332\ W_{t-1}$	45	0.90232
(85.8099) (0.5654) (0.5749)		

Retail Trade

The following are the estimated regression equations used to derive an estimate of the average annual wage in the next n years ahead (n=1,2,3, . . .9).

Equation	d.f.	$\bar{R}^2$
$\hat{W}_1 = \underset{(21.5160)}{17.4682} + \underset{(0.13952)}{1.4271}\, W_t - \underset{(0.1444)}{0.4133}\, W_{t-1}$	43	0.9938
$\hat{W}_2 = \underset{(29.8875)}{29.4019} + \underset{(0.1878)}{1.4950}\, W_t - \underset{(0.1948)}{0.4701}\, W_{t-1}$	42	0.9881
$\hat{W}_3 = \underset{(37.0192)}{39.8592} + \underset{(0.2295)}{1.5891}\, W_t - \underset{(0.2388)}{0.5527}\, W_{t-1}$	41	0.9815
$\hat{W}_4 = \underset{(45.0110)}{47.8875} + \underset{(0.2711)}{1.6745}\, W_t - \underset{(0.2827)}{0.6238}\, W_{t-1}$	40	0.9728
$\hat{W}_5 = \underset{(53.6272)}{51.6231} + \underset{(0.3130)}{1.7412}\, W_t - \underset{(0.3272)}{0.6727}\, W_{t-1}$	39	0.9620
$\hat{W}_6 = \underset{(62.6676)}{52.4260} + \underset{(0.3533)}{1.8093}\, W_t - \underset{(0.3698)}{0.7204}\, W_{t-1}$	38	0.9490
$\hat{W}_7 = \underset{(72.6330)}{55.4136} + \underset{(0.3945)}{1.8772}\, W_t - \underset{(0.4142)}{0.7691}\, W_{t-1}$	37	0.9331
$\hat{W}_8 = \underset{(84.0379)}{58.5836} + \underset{(0.4381)}{1.9243}\, W_t - \underset{(0.4620)}{0.7955}\, W_{t-1}$	36	0.9132
$\hat{W}_9 = \underset{(97.1410)}{59.8471} + \underset{(0.4834)}{1.9523}\, W_t - \underset{(0.5133)}{0.7997}\, W_{t-1}$	35	0.8892
$\hat{W}_{26} = \underset{(85.6793)}{687.5397} + \underset{(0.7052)}{2.0368}\, W_t - \underset{(0.7170)}{0.9288}\, W_{t-1}$	63	0.9597
$\hat{W}_{44} = \underset{(133.3482)}{1301.1088} + \underset{(0.9022)}{1.5008}\, W_t - \underset{(0.9317)}{0.1832}\, W_{t-1}$	45	0.8797

the expected annual wages in the years ahead and the expected increments in the annual wages from four current years 1917, 1933, 1944, 1962 are given on the next page. These four years are selected to represent the starting year of the time period, depression year, year in the Second World War and the end year of the time period.

Broadly speaking, the expected annual wage in any n^{th} year ahead (n=1,2, . . .9) from any current year during the period 1917-62 is higher than the current year annual wage. This is true in each occupation considered in this study. Another generalization with an exception can be made in regard to the expected average increments in the annual wage. The expected increment in the annual wage from the tenth year to the $(n_1-1)^{th}$ year ahead, decreases in all the occupations except in farming and laundries as the current year annual wage increases. The expected increment in the annual wage from the n_1th to the $(n_2-1)^{th}$ year ahead increases in all the occupations except in farming and laundries as the current year annual wage increases. In farming and in laundries the relationships are reversed.

TABLE 7.--Current and expected annual wage in the next year, 5th year, 9th year, and expected increments in the annual wage in various occupations, U.S., Selected Years.

Year	Annual wage (dollars) in the current year	expected for the next year	expected for the 5th year	expected for the 9th year	Expected increments in the annual wage Δ_1	Δ_2
			Farming			
1917	486	548	697	1,007	67.08	70.44
1933	306	303	356	512	80.05	6634
1944	1,092	1,197	1,434	1,749	63.68	70.96
1962	2,483	2,552	2,807	2,739	86.88	61.92
			Manufacturing			
1917	778	842	1,022	1,270	160.49	73.03
1933	866	890	1,074	1,265	155.68	110.16
1944	2,376	2,487	2,925	3,474	113.84	213.91
1962	5,021	5,229	6,099	7,178	37.60	434.33
			Construction			
1917	715	774	892	937	253.54	37.65
1933	1,332	1,345	1,583	1,881	158.04	306.13
1944	1,966	2,036	2,457	3,002	151.88	330.70
1962	6,470	6,748	8,356	10,676	- 67.77	985.88

			Laundries			
1917	307	356	516	705	47.36	64.11
1933	746	761	909	1,063	68.64	56.51
1944	1,349	1,435	1,663	1,837	49.30	79.51
1962	2,630	2,691	2,946	3,063	80.40	78.68
			Retail Trade			
1917	510	554	689	794	99.62	53.79
1933	911	921	1,063	1,253	87.54	107.20
1944	1,392	1,471	1,742	2,025	78.16	110.77
1962	3,429	3,535	4,061	4,758	26.03	272.58

Source: Appendix B.

CHAPTER VI

PRESENT VALUES AND SUPPLY FUNCTIONS

Introduction

In this chapter the present values of the expected future income streams for 25 and 45 year old workers in all the occupations from 1917 to 1962 are discussed. Consistency of present values with the political and economic events is also discussed. The supply function of total number of agricultural workers and the supply function of total number of farm operators in each age group of farm operators are estimated. The independent variable in all the types of supply function was taken as the ratio of present value of the expected future income stream in the nonfarm occupation to the same in farm occupation.

Present Values of the Expected Future Income Stream

The method of estimation of present value was discussed in the second chapter on "Methodology." However, a brief explanation is given here. Present value consists of four components: (1) expected annual wage, (2) expected unemployment rate, (3) interest rate, and (4) expected remaining years of life. Given all of these four types of data, the present values in the nonfarm occupation and in farming, were estimated by the formulas given in Chapter II on "Methodology." The present values in various occupations are given in Appendix D. The present value of the expected future income stream for a 25 year old worker increased from $19,381 in 1917 to $56,423 in 1962 in farming; from $27,278 to $117,827 in manufacturing; from $27,412 to $155,543 in construction; from $13,007 to $57,271 in laundries; and finally, from $17,909 in 1917 to $78,303 in 1962 in retail trade. The present value of a 45 year old worker increased from $13,479 in 1917 to $43,709 in 1962 in farming; from $18,516 to $88,705 in manufacturing, from $17,747 to $112,581 in construction; from $8,888 to $44,136 in laundries; and finally from $12,173 in 1917 to $59,229 in 1962 in retail trade.

Apart from fluctuations in the present value of the expected future income stream due to major political or economic events, they showed a phenomenal increase from 1917 to 1962. This phenomenal increase can be attributed to (1) the price level increase, (2) to the increase in the productivity of the worker, finally (3) to the quality of the worker which was increased by the general level of education and knowledge. The present value of the expected future income stream for a 45 year old worker increased by about 324 per cent in farming, by about 479 per cent in manufacturing, by about 634 per cent in construction, by about 497 per cent in laundries, and by about 487 per cent in retail trade. The present value of the expected future income stream for a 25 year old worker increased by 291 per cent in farming, by about 432 per cent in manufacturing, by about 567 per cent in construction, by about 440 per cent in laundries and by about 437 per cent in retail trade.

Consistency of Present Values with Political and Economic Events

The present values of the expected future income stream are consistent with major economic and political events.

After the end of the First World War in 1918, the expected annual wage fell in retail trade. This was reflected in the low present value of the expected future income stream in all the occupations and in the case of both workers of age 25 and 45 in the year 1921. The onset of the depression in the American economy in the early thirties was followed by low wage expectations. In the post depression and in the beginning of the Second World War, present values increased for almost all occupations and for both 25 and 45 year old workers.

The Pearl Harbor attack by the Japanese and the participation of America in the Second World War in the year 1941 had a tremendous impact on the expectations about the future income stream. Present values rose in

1941 in almost all the occupations and in the case of both 25 and 45 year old workers. Especially in manufacturing and in construction, present values suddenly increased from $44,730 in the year 1940 to $53,391 in the year 1941 and from $54,415 in the year 1940 to $61,603 in the year 1941 respectively in the case of a 25 year old worker. In the case of a 45 year old worker, present value suddenly increased from $29,367 in the year 1940 to $36,235 in the year 1941 and from $34,561 in 1940 to $39,893 in 1941 respectively, in manufacturing and construction.

The Korean War was associated with increases in the value of expected future income streams. The present value for a 25 year old worker increased from $47,129 in 1950 to $54,824 in 1951 in farming; from $89,805 to $96,593 in manufacturing; from $104,231 to $114,879 in construction; from $49,377 to $52,518 in laundries; and from $52,124 to $68,013 in retail trade. In the case of a 45 year old worker, the present value of the expected future income stream increased from $30,601 in 1950 to $38,922 in 1951 in farming; from $61,232 to $66,376 in manufacturing; from $67,810 to $76,132 in construction; from $34,706 to $37,319 in laundries; and from $65,662 to $47,045 in retail trade.

The end of the Korean War was followed by reductions in the present values of the future income stream. In the case of a 25 year old worker, the present value decreased from $53,068 in 1953 to $50,680 in 1954 in farming; from $99,288 to $94,572 in manufacturing; from $119,062 to $115,824 in construction; from $52,087 to $51,516 in laundries and from $68,914 to $68,725 in retail trade. In the case of a 45 year old worker, the present value of the expected future income stream decreased from $38,160 in 1953 to $36,264 in 1954 in farming; from $69,315 to $65,422 in manufacturing; from $80,997 to $77,577 in construction; from $37,519 to $37,122 in laundries; and from $48,504 to $48,339 in retail trade.

After 1954, present values in all occupations which cannot be attributed to any specific major event, increased with minor fluctuations to 1962. The present value of the expected future income stream in the year 1962 reached 43,709 dollars in farming, 88,705 dollars in manufacturing, 112,581 dollars in construction; 44,138 dollars in laundries and 59,229 dollars in retail trade.

The present values estimated in this thesis probably have been underestimated in some years and overestimated in other years. In addition to the current and past annual wages, outlook information supplied by the government and other research agencies might have been taken into account by the workers in estimating the future expected annual wages. The outlook information might be concerned with the expected gross national product, imports, exports, consumer prices, and changes in the labor legislation.

The major political and economic events that occurred in the recent past and expected events in the future might greatly influence the expected annual wages. Hence, in the light of the past and future events, present values estimated in this study might be subjectively adjusted to yield better estimates of "actual" expectations held by workers.

Testing the Validity of the Present Values

Introduction

One way of testing the validity and relevance of the present values of the expected future income stream in the nonfarm and the farm sector is to test the hypothesis that the number of agricultural workers in the agricultural sector depends upon the ratio of the present value of the expected future income stream in the nonfarm sector to the same in the farm sector. Over time, this ratio has been increasing. In addition to other factors, if this variable is found to be significantly related to the decreasing numbers of farm workers, then it is safe to conclude that the estimates of the present values have some validity and are relevant in the context of migration of workers.

Another method of finding the validity of the estimates of the present values of the expected future income stream is to test the hypothesis that decisions of farm operators to continue or leave farming depends upon the ratio of expected present value in the nonfarm sector to the same in the farm sector. If the relationship between the ratio of the expected present value in the nonfarm sector to the same in the farm sector and the number of farm operators is found to be significantly different from zero at an acceptable probability level, then the estimates of present values can be considered to be at least partially validated and relevant.

First Method of Testing the Validity of the Estimates

The following regression equations are fitted with the ratio of number of agricultural workers in the year t to the number of agricultural workers in the base year 1917 as the dependent variable.

The emphasis in this section is on testing the relevance of the present values in the context of supply function of total number of agricultural workers. In this context, it is to be pointed out that these relationships are merely an outcome of a preliminary analysis and full analysis of these relationships must await a full scale effort on the part of another investigator.

All the regressions fitted with the ratio of present values as the independent variables, explain a high degree of variation in the dependent variable. Almost all of the regression coefficients in all the regressions are significantly different from zero at the one per cent level. The

$$1(a)\quad \frac{\hat{N}_t}{N_o} = \underset{(0.05650)}{1.101902} - \underset{(0.052343)}{0.160820}\, R^{M}_{25,t} + \underset{(0.013209)}{0.080882}\, R^{L}_{45,t} - \underset{(0.000421)}{0.010162}\, t$$

$$d.f. = 42 \qquad \bar{R}^2 = 0.965335$$

$$(b)\quad \log \frac{\hat{N}_t}{N_o} = \underset{(0.028093)}{0.031391} - \underset{(0.123232)}{0.350302} \log R^{M}_{25,t} + \underset{(0.042399)}{0.224432} \log R^{L}_{45,t} - \underset{(0.000754)}{0.013255}\, t$$

$$d.f. = 42 \qquad \bar{R}^2 = 0.937765$$

$$2(a)\quad \frac{\hat{N}_t}{N_o} = \underset{(0.064493)}{1.08829} - \underset{(0.060855)}{0.141230}\, R^{M}_{25,t} + \underset{(0.020793)}{0.090103}\, R^{T}_{45,t} - \underset{(0.000466)}{0.01055}\, t$$

$$d.f. = 42 \qquad \bar{R}^2 = 0.95466$$

$$(b)\quad \log \frac{\hat{N}_t}{N_o} = \underset{(0.030403}{0.064436} - \underset{(0.141941)}{0.264708} \log R^{M}_{25,t} + \underset{(0.05825)}{0.197040} \log R^{T}_{45,t} - \underset{(0.000834)}{0.013970}\, t$$

$$d.f. = 42 \qquad \bar{R}^2 = 0.918459$$

$$3(a)\quad \frac{\hat{N}_t}{N_o} = \underset{(0.032741)}{1.050768} - \underset{(0.031602)}{0.137960}\, R^{C}_{25,t} + \underset{(0.014205)}{0.102606}\, R^{L}_{45,t} - \underset{(0.000451)}{0.009508}\, t$$

$$d.f. = 42 \qquad \bar{R}^2 = 0.970796$$

$$(b)\quad \log \frac{\hat{N}_t}{N_o} = \underset{(0.023190)}{0.022787} - \underset{(0.081726)}{0.411072} \log R^{C}_{25,t} + \underset{(0.044983)}{0.324538} \log R^{L}_{45,t} - \underset{(0.000763)}{0.011734}\, t$$

$$d.f. = 42 \qquad \bar{R}^2 = 0.95369$$

$$4(a)\quad \frac{\hat{N}_t}{N_o} = \underset{(0.036532)}{1.056859} - \underset{(0.041122)}{0.170552}\, R^{C}_{25,t} + \underset{(0.025025)}{0.145471}\, R^{T}_{45,t} - \underset{(0.000522)}{0.009535}\, t$$

$$d.f. = 42 \qquad \bar{R}^2 = 0.9637104$$

$$(b)\quad \log \frac{\hat{N}_t}{N_o} = \underset{(0.024788)}{0.063400} - \underset{(0.113663)}{0.481270} \log R^{C}_{25,t} + \underset{(0.074623)}{0.397613} \log R^{T}_{45,t} - \underset{(0.000928)}{0.011845}\, t$$

$$d.f. = 42 \qquad \bar{R}^2 = 0.938121$$

Where

$$R^{M}_{25,t} = \frac{\text{Ratio of the present value in manufacturing for a 25 year old worker in the year t to its base value in the year 1917}}{\text{Ratio of the present value in farming for a 25 year old worker to its base value in the year 1917}}$$

$$R^{C}_{25,t} = \frac{\text{Ratio of the present value in construction for a 25 year old worker in the year t to its base value in the year 1917}}{\text{Ratio of the present value in farming for a 25 year old worker to its base value in the year 1917}}$$

$$R^{L}_{45,t} = \frac{\text{Ratio of the present value in launuries for a 45 year old worker in the year t to its base value in the year 1917}}{\text{Ratio of the present value in farming for a 45 year old worker to its base value in the year 1917}}$$

$$R^{T}_{45,t} = \frac{\text{Ratio of present value in trade for a 45 year old worker in the year t to its base value in the year 1917}}{\text{Ratio of present value in farming for a 45 year old worker to its base value in the year 1917}}$$

$$\frac{\hat{N}_t}{N_o} = \frac{\text{Total number of agricultural workers in the year t}}{\text{Total number of agricultural workers in the year 1917}}$$

't' is the time variable. This variable is included as a proxy for many factors, [illegible] nonmonetary, which are highly correlated with the time, such as average level of education and aspiration to live in urban area.

regression coefficients of the ratio of present value in nonfarm occupations to the same in farming for 25 year old workers have the right sign in all the regression equations. The regression coefficients of the present value in nonfarm occupations to the same in farming for a 45 year old worker shows generally the wrong sign. The regression coefficients of the time variable have the right sign in all the regression equations. For further explanation the linear regression equation 1(a) is used. The explanation for this equation applies more or less to all the other regression equations.

Regression equation 1(a) explains over 96.5 per cent of the variation in the ratio of the number of agricultural workers in the year t to the number of agricultural workers in the base year 1917. The regression coefficient of the ratio of expected present value in manufacturing to the expected present value in farming for a 25 year old worker is significantly different from zero at the 1 per cent level. The ratio of the present value in manufacturing to the present value in farming for a 25 year old worker has steadily increased over time. The regression coefficient of this variable indicates that as the ratio increases over time, the ratio of the number of agricultural workers to the number of agricultural workers in the base year decreases. This is quite consistent with the normally expected behavior of agricultural workers. In other words, when the present value of the expected future income stream in manufacturing for a 25 year old worker increases over time as compared to its counterpart in farming, rational agricultural workers, move to manufacturing to maximize their income. The number of entrants in the younger age group into farming decreases and the exits in the younger age group out of farming increases, resulting in a net decrease in the number of younger farm workers.

The regression coefficient of the ratio of the expected present value in laundries to the expected present value in farming for a 45 year old worker is also significantly different from zero at the 1 per cent level. The sign of the regression coefficient is negative. This sign does not seem to be inconsistent with reasonable theoretical models under some special conditions. The consistency of this negative relationship (between the total number of agricultural workers and the ratio of present values of the expected future income stream in laundries to the same in farming, in the case of a 45 year old workers) with the reasonable theoretical models is discussed below.

The following theoretical model,[1] represents one possible explanation for the observed negative relationship (between the total number of agricultural workers and the ratio of present values of the expected future income stream in laundries to the same in farming in the case of 45 year old worker) brought out in this study.

---

[1]This development was suggested by Dr. Robert L. Gustafson.

Let 1 $W_F = a_1 + b_1 (Q_{25} + Q_{45})$; $b_1 < 0$

2 $Q_{25} = a_2 + b_2 R_M$ $b_2 < 0$

3 $Q_{45} = a_3 + b_3 R_L$ $b_3 < 0$

$R_M = W_M/W_F$ $R_L = W_L/W_F$

Assumptions: W_M, W_L exogenous variables

W_F, R_M, R_L, Q_{25}, Q_{45} endogeneous variables

W_F: wage rate in farming

Q_{25}: number of 25 year old farm workers

Q_{45}: number of 45 year old farm workers

W_M: wage rate in manufacturing

W_L: wage rate in laundries

a_i (i=1,2,3) and b_i (i=1,2,3) are constants.

The first equation denotes a form of demand equation in farming. The second and third equations denote supply functions. The interpretation of these equations are as follows.

The farm wage rate is a decreasing function of total number of farm workers. The higher the total number of farm workers, the lower is the farm wage rate and the lower is the total number of farm workers, the higher is the farm wage rate. The farm wage rate is determined by the total number of farm workers. Hence farm wage rate is endogeneous variable because it is determined by the ratio of wage rates in the nonfarm occupations to the same in farming. Wage rates in nonfarm occupations are assumed to be exogeneous variables. The higher the ratio of manufacturing wage rate to the farm wage rate, the higher is the off-farm mobility of 25 year old farm workers and hence the lower is the total number of 25 year old farm workers in farming. The higher the ratio of wage rate in laundries to the wage rate in farming, the higher the off-farm mobility of 45 year old farm workers and hence the lower is the total number of 45 year old farm workers in farming.

Now suppose there is a change in W_M, manufacturing wage rate (exogeneous variable) and W_L, wage rate in laundries is constant. Differentiating with respect to W_M

4 $$dW_F = b_1\left(\frac{dQ_{25}}{dW_M} + \frac{dQ_{45}}{dW_M} \right)$$

5 $$\frac{dQ_{25}}{dW_M} = b_2 \frac{dR_M}{dW_M}$$

6 $$\frac{dQ_{45}}{dW_M} = b_3 \frac{dR_L}{dW_M}$$

7 $$\frac{dR_M}{dW_M} = \frac{W_F - W_M \frac{dW_F}{dW_M}}{W_F^2}$$

8 $$\frac{dR_L}{dW_M} = \frac{-W_L \frac{dW_F}{dW_M}}{W_F^2}$$

Let $\frac{dW_F}{dW_M} = X_1$; $\frac{dQ_{25}}{dW_M} = X_2$; $\frac{dQ_{45}}{dW_M} = X_3$

$\frac{dR_M}{dW_M} = X_4$; $\frac{dR_L}{dW_M} = X_5$

Now the equations 4 to 8 can be written as follows.

$$9 \quad X_1 - b_1X_2 - b_1X_3 = 0$$

$$10 \quad X_2 - b_2X_4 = 0$$

$$11 \quad X_3 - b_3X_5 = 0$$

$$12 \quad X_4 + \frac{W_M}{W_F^2} X_1 = \frac{1}{W_F}$$

$$13 \quad X_5 + \frac{W_L}{W_F^2} X_1 = 0$$

Solving these five linear equations (9-13) in five unknowns for the variables of interest and applying the assumed signs of b's we obtain the following results. (See Appendix F)

If W_M increases and W_L is constant

$R_M = \frac{W_M}{W_F}$ increases since $\frac{dR_M}{dW_M} > 0$

$R_L = \frac{W_L}{W_F}$ decreases since $\frac{dR_L}{dW_M} < 0$

Q_{25} decreases since $\frac{dQ_{25}}{dW_M} < 0$

Q_{45} increases since $\frac{W_L}{W_F}$ decreases

$Q_{25} + Q_{45}$ decreases since $\frac{d(Q_{45}+Q_{25})}{dW_M} < 0$

W_F increases since $Q_{25}+Q_{45}$ decreases and therefore there is negative correlation between $(Q_{25}+Q_{45})$, R_M and a positive correlation between $(Q_{25}+Q_{45})$, R_L. However, by symmetry, if W_L increases and W_M is constant the following conclusions are true.

$R_L = \frac{W_L}{W_F}$ increases, $R_M = \frac{W_M}{W_F}$ decreases,

Q_{45} decreases, Q_{25} increases,

$Q_{45}+Q_{25}$ decreases, W_F increases,

and therefore there is positive correlation between $(Q_{25}+Q_{45})$, R_M and negative correlation between $(Q_{25}+Q_{45})$, R_L.

Since the positive correlation between $(Q_{25}+Q_{45})$, R_L and negative correlation between $(Q_{45}+Q_{25})$, R_M are observed, the probable implication in this model might be the variation in the W_M (present value of the expected future income stream in manufacturing) is higher than the variation in W_L (Present value of the expected future income stream). The calculated data on W_M and W_L (present values, of course) support this implication.

All the regression equations even with different variables, support the argument that the signs of the regression coefficients of the concerned variables are consistent and validate the relevancy of the estimates of the present values in various occupations insofar as they are considered as indicators for decision making for farm workers whether to stay on farm or move out off-farm. The same arguments need not be repeated in repeated discussions of all the other regression equations.

Trend in the Expected Present Value of the Future Income Stream

Projections of the number of agricultural workers into the future required as a first step projection of the expected present values in the nonfarm and farm sector. The following sections deal with two types of functional form for fitting the trend in the present values for a 45 year old and 25 year old worker.

Both the linear regressions of the form $\frac{P_t}{P_o} = \delta_o + \beta t + U_t$ in actual values and of the form $\log \frac{P_t}{P_o} = \delta_o + \beta t + U_t$, where P_t is the present value and P_o is the present value in 1917 and δ_o, β are the parameters and t is the time variable, were fitted to the present values during the period 1917-62. These fitted regression equations were used for projecting the present values into the future. The foregoing analysis required the projections of present values only in the occupations; farming, manufacturing and construction in the case of a 25 year old worker and in farming, laundries and retail trade in the case of a 45 year old worker, hence the trends in those occupations were fitted. However, similar trends can be fitted for the present values in the other occupations. The fitted regression equations in various occupations in the case of 25 year and 45 year old worker are given below. P_t^F, P_t^M, P_t^C, P_t^L, P_t^T, are the present values in the year t in farming, manufacturing, construction, laundries and in

Trend in the Present Values in the Case of a 25 year old Worker

1. Farming

		d.f.	$\bar{R}^2$
1.a.	$P^F_t = \underset{(0.10151)}{0.44704}\, P^F_0 + \underset{(0.00389)}{0.05629}\, P^F_0\, t$	44	0.8227
b.	$\log P^F_t = \underset{(0.06731)}{-0.33529} + \log P^F_0 + \underset{(0.00258)}{0.03344}\, t$	44	0.7882

2. Manufacturing

		d.f.	$\bar{R}^2$
2.a.	$P^M_t = \underset{(0.122320)}{0.434230}\, P^M_0 + \underset{(0.004682)}{0.080224}\, P^M_0\, t$	44	0.8667
b.	$\log P^M_t = \underset{(0.059794)}{-0.154250} + \log P^M_0 + \underset{(0.002289)}{0.036637}\, t$	44	0.8501

3. Construction

		d.f.	$\bar{R}^2$
3.a.	$P^C_t = \underset{(0.149401)}{0.353856}\, P^C_0 + \underset{(0.005719)}{0.102059}\, P^C_0\, t$	44	0.8759
b.	$\log P^C_t = \underset{(0.052354)}{-0.055943} + \log P^C_0 + \underset{(0.002004)}{0.039142}\, t$	44	0.8942

Trend in the Present Values in the Case of a 45 year old Worker

1. Farming

		d.f.	$\bar{R}^2$
1.a.	$\hat{P}^F_t = \underset{(0.119091)}{0.351845}\, P^F_0 + \underset{(0.004559)}{0.061146}\, P^F_0\, t$	44	0.7991
b.	$\widehat{\log}\, P^F_t = \underset{(0.080723)}{-0.394113} + \log P^F_0 + \underset{(0.003090)}{0.035403}\, t$	44	0.7433

2. Laundries

		d.f.	$\bar{R}^2$
2.a.	$\hat{P}^L_t = \underset{(0.10512)}{0.83305}\, P^L_0 + \underset{(0.00402)}{0.08789}\, P^L_0\, t$	44	0.9137
b.	$\widehat{\log}\, P^L_t = \underset{(0.036828)}{0.205415} + \log P^L_0 + \underset{(0.001410)}{0.032444}\, t$	44	0.9216

3. Retail trade

		d.f.	$\bar{R}^2$
3.a.	$\hat{P}^T_t = \underset{(0.123866)}{0.590924}\, P^T_0 + \underset{(0.004741)}{0.088161}\, P^T_0\, t$	44	0.8798
b.	$\widehat{\log}\, P^T_t = \underset{(0.042628)}{0.042410} + \log P^T_0 + \underset{(0.001632)}{0.034274}\, t$	44	0.9073

retail trade respectively. P_0^F, P_0^M, P_0^C, P_0^L, P_0^T are the present values in the year 1917 in farming, manufacturing, construction, laundries and in retail trade respectively. 't' is the time variable.

The constant and the regression coefficient of the time variable in each functional form and in each occupation in the cases of a 25 year old and 45 year old worker, are significantly different from zero even at the one per cent level. All the fitted regression equations explain above 74 per cent of the variation in the dependent variables. These fitted regression equations with time as an independent variable will be used in the following sections for projecting the present values. These projected present values will be used for projecting the total number of agricultural workers and also total number of farm operators in each age group.

Second Method of Testing the Validity of the Estimates of Present Values

The second test involves the relationship between the number of farm operators by age group and the ratio of present values in the nonfarm and farm occupations. For each age group two estimates, one linear and the other logarithmic, are given. For each age group regression equations were fitted with the ratio of the number of farm operators to the number of rural survived males who were

10 years younger in the previous census period as the dependent variable and the ratio of present value in the nonfarm occupation to the same in farming as the independent variable. The dependent variable relate to the four census years 1930, 1940, 1950, 1960. The independent variable is the ratio of the average present value in nonfarm occupation to the same in farming. The present values are averaged in the previous 10 years from the census year. For example, the corresponding independent variable for the dependent variable in the census year 1930 is the ratio of average present value during the period 1920-29 in the nonfarm occupation to the same in farming. Since present values for the entire period 1910-19 were not available, the census year 1920 was eliminated from the census years used in this study. Therefore the number of observations for this study is only four.

For each age group and for each functional form, four regression equations were fitted. The independent variable in each regression is the ratio of present value in the corresponding nonfarm occupation to the same in farming. On the basis of the results, one occupation for each age group was selected for further use. The results revealed that the ratio of present value in manufacturing to the same in farming was highly correlated with the dependent variable in the lower age groups and the ratio of present value in laundries to the same in farming was highly correlated with the dependent variable in the higher age groups.

These findings are quite consistent with economic reasoning having to do with acquisition costs and salvage values of laborers in the farm sector. The young farm workers are more attracted to the high paid nonfarm occupations like manufacturing. Older people cannot get jobs in manufacturing because of technical educational, experience and training requirements associated with the jobs. Hence, older farm workers are likely to get only low paid nonfarm jobs in occupations like laundries or retail trade.

The following are the empirical results in each age group. In the first two age groups, the sign of the regression coefficient is negative, which indicates that as the ratio of present value in manufacturing to the present value in farming increases over time, the number of farm operators will decrease, given the number of survived rural males. This is due to the fact that the number of young people who enter farming decreases due to the attractiveness of urban jobs, and the number of young people who leave farming increases for the same reason. Therefore it is reasonable to conclude that the ratio of present values is playing its expected role as a guide for directing the flow of young people. Hence, estimates of present values are relevant in explaining the occupational choice of the farm operators. In the rest of the age groups, the sign of the regression coefficient is positive which it can be interpreted in a reasonably way. The ratio of the present value

Age Group: 15-24 Years

	Equation	d.f.	$\bar{R}^2$
1.a.	$(\hat{F_t/S_t}) = 0.996250 - 0.513848\ R^M_{25,t}$	2	0.66465
	$(0.354894)\ (0.194970)$		
b.	$\hat{\log}\ (f_t/S_t) = 3.764719 - 19.319177 \log R^M_{25,t}$	2	0.871761
	$(1.086341)\ (4.176811)$		

Age Group: 25-34 Years

	Equation	d.f.	$\bar{R}^2$
2.a.	$(\hat{f_t/S_t}) = 2.421993 - 1.162381\ R^M_{25,t}$	2	0.582466
	$(0.929187)\ (0.510472)$		
b.	$\hat{\log}\ (f_t/S_t) = 1.415935 - 7.454133 \log R^M_{25,t}$	2	0.668560
	$(0.730098)\ (2.807110)$		

Age Group: 35-44 Years

	Equation	d.f.	$\bar{R}^2$
3.a.	$\hat{f_t/S_t} = 0.348837 + 0.294460\ R^L_{45,t}$	2	0.66465
	$(0.143499)\ (0.120707)$		
b.	$\hat{\log}\ (f_t/S_t) = -0.194052 + 0.524684 \log R^L_{45,t}$	2	0.662715
	$(0.018170)\ (0.199822)$		

Age Group: 45-54 Years

	Equation	d.f.	$\bar{R}^2$
4.a.	$\hat{f_t/S_t} = 0.471254 + 0.305632\ R^L_{45,t}$	2	0.541985
	$(0.170337)\ (0.143282)$		
b.	$\hat{\log}\ (f_t/S_t) = -0.112303 + 0.46270 \log R^L_{45,t}$	2	0.61302
	$(0.017596)\ (0.193498)$		

Age Group: 55-64 Years

	Equation	d.f.	$\bar{R}^2$
5.a.	$(\hat{f_t/S_t}) = 0.358871 + 0.417370\ R^L_{45,t}$	2	0.80978
	$(0.133708)\ (0.112471)$		
b.	$(\hat{\log}\ (f_t/S_t) = -0.112250 + 0.603165 \log R^L_{45,t}$	2	0.839015
	$(0.013448)\ (0.147884)$		

Age Group: 65 Years and Above

	Equation	d.f.	$\bar{R}^2$
6.a.	$(\hat{f_t/S_t} = 0.145261 + 0.414028\ R^L_{45,t}$	2	0.841750
	$(0.119527)\ (0.100543)$		
b.	$\hat{\log}\ (f_t/S_t) = -0.254853 + 0.797935 \log R^L_{45,t}$	2	0.85605
	$(0.016717)\ (0.183834)$		

in laundries to the present value in farming has been decreasing over time. This tendency is not only exhibited in the case of laundries but also in many occupations similar to laundries in which older farmers have been able to enter. Even though the ratio has been decreasing, the magnitude of present value in the laundries has been greater than the present value in farming. Hence, the older farmers who find occupations similar to laundries and retail trade as the only occupations in which they can enter, are inclined to move into these occupations because they do not possess the higher skills and technical training to enter other occupations. One possible explanation for the positive relationship is that both the number of older farmers, mainly because of deaths, retirement and other reasons, and the ratio of expected present values have been declining over time. Since both are highly negatively correlated with time, these two variables are positively correlated. Whatever may be the cause, the relationships are fairly strong, and most of the regression coefficients are significantly different from zero at the five per cent level in most of the age groups.

Projection of Number of Agricultural Workers and Comparisons With the Previous Projections

For the purpose of projection of number of agricultural workers to 1980, two of the estimated regression equations 1(a) and 2(a) in the page 105 are used. For the ratios, only linear trends are used

1(a) $$\frac{\hat{N}_t}{N_o} = 1.101902 - 0.160820\ R^M_{25,t} + 0.080882\ R^L_{45,t} - 0.01062\ t.$$

2(a) $$\frac{\hat{N}_t}{N_o} = 1.088290 - 0.141230\ R^M_{25,t} + 0.090103\ R^T_{45,t} - 0.01055\ t$$

$(\frac{N_t}{N_o})$ can be derived as a function of time only by simply substituting estimated functions of time for $R^M_{25,t}$ and $R^L_{25,t}$. One method of projecting $(\frac{N_t}{N_o})$ for any year in the future is by simply substituting the number of year in the future after derivation of $(\frac{N_t}{N_o})$ as simply a function of time. An equivalent method is a two stage procedure. Firstly, $R^M_{25,t}$ and $R^L_{45,t}$ are projected in the future. These values are substituted for each year in the future to arrive at $\frac{N_t}{N_o}$ in the future. The following table gives the estimated values for each variable in the future.

The ratio of present value of the expected future income stream in manufacturing to the same in farming for a 25 year old worker increased from 1.35837 in 1963 to 1.37214 in 1980. The rate of increase seems to be very low and is decreasing over time. The ratio of present value of the expected future income stream in laundries to the same in farming for a 45 year old worker is decreasing over time.

TABLE 8.--Estimated ratios of present values and total number of agricultural workers in the U. S., 1963-80.

Year	$R^{M}_{25,t}$	$R^{L}_{45,t}$	$R^{T}_{45,t}$	(Number given to the year)	$\hat{N}_t$ Equation (1a) (in thousands)	$\hat{N}_t$ Equation (2a) (in thousands)
1963	1.35837	1.54081	1.43906	46	7,335	7,338
1964	1.35958	1.53885	1.43859	47	7,192	7,192
1965	1.36076	1.53696	1.43804	48	7,050	7,046
1966	1.36189	1.53514	1.43751	49	6,908	6,900
1967	1.36298	1.53339	1.43700	50	6,765	6,754
1968	1.36404	1.53169	1.43651	51	6,623	6,608
1969	1.36505	1.53006	1.43604	52	6,481	6,462
1970	1.36604	1.52848	1.43558	53	6,340	6,317
1971	1.36700	1.52696	1.43514	54	6,198	6,171
1972	1.36792	1.52548	1.43471	55	6,057	6,026
1973	1.36882	1.52406	1.43429	56	5,915	5,880
1974	1.36969	1.52268	1.43389	57	5,774	5,735
1975	1.37053	1.52134	1.43350	58	5,633	5,590
1976	1.37134	1.52004	1.43313	59	5,492	5,445
1977	1.37214	1.51878	1.43276	60	5,351	5,300
1978	1.37291	1.51756	1.43241	61	5,210	5,155
1979	1.37365	1.51638	1.43206	62	5,069	5,010
1980	1.37438	1.51523	1.43173	63	4,928	4,865

Heady and Tweeten[1] have pointed out that projecting 1950-60 trends yields a prediction that the farm labor force will decline from 7.1 million in 1960 to 4 million in 1980, a 44 per cent decline. In an alternative procedure, they estimated the number of workers required in 1980 to be 3.6 million. This result was based on the compound interest formula assuming annual increases in output and output per man-hour to be 1.8 and 5 per cent respectively. In the present study, total number of agricultural workers is projected to 1980 using two regression equations. On the basis of regression equation (1a), the estimate of total number of workers in 1980 is 4.93 million, and on the basis of regression equation (2a) it is 4.87 million. The estimates in this study are higher than what Heady and Tweeten estimated. The total number of workers will decline from 6.70 million in 1962 to 4.93 or 4.87 million in 1980 if these projections were true. These estimates indicate that there will be at least a reduction of 1.77 million agricultural workers.

Projection of Number of Farm Operators and Comparison With the Previous Projections

The number of farm operators in each age group is projected for 1970. The projected total number of farm

---

[1]Earl O. Heady, Luther Y. Tweeten, Resource Demand and Structure of the Agricultural Industry (Ames, Iowa: Iowa State University Press, 1963).

operators is obtained by adding all the projected number of farm operators in each age group. The projection of the number of farm operators in each age group is made as follows. From the projections of the present values in the farm and some of the nonfarm occupations, the average present values in each occupation during the period 1960-70 is estimated. Then the ratio of average present values in the nonfarm occupation to the same in farming is used in the regression equation for estimating the ratio of farm operators to the survived rural farm males in each age group. After obtaining these ratios in the age groups, they are multiplied by the estimates of rural survived males in the corresponding age group to obtain the estimates of farm operators in each age group for 1970. The estimates of rural survived males for 1970 are given in the Appendix D.

Table 9, on the next page, gives the number of farm operators in each age group from census year 1920 to census year 1960 and also projected number of farm operators for 1970 along with previous projections.

Bishop and Tolley estimated the total number of farm operators for 1970 at 2.65 million. This figure given in terms of the 1960 census definition of a farm, is equivalent to approximately 2.82 million "1950" farms when adjusted by the total U. S. farm definitional change weight of 0.941.

Fox (1962) has estimated that there will be 1.4 million commercial farms selling $2,500 worth or more of

TABLE 9.--Number of farm operators by age group by census years (1920-60) and projections of number of farm operators for 1970 according to 1950 census definition, U. S.

Year	Farm Operators						
	Total	<25	25-34	35-44	45-54	55-64	65+
				(thousands)			
1920	6,448	388	1,305	1,608	1,502	1,007	592
1930	6,289	384	1,085	1,504	1,512	1,103	701
1940	6,097	244	992	1,207	1,491	1,198	865
1950	5,379	175	844	1,266	1,234	1,066	794
1960	3,933	65	428	858	1,047	851	683

Source: Agricultural Census, U. S., 1920, 1930, 1940, 1950, 1960

Estimated for 1970 by Other Studies

Bishop[a] and Tolley (1963)	2,820	58	283	424	716	728	611
Fox[b] (1962)	2,657	45	247	404	683	696	583
Johnston[c] (1963)	2,756	52	267	421	702	715	599
Marion Clawson[d]	2,787	80	200	475	764	720	548
	(2,440)	(50)	(150)	(400)	(690)	(650)	(500)

Estimated for 1970 on the Basis of this Study

Linear	2,770	27	212	442	736	740	613
Cobb-Doublass	2,780	31	234	439	729	737	610

[a]C. E. Bishop and G. S. Tolley, Manpower in farming and related occupations, Education for a changing world of work. Appendix II. Report of the panel of consultants on vocational education, (Washington D.C.: U. S. Department of Health, Education and Welfare, U. S. Government Printing Office, 1963).

[b]K. A. Fox, "Commercial Agriculture: Perspectives and Prospectives," in Farming, Farmers and Market for Farm Goods, Supplementary Paper No. 15 (New York: Committee for Economic Development, 1962)

[c]W. E. Johnston, The Supply of Farm Operators, an unpublished thesis, North Carolina State of the University of North Carolina, Raleigh, North Carolina, 1963).

[d]Marion Clauson, "Aging Farmers and Agricultural Policy," Journal of Farm Economics, Vol. 45 (February, 1963), p. 15, Table 1. The Figures in this bracket are low estimates. The figures in this study relate to only the number of farm operators reporting age.

farm products in 1970. If, as in the case of 1960, commercial farms were to make up 56 per cent of the total farm population, there would be 2.5 million farms in 1970 according to 1960 definition. This estimate would be equivalent to about 2.657 million "1950" farms.

Johnston, utilizing an iterative procedure, estimated the number of total farm operators. He estimated the total number of farm operators as 2.593 and 2.756 million as per 1960 and 1950 census definition respectively.

Marion Clawson (1963) assuming that the same rates of entry and withdrawal in each age group in the past censuses, will continue in the future, estimated the total number of farm operators for 1970. He provided high and low estimates in each age group.

The number of farm operators in the age group 15-24 in the 1960 census is 62 thousand. The number of farm operators projected for 1970 in this study is 26 thousand by linear regression method and 30 thousand by the log linear method as compared to 56, 43, 50 thousand estimated by Bishop and Tolley, Fox and Johnston respectively. The estimates of this number made in this study are low relative to other estimates, they may very well be nearer correct. The highly favorable nonfarm opportunities for farm youth will reduce the number of entrants to and encourage the number of withdrawals from farming operations. If we compare the decrease in number of farm operators in the age group 15-24 from 175 thousand in 1950 census to 65 thousand in 1960 census, the estimated decrease from 62 thousand in the 1960 census to 26 or 30 thousand in 1970 does not seem to be unnatural or unreasonable. In the light of this fact, the estimated decrease from the 1960 census to the 1970 census in the number of farm operators in the age group 15-24 by other studies appears too low. From the same point of view, the estimated decrease in number of farm operators for 1970 in the age group 25-34 by other studies also appears underestimated as compared to the estimated decrease of this study. The estimates made in this study in the higher age groups are higher than the estimates made in the previous studies.

Table 10, on the following page, gives the age composition of farm operators in the 1960 census and the projected number of farm operators according to the definition of 1960 census.

For the United States, according to 1960 census definition the estimate of total number of farm operators for 1970 in this study is 2.607 million by linear regression method and 2.616 million by the log linear method as compared to the 1960 enumeration of 3.701 million.

The total number of farm operators projected for 1970 on the basis of methods used in the previous studies by Bishop and Tolley, Fox, Johnston and Clawson and in this study do not deviate much from each other. Even though the

TABLE 10.--Number of farm operators by age group in the years 1960, 1970 according to 1960 census definition, U. S.

Year	Farm Operators						
	Total	<25	25-34	35-44 (thousands)	45-54	55-65	65+
1960	3,701	62	407	812	988	809	623
				Estimates for 1970 by Different Studies			
				Bishop and Tolley (1963)			
1970	2,654	56	269	401	676	692	557
				Fox (1962)			
1970	2,500	43	235	382	645	662	531
				Johnston (1963)			
1970	2,593	50	254	398	663	680	546
				Present Study			
1970 Linear 1	2,607	26	201	418	695	704	558
Cobb-Douglas 2	2,616	30	222	415	688	701	556

projected total number of farm operators for 1970 in this study does not differ much from the previous projections, the age distribution of farm operators is quite different from those obtained in the previous studies. The projected number of younger farm operators for 1970 in this study is generally lower than those in the previous studies and the projected number of older farmers in this study is generally higher than the same estimates for 1970 in the other studies. This is probably due to the fact that the method adopted in this study is (1) based on data compiled herein but not available to previous investigators and (2) employes, implicitely recent contributions concerning the fixity and variability of labor in farming.

The basic economic rationale behind all the studies mentioned above is that farm workers move out to nonfarm occupations whenever they find that the ratio of nonfarm wage rates to the same in farming is higher than the minimum ratio at which they are indifferent. Since the ratio of wage rate in nonfarm occupations to the same in farming, on the basis of which farm workers of different ages respond in terms of mobility to nonfarm occupations has not been available, different investigators used different ratios to reflect nonfarm-farm wage ratios.

Marion Clawson projected for 1970 the number of farm operators in each age group. For projection, he used the average net entries or net withdrawals of farm operators from one age group in one census period to the next age group in the next census period. These averages were based on the census periods from 1890 to 1960. The monetary and nonmonetary conditions which influenced the age specific mobility in 1890 were not the same as in 1960. Therefore, his projections of number of farm operators for 1970 are based on less information than those in this study.

Bishop and Tolley projected the number of farm operators in each age group in the U. S. for 1970 on the assumption that the ratio of number of farm operators in the ith age group in the t^{th} census period to the number of farm operators in the (i-1)th age group in (t-1) census period is a function of the ratio of total number of farm operators in the t^{th} census period to the same in (t-1) census period. They assumed that the ratio of total number of farm operators in the t^{th} census period to the same in $(t-1)^{th}$ census period has been a reflection of the ratio of wage rate in nonfarm occupations to the same in farming. The substitutions of the ratio of the total number of farm operators in the t^{th} census period to the same in (t-1)th census period for the ratio of nonfarm wage rates to the wage rate in farming during the interval of the two census periods is rather an unsophisticated method.

Johnston used a different approach from the one used by Tolley and Bishop. Since a suitable measure of the ratio of nonfarm-farm wage rate was not available he estimated by iterative procedure such measures for states, regions and for the nation. The estimated ratios of nonfarm wage rate to the same in farming in the past decades were those assumed to cause the ratios (observed in the past decades) of the number of farm operators to the survived rural farm males in each age group in the past decades. Johnston projected the total number of farm operators for 1970 (one of his projections) on the assumption that the estimated ratio of nonfarm wage rate to the wage rate in farming for 1960 will also be the same for 1970. Even though the ratio is assumed the same in 1970 as in 1960, the estimated number of rural survived farm males for 1970 in each age group were used to estimate the number of farm operators for 1970 in each age group.

Fox first estimated for 1970 the number of commercial farms with sales of $2,500 or more and then adjusted by the proportion of commercial farms to the total number of farms in 1960 to estimate the total number of farms in 1970.

Heady and Tweeten projected the farm labor force for 1980 on the basis of linear trend during the period 1950-60. They also projected the number of farm workers on the basis of compound interest formula assuming annual increases in output and output per man hour of 1.8 and 5 per cent respectively.

Most of the previous studies for projecting the farm operators in different age groups were based either directly or indirectly on the hypothesis that the mobility of farm workers to nonfarm occupations is responsive to the ratio of current nonfarm wage rate to the current wage rate in farming. This assumption is not entirely correct. Farm workers (or anybody else) in changing occupations generally think in terms of lifetime expected returns, and their present values rather than simply current year annual wages. Therefore in this study the mobility of farm workers was assumed to be responsive to the ratio of present value of the expected future income stream in nonfarm occupation to the same in farming. Hence the method used in this study may be better than any other technique used in the previous studies. If the estimated streams of income are accurately enough estimated then one can assert that the method used in this study is better than any other previous study.

The projected number of farm operators in each age group for 1970 indicates that the trend of aging of farm operators is not going to be reversed. This is clearly exhibited by the very small number of farm operators in the age group 15-24. This trend of aging of farm operators will be reversed in the future only if the ratio of present values of the expected future income stream in the nonfarm to farm sector turns out to be favorable for farming. This occurs only if the farm enterprises are found most desirable compared to nonfarm occupations. According to the projected number of farm operators for 1970, in this study, there will be a reduction of at least 1.15 million in the number of farm operators.

CHAPTER VII

SUMMARY AND CONCLUSIONS

A conspicuous characteristic of American agriculture is the dramatic decline in farm labor input and increase in farm output. The total number of farm workers also decreased but not in the same proportion as total farm labor input. Despite the recent unparalleled decline in farm labor input, farm output continues to be in excess over what is demanded. Hence, labor transfer from the farm sector to the nonfarm sector has long been a concern to economists, rural sociologists and agricultural policy designers. The overcommitment of labor in agriculture involves labor flows from the nonfarm sector but, mainly, failure to induce a sufficient flow of labor from the farm sector. Hence, knowledge of the impact of important factors influencing the mobility of agricultural workers will be of great help for policy makers.

Age is an important independent factor influencing the mobility of farm workers. Among the monetary variables, the ratio of the present value of the expected future income stream of a worker in the nonfarm sector to the present value of the expected future income stream in the farm sector is considered to be the basis upon which farm workers decide their occupational choice. This is a variable which has not been estimated and used in the previous studies.

In calculating the present value of the future income stream in the nonfarm sector, a question arose as to what kind of jobs farm workers usually take as they move to the nonfarm sector. On the basis of information in the literature, the occupations in the nonfarm sector which the farm workers have been mostly entering are taken as (1) building trades (helpers and laborers), (2) manufacturing, (3) service industries, (4) trade (retail) and (5) local government.

Since age is one of the main factors in relation to the mobility of farm workers, data on the present values of the expected future income stream for a worker of age 25 and 45 were produced to this study. Since the expected remaining number of years of life of worker is a part of the calculation of the present value of the future income stream, the expected remaining years of life of 25 year and 45 year old workers since 1917 to 1962, were taken from life tables. An assumption made in this study was that the workers retire through death.

One of the variables included in the calculation of the present value of the future income stream was the current rate of interest. The average rate of interest for farm mortgage loans was used for the purpose in this study. For comparative purposes, the annual wage rate for hired labor in the farm sector and annual wage rate in the nonfarm occupations were used in this study. Unemployment in the nonfarm sector can seriously reduce the expected income stream of a potential off-farm migrant. Hence an adjustment of the annual wage in the nonfarm sector was made with the factor $(1-\frac{U}{100})$ where U is the percentage of unemployment in the concerned occupation in the nonfarm sector.

Unemployment rates in the nonfarm occupations were available only for the period 1948-1962 but were projected backwards to 1917. Stanley Leborgott in the appendix of his book "Manpower and Economic Growth" has given an unemployment rate series as defined by the percentage of unemployed to nonfarm employees. This series is available from 1917 to 1960. During the period 1948-60, the unemployment rate in all the occupations was highly correlated with the unemployment rate given by Leborgott. Hence, a linear regression was run with the unemployment rate in the concerned occupation as the dependent variable and unemployment rate given by Leborgott as the independent variable. The unemployment rate in all the occupations was projected back to 1917 on the basis of this procedure.

Annual wage data in trade and laundries were not available from 1917 to 1938 and from 1917 to 1933 respectively. Annual wage data in building trades (helpers and laborers) were available from 1917. It was also clear that annual wages in retail trade and in launderies were highly correlated with the annual wage in building trades (helpers and laborers) during the periods 1934-1947 and 1939-51, respectively. Hence, it was decided to fit a regression line with the annual wage in retail trade and in laundries as dependent variables and annual wage in building trades as the independent variable and to project backwards the annual wage in retail trade for the period 1917 to 1938 and the annual wage in laundries for the period 1917-1933.

The annual wage in all the occupations was also projected forward to 2007, after fitting a linear regression with the annual wage as dependent variable and time as independent variable during the period 1950-1962. Thus, estimates of annual wages in the five occupations were made available from 1917 to 2007 and unemployment rates were made available from 1917 to 1962.

An important phase of this study was the formulation of a method by which estimates could be made of workers expectations about the annual wages and unemployment rates in the future.

In this study, it was assumed that workers base their estimates for the future years on current as well as past observations. Firstly, the average annual wage or the average unemployment rate in the next n years from the current year (n=1,2, . . .9) were estimated by regression lines, fitted with current year and past year annual wages and unemployment rate as independent variables. From these estimated averages the annual wage and unemployment rate in any nth year ahead from the current year were derived in such a way that the average of all the estimates in each year up to n years ahead was equal to the estimate of the average in the next n years ahead. In the case of the unemployment rate, the estimated average in the next nine years was used for the estimate of the expected unemployment rate from the tenth year to the n_2th year ahead from the current year.

But in the case of the annual wage estimate a different procedure was adopted. Firstly, two regression equations for estimating the average of annual wage in the next 26 years, were fitted with current year and past year annual wages as independent variables. From these two fitted regression equations, two increments in annual wage were Δ_1 being the annual increment from ninth year ahead to 26th year ahead and Δ_2 being the annual increment from 26th year to 44th year ahead. They were derived as functions of current and past year annual wages. Secondly, Δ_1 an increment in annual wage was added to the annual wage in the ninth year ahead every year up to (n_1-1)th year ahead to arrive at the annual wage expected in each year from the ninth to the 26th year ahead from the current year. Thirdly, Δ_2, an increment in annual wage, was added to the annual wage in the (n_1-1)th year ahead, every year up to

(n_2-1)th year ahead to arrive at the annual wage expected in each year from (n_1-1)th year to (n_2-1)th year ahead from the current year. After estimating the unemployment rate, and annual wage up to (n_2-1) years ahead from the current year, annual wage in the relevant nonfarm occupations was adjusted for unemployment rate in the concerned occupation in the nonfarm sector. After adjustment of annual wage for unemployment rate, present values of the expected future income stream in each year since 1917 to 1962 were calculated for both the 45 and 25 year old worker in the nonfarm and farm occupations. This calculation took into account the variable interest rate and the variable expected number of remaining years of life of 45 year old and 25 year old worker.

The present values of the expected future income stream seems to be consistent with economic and political events overtime, 1917 to 1962. The present value of the expected future annual wage for a 25 year old worker increased from $19381 in 1917 to $56,423 in 1962 in farming; from $27,278 to $117,827 in manufacturing; from $27,412 to $155,543 in construction; from $13,007 to $57,271 in laundries; and finally, from $17,909 in 1917 to $78,303 in 1962 in retail trade. The present value for a 45 year old worker increased from $13,479 in 1917 to $43,709 in 1962 in farming; from $18,516 to $88,705 in manufacturing, from

$17,747 to $112,581 in construction; from $8,888 to $44,136 in laundries; and finally from $12,173 in 1917 to $59,229 in 1962 in retail trade.

After the end of the First World War in 1918, the expected annual wage fell. This was reflected in the low present value of the expected future income stream in all the occupations and in the case of both workers of age 25 and 45 in the year 1921. The onset of the depression in the American economy in the early thirties was followed by low wage expectations. In the post depression and in the beginning of the Second World War present values increased for almost all the occupations and in the case of both 25 and 45 year old workers.

The Pearl Harbor attack by the Japanese and the participation of America in the Second World War in the year 1941 had a tremendous impact on the expectations about the future income stream. Present values rose in 1941 in almost all the occupations and in case of both 25 and 45 year old workers. Especially in manufacturing and in construction, present value suddenly increased from $44,730 in 1940 to $53,391 in 1941 and from $54,415 in the year 1940 to $61,603 in the year 1941 respectively in the case of a 25 year old worker. In the case of a 45 year old worker, present value suddenly increased from $29,367 in the year 1940 to $36,235 in the year 1941 and from $34,561 in 1940 to $39,893 in 1941, respectively in manufacturing and construction.

The Korean War was followed by increases in the value of expected future income streams. The present value for a 25 year old worker in farming increased from $47,129 in 1950 to $54,824 in 1951. In manufacturing, it increased from $89,805 in 1950 to $96,593 in 1951. In construction, it increased from $104,231 in 1950 to $114,879 in 1951. In laundries, it increased from 49,377 in 1950 to 52,518 in 1951 and, finally, in retail trade, it increased from $52,124 in 1950 to $68,013 in 1951. In the case of a 45 year old worker, the present value of the expected future income stream increased from $30,601 in 1950 to $38,922 in 1951 in farming, from $61,232 in 1950 to $66,376 in the year 1951 in manufacturing, from $67,810 in 1950 to 76,132 in 1951 in construction, from $34,706 in 1950 to $37,319 in 1951 in laundries, and finally from $35,662 in 1950 to 47,045 in 1951 in retail trade.

The end of the Korean War was followed by reductions in the present values of the future income stream. In 1954 and in the case of a 25 year old worker, the present value decreased in farming from $53,068 in 1953 to $50,680 in 1954; in manufacturing from $99,288 in 1953 to $94,572 in 1954; in construction from $119,062 in 1953 to $115,824 in 1954; in laundries from $52,087 in 1953 to $51,516 in 1954 and finally in retail trade from $68,914 in 1953 to $68,725 in 1954. In the case of a 45 year old worker, the present value of the expected future income stream decreased from

$38,160 in 1953 to $36,264 in 1954 in farming; from $69,315 in 1953 to $65,422 in 1954 in manufacturing; from $80,997 in 1953 to $77,577 in 1954 in construction; from $37,519 in 1953 to $37,122 in 1954 in laundries; and from $48,504 in 1953 to $48,339 in 1954 in retail trade.

One of the methods of testing the validity of the estimates of the present values of the expected future income stream is to test the strength of the relationship between the number of farm operators by age group and the ratio of present value in nonfarm occupation to the same in farming. For this purpose a linear regression line was fitted for each age group with the ratio of number of farm operators to the number of rural survived males ten years younger in the previous census, as the dependent variable and the appropriate ratio of present values in nonfarm-farm sectors as the independent variable. The relationships found were fairly consistent and tend to validate the estimates of present values. On the basis of projected present values to 1970 and the fitted regression lines in each age group of farm operators and number of rural survived males, the total number of farm operators in each age group is projected to 1970.

For the United States, the estimate of total number of farm operators for 1970 in this study is 2.607 million by the linear equation method and 2.616 million by the "linear-in-logarithms" equation as compared to the 1960 enumeration of 3.701 million. The number of farm operators in the age group 15-24 in the 1960 census is 62 thousand. The number projected in this study for 1970 is 26 thousand by the linear equation and 31 thousand by the logarithmic equation. The projected number of farm operators for 1970 in the age group 25-34 is 0.201 million by the linear regression method, and 0.222 million by the linear-in-logarithms method, as compared to 0.407 million in 1960 census. The projected number of farm operators for 1970 in the age group 35-44 is 0.418 and 0.415 million by linear regression method and by linear in logarithms method respectively; in the age group 45-54 it is 0.695 million by linear regression method and 0.688 million by the linear logarithm method; in the age group 55-64 it is 0.704 million by the linear regression method and 0.701 million by the logarithmic method and finally in the age group 65 and over, it is 0.558 million by linear regression method, and 0.556 by the linear in the logarithmic method.

The ratio of present value of the expected future income stream in manufacturing to the same in farming for a 25 year old worker increases from 1.35837 in 1963 to 1.37214 in 1980. The rate of increase seems to be very low and is decreasing overtime. The ratio of present value of the expected future income stream in laundries to the same in farming for a 45 year old worker is decreasing overtime.

On the basis of the two different regression lines, total number of agricultural workers is projected to 1980. They are 4.93 million and 4.87 million.

The number of farm operators projected for 1970 in the previous studies by Bishop and Tolley, Fox, Johnston and Clawson, as well as in this study is more or less the same. However, the number of farm operators in the younger age groups are generally lower in this study than the numbers projected in the previous studies. The number of older farm operators is generally higher in this study as compared with the numbers projected in the previous studies. This is probably due to the fact that the methods adopted in this study are (1) based on data compiled herein but not available to previous investigators and (2) employ implicitly recent contributions concerning the fixity and variability of labor in farming.

The projected number of farm operators in each age group for 1970 indicates that the trend of aging of farm operators is not going to be reversed. This is clearly exhibited by the very small number of farm operators in the age group 15-24. This trend of aging of farm operators will be reversed in the future only if the ratio of present values of the expected future income stream in the nonfarm to farm sector turns out to be favorable for farming. This occurs only if the farm enterprises are found most desirable compared to nonfarm occupations. According to the projected number of farm operators for 1970, in this study, there will be a reduction of at least 1.15 million in the number of farm operators.

This study, in spite of many limitations, at least paves the way for further research in finding refined techniques for estimating the present values of a worker in any occupation. The series on present values of a worker in different occupations given in this study, are very useful for researchers in studying labor mobility among occupations. However, these series could be further improved by being adjusted in the light of information on hand at each point in time about the future as a result of political and economic events and changes in the institutional factors. This adjustment is necessary for improving the estimates of expectations held by workers. These estimates might also be useful for estimating the compensation to be paid for a person hit by an automobile or killed in an accident in a factory or for otherwise valuing the economic component of human worth.

LIST OF

REFERENCES

LIST OF REFERENCES

Baumgartner, H. W. "Potential Mobility in Agriculture: Some Reasons of the Existence of a Labor Transfer Problem," Journal of Farm Economics, Vol. 47 (Feb., 1965), p. 74.

Bishop, C. E. and Tolley, G. S. Manpower in Farming and Related Occupations. Education for a Changing World of Work. Appendix II, Report of the Panel of Consultants on Vocational Education, U.S. Department of Health, Education and Welfare, U.S. Government Printing Office, Washington, 1963.

______. Geographic and Occupational Mobility of Rural Manpower. Preliminary 14103, 1964, O.E.C.E.D., Paris.

Bowles, Gladys. "Migration Patterns of the Rural Farm Population, Thirteen Economic Regions of the United States, 1940-50," Rural Sociology, Vol. 22 (March, 1957), p. 3, Chart 1.

Bureau of Agricultural Economics, Washington, D.C. Average Rates of Interest Charged on Farm Mortgage Recordings of Selected Lender Groups. 1960. 60 pp.

Cagan, Phillip. The Monetary Dynamics of Hyper Inflations. Studies in the quantity theory of money. Edited by Milton Friedman. Chicago: University of Chicago Press, 1956.

Clawson, M. "Aging Farmers and Agricultural Policy," Journal of Farm Economics. Vol. 45, No. 1 (1963), pp. 13-30.

Fox, F. A. "Commercial Agriculture: Perspectives and Prospectives," in Farming, Farmers and Markets for Farm Goods, Supplementary Paper No. 15, Committee for Economic Development (New York), 1962.

Friedman, Milton. A Theory of Consumption Function. National Bureau of Economic Research. No. 62, General Series. New Jersey: Princeton University Press, 1957, p. 142.

Gallaway, Lowell E. "Labor Mobility, Resource Allocation and Structural Unemployment," American Economic Review, Vol. LIII, No. 4 (Sept., 1963), pp. 694-715.

Haver, Cecil B. "Institutional Rigidities and Other Imperfections in the Factor Markets," Agricultural Adjustment Problems in a Growing Economy(E. O. Heady et al., eds.) Iowa State College Press, Ames, Iowa.

Heady, E. O., Back, W. B. and Peterson, G. A. Interdependence Between the Farm Business and the Farm Household with Implications on Economic Efficiency, Res. Bul. 398, Iowa Agr. Expt. Sta., 1953, p. 421.

Heady, E. O. and Tweeten, Luther Y. Resource Demand and Structure of the Agricultural Industry, Iowa State University Press, Ames, Iowa, 1963.

Hesser, Leon F. The Market for Farm Mortgage Credit--An Econometric Study, Res. Bul. No. 770. Lafayette, Indiana: Purdue University Agr. Expt. Sta., Dec., 1963.

Hicks, J. A. Value and Capital. Second edition. Oxford: Clarendon Press, 1946, p. 119.

Johnson, D. Gale. "Mobility as a Field of Economic Research," Southern Economic Journal, Vol. XV (Oct, 1948), p. 152.

Johnson, Glenn L. Book Review of The Dynamics of Supply by Marc Nerlove, Agricultural Economics Research, Vol 12 (Jan., 1960), p. 26.

Johnson Glenn L. "The Labor utilization Problem in European and American Agriculture," Agricultural Economics Journal, Vol. XIV, No. 1 (1960).

Johnson, S. S. and Heady, E. O. Demand for Labor in Agriculture, C.A.E. Report 13T, Center for Agricultural and Economic Adjustment, Iowa State University, Ames, Iowa.

Johnston, E. W. The Supply of Farm Operators. Unpublished Ph.D. thesis submitted to the Department of Agricultural Economics (Raleigh, North Carolina: North Carolina State University, 1963.

Kanel, D. "Farm Adjustments by Age Groups, North Central States, 1950-59," Journal of Farm Economics, Vol. 45, No. 1 (1963), pp. 47-60.

Kanel, D. "Age Components of Decrease in Number of Farms, North Central States, 1890-1954," Journal of Farm Economics, Vol. 43 (1961), pp. 247-263.

Keynes, J. M. The General Theory of Employment, Interest and Money. London: McMillan, 1936.

Lebergott, Stanley. Manpower in Economic Growth, the American Record Since 1800. New York: McGraw-Hill, 1964.

Loomis, Ralph. Occupational Mobility in Rural Michigan. Unpublished Ph. D. thesis, Department of Agricultural Economics, Michigan State University, East Lansing, Michigan.

Marshall, Alfred. Principles of Economics (8th edition) London: McMillan Co., 1949, p. 311.

Nerlove Marc. "Estimates of Elasticities of Supply of Selected Agricultural Commodities," Journal of Farm Economics, Vol. 38 (1956).

Perkins, Brian B. The Mobility of Labor Between the Farm and Nonfarm Sector. Unpublished Ph. D. thesis, Dept. of Agricultural Economics, Michigan State University, East Lansing, Michigan, 1964.

Prodipto, Roy. "Factors Related to Leaving Farming," Journal of Farm Economics, Vol. 43 (Aug., 1961).

Schnittker, John A. and Owens, Gerald P. Farm to City Migration: Perspective and Problems, Agricultural Economics Report No. 84, Kansas Agr. Expt. Sta., 1959.

Schultz, T. W. "The United States Farm Problem in Relation to the Growth and Development of the United States Economy," Policy for Commercial Agriculture: Its Relation to Economic Growth and Stability, Washington Joint Economic Committee, 1957, p. 4.

Schuh, G. E. "An Econometric Investigation of the Market for Hired Labor in Agriculture," Journal of Farm Economics, Vol. 44(2): 307-321.

Sjaastad, Larry. "Occupational Structure and Migration Patterns," Labor Mobility and Population in Agriculture, Iowa State University Press, Ames, 1961.

Tolley, G. S. and Hjort, H. W. "Age-Mobility and Southern Farmer Skill: Looking Ahead for Area Development," Journal of Farm Economics, Vol. 45, No. 1 (1963), pp. 31-46.

U. S. Department of Agriculture, Major Statistical Series of the U.S.D.A., How They are Constructed and Used, Vol. 7, Farm Population Employment and Levels of Living, Agr. Handbook, No. 118, 1957.

U. S. Department of Agriculture, Stat. Reporting Service, Changes in Farm Production and Efficiency, Stat. Bul. No. 233, 1963.

U. S. Department of Agriculture, Stat. Reporting Service, Farm Employment, Statistical Bul. No. 334, no date.

U. S. Department of Health and Education and Welfare, Vital Statistics of the United States - Life Tables, Vol. II, Section 2 (1960), p. 4.

U. S. Department of Labor, Bureau of Labor Statistics, Labor Force, Employment and Unemployment Statistics, 1947-61, Table 16, 1962, p. 16.

U. S. Department of Labor, Bureau of Labor Statistics, Union Wages and Hours: Building Trades, July 1, 1961 and Trend, 1907-63, Bul. No. 1397, 1963.

U. S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for the United States, 1909-62, issued 1963. Bulletins No. 1312-1.

APPENDICES

APPENDIX A

TABLE 1.--Available annual wage (in current dollars) data from published sources in the U. S., 1917-62.

Year	Farming $	Manufacturing $	Construction $	Laundries $	Retail Trade $
1917	486	778	715		
1918	582	994	835		
1919	672	1,156	949		
1920	780	1,353	1,375		
1921	534	1,141	1,375		
1922	522	1,107	1,252		
1923	570	1,225	1,327		
1924	588	1,231	1,448		
1925	588	1,254	1,493		
1926	600	1,268	1,609		
1927	600	1,272	1,658		
1928	600	1,284	1,658		
1929	612	1,288	1,649		
1930	576	1,196	1,701		
1931	456	1,073	1,689		
1932	348	878	1,405		
1933	306	866	1,332		
1934	336	946	1,332	774	
1935	366	1,035	1,325	862	
1936	390	1,121	1,414	839	
1937	438	1,239	1,547	875	
1938	432	1,148	1,668	895	
1939	432	1,229	1,668	917	1,093
1940	450	1,298	1,697	932	1,110
1941	534	1,533	1,786	972	1,153
1942	708	1,907	1,939	1,058	1,215
1943	924	2,240	1,945	1,200	1,289
1944	1,092	2,376	1,966	1,349	1,392
1945	1,212	2,298	2,070	1,442	1,487
1946	1,296	2,253	2,383	1,570	1,712
1947	1,404	2,557	2,793	1,701	1,921
1948	1,537	2,962	3,143	1,780	2,067
1949	1,599	2,802	3,266	1,819	2,164
1950	1,612	3,033	3,430	1,844	2,244
1951	1,794	3,294	3,677	1,966	2,403
1952	1,898	3,492	3,903	2,009	2,485
1953	1,963	3,664	4,190	2,064	2,587
1954	1,950	3,665	4,354	2,085	2,663

TABLE 1.--Continued.

Year	Farming $	Manufacturing $	Construction $	Laundries $	Retail Trade $
1955	1,976	3,936	4,540	2,116	2,760
1956	2,054	4,097	4,827	2,201	2,847
1957	2,145	4,243	4,094	2,256	2,958
1958	2,210	4,301	5,340	2,355	3,059
1959	2,314	4,590	5,690	2,413	3,160
1960	2,379	4,665	5,957	2,502	3,243
1961	2,418	4,802	6,244	2,563	3,329
1962	2,483	5,021	6,470	2,630	3,429

TABLE 2.--Projected annual wage rates (in current dollars) per worker in farming, manufacturing, construction, retail trade and in laundries in the U. S., 1963-2007.

Year	Farming	Manufacturing	Construction	Retail Trade	Laundries
	current dollars	current dollars	current dollars	current dollars	current dollars
1963	2,554	5,159	6,683	3,531	2,670
1964	2,620	5,315	6,937	3,627	2,732
1965	2,686	5,472	7,192	3,723	2,795
1966	2,752	5,629	7,446	3,820	2,857
1967	2,818	5,785	7,701	3,916	2,920
1968	2,884	5,942	7,955	4,012	2,983
1969	2,950	6,099	8,210	4,108	3,045
1970	3,016	6,255	8,464	4,204	3,108
1971	3,082	6,412	8,710	4,300	3,171
1972	3,148	6,569	8,973	4,396	3,233
1973	3,214	6,725	9,228	4,492	3,296
1974	3,280	6,882	9,482	4,588	3,359
1975	3,346	7,039	9,737	4,684	3,421
1976	3,412	7,196	9,991	4,780	3,484
1977	3,478	7,352	10,246	4,876	3,547
1978	3,544	7,509	10,500	4,972	3,609
1979	3,610	7,666	10,754	5,068	3,672
1980	3,676	7,822	11,009	5,164	3,734
1981	3,742	7,979	11,263	5,260	3,797
1982	3,808	8,136	11,518	5,356	3,860
1983	3,874	8,292	11,772	5,452	3,922
1984	3,940	8,449	12,027	5,548	3,985
1985	4,006	8,606	12,281	5,644	4,048
1986	4,072	8,762	12,536	5,741	4,110
1987	4,138	8,919	12,790	5,837	4,173
1988	4,204	9,076	13,045	5,933	4,236
1989	4,270	9,233	13,299	6,029	4,298
1990	4,336	9,389	13,554	6,125	4,361
1991	4,402	9,546	13,808	6,221	4,423
1992	4,468	9,703	14,063	6,317	4,486
1993	4,534	9,859	14,317	6,413	4,549
1994	4,600	10,016	14,572	6,509	4,611
1995	4,666	10,173	14,826	6,605	4,674
1996	4,732	10,329	15,081	6,701	4,737
1997	4,798	10,486	15,335	6,797	4,799
1998	4,864	10,643	15,590	6,893	4,862
1999	4,930	10,799	15,844	6,989	4,925

TABLE 2.--Continued.

Year	Farming	Manufacturing	Construction	Retail Trade	Laundries
	current dollars	current dollars	current dollars	current dollars	current dollars
2000	4,996	10,956	16,099	7,085	4,987
2001	5,062	11,113	16,353	7,181	5,050
2002	5,128	11,269	16,608	7,277	5,113
2003	5,194	11,426	16,862	7,373	5,175
2004	5,260	11,583	17,117	7,469	5,238
2005	5,326	11,740	17,371	7,565	5,300
2006	5,392	11,896	17,626	7,662	5,363
2007	5,458	12,053	17,880	7,758	5,426

TABLE 3.--Percentage of unemployment (estimated for the period 1917-47 and actual for the period 1948-62) in manufacturing, construction, retail trade and in laundries in the U.S., 1917-62.

Year	Manufacturing	Construction	Retail Trade	Laundries
	Per Cent	Per Cent	Per Cent	Per Cent
1917	7.6	13.0	6.4	4.9
1918	0.6	3.4	2.1	1.9
1919	0.6	3.4	2.1	1.9
1920	8.1	13.7	6.6	5.1
1921	21.2	31.8	14.7	10.6
1922	11.5	18.3	8.7	6.5
1923	2.7	6.2	3.3	2.8
1924	7.7	13.2	6.4	4.9
1925	4.2	8.4	4.3	3.4
1926	1.2	4.2	2.4	2.2
1927	4.2	8.4	4.3	3.4
1928	6.1	10.9	5.4	4.2
1929	4.1	8.2	4.2	3.4
1930	14.9	23.9	10.8	7.9
1931	28.1	41.2	18.9	13.5
1932	41.5	59.6	27.1	19.1
1933	43.1	61.8	28.1	19.8
1934	37.0	53.5	24.4	17.2
1935	34.1	49.5	22.6	16.0
1936	28.4	41.5	19.0	13.6
1937	23.4	34.7	16.0	11.5
1938	31.4	45.7	20.9	14.9
1939	28.1	41.2	18.9	13.5
1940	23.4	34.7	16.0	11.5
1941	15.1	23.3	10.9	8.0
1942	5.9	10.7	5.3	4.1
1943	1.0	3.9	2.3	2.1
1944	0.0	2.3	1.6	1.6
1945	1.0	3.9	2.3	2.1
1946	4.4	8.6	4.3	3.5
1947	4.2	8.4	4.2	3.4
1948	3.5	7.6	4.3	3.5
1949	7.2	11.9	5.8	5.1
1950	5.6	10.7	5.8	5.0
1951	3.3	6.0	3.7	3.1
1952	2.8	5.5	3.1	2.6
1953	2.5	6.1	3.0	2.4
1954	6.1	10.5	5.2	4.0
1955	4.2	9.2	4.3	3.8
1956	4.2	8.3	4.1	3.2
1957	5.0	9.8	4.5	3.4
1958	9.2	13.7	6.7	4.6
1959	6.0	12.0	5.8	4.3
1960	6.2	12.2	5.9	4.1
1961	7.7	14.1	7.2	4.9
1962	5.8	12.0	6.3	4.3

APPENDIX B

TABLE 1.--Estimates of the annual wage (in current dollars) in the $(t + n)^{th}$ year head ($n = 0, 1....9$) and the increments in the annual wage of (Δ_1 and Δ_2) expected in each current year from 1917 to 1962 in farming in the United States.

	Expected Annual Wage in the Year										Expected Increment	
Year t	(t+0)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)	(t+9)	Δ_1	Δ_2
						FARM WAGE RATE						
1917	486	548	594	630	666	697	769	819	904	1007	67.08	70.44
1918	582	647	696	736	776	807	886	934	1013	1109	67.24	70.29
1919	672	735	784	826	867	896	982	1024	1093	1175	68.66	69.73
1920	780	853	907	954	1004	1032	1129	1170	1237	1317	67.61	69.97
1921	534	436	410	409	403	370	406	380	317	200	104.43	58.07
1922	522	535	560	586	609	621	683	710	747	782	78.60	66.60
1923	570	612	651	685	718	740	813	850	910	977	72.41	68.59
1924	583	616	648	679	710	725	696	826	871	917	75.86	67.44
1925	588	608	636	665	693	705	774	800	837	871	77.84	66.78
1926	600	626	656	687	717	731	802	831	872	913	76.63	67.17
1927	600	620	648	677	706	718	788	813	850	882	77.94	66.74
1928	600	620	648	677	706	718	788	813	850	882	77.94	66.74
1929	612	638	669	700	730	744	816	844	884	923	76.73	67.13
1930	576	579	598	623	646	652	715	734	757	770	81.70	65.52
1931	456	417	417	429	436	429	473	479	476	449	89.91	62.94
1932	348	314	315	325	330	326	364	377	388	382	87.67	63.78
1933	306	303	318	334	346	356	398	427	471	512	80.05	66.34
1934	336	368	398	423	446	469	522	566	638	721	72.39	68.83
1935	366	398	429	455	479	501	556	599	668	748	72.65	68.72
1936	390	419	449	476	499	520	576	616	681	754	73.51	68.41
1937	438	479	515	545	574	598	661	705	775	858	71.28	69.10
1938	432	447	472	496	517	531	587	619	667	716	77.17	67.16

1939	432	450	476	500	523	538	595	628	678	731	76.51	67.38
1940	450	477	507	534	559	577	638	674	731	793	74.68	67.96
1941	534	593	639	676	713	742	816	863	941	1035	68.15	70.04
1942	708	812	879	932	987	1029	1128	1187	1289	1419	59.74	72.64
1943	924	1050	1130	1193	1262	1308	1428	1487	1588	1720	56.96	73.34
1944	1092	1197	1269	1332	1400	1434	1561	1602	1669	1749	63.68	70.96
1945	1212	1295	1358	1419	1486	1508	1640	1665	1700	1736	69.98	68.76
1946	1296	1363	1419	1479	1544	1558	1691	1705	1717	1720	74.65	67.13
1947	1404	1483	1547	1612	1685	1700	1845	1859	1873	1878	72.94	67.59
1948	1537	1629	1700	1772	1853	1871	2029	2042	2055	2061	71.32	67.99
1949	1599	1658	1715	1780	1854	1857	2012	2007	1984	1937	79.66	65.18
1950	1612	1648	1694	1754	1822	1816	1966	1950	1905	1824	85.16	63.35
1951	1794	1912	1998	2083	2180	2201	2385	2398	2410	2416	68.13	68.79
1952	1898	1980	2050	2129	2220	2225	2407	2399	2368	2312	77.60	65.56
1953	1963	2027	2090	2166	2254	2250	2434	2413	2360	2271	82.44	63.90
1954	1950	1977	2022	2089	2167	2149	2322	2285	2200	2062	90.90	61.12
1955	1976	2021	2076	2148	2232	2220	2400	2371	2300	2184	86.84	62.44
1956	2054	2125	2192	2272	2366	2362	2554	2533	2478	2386	81.79	64.03
1957	2145	2223	2294	2379	2477	2475	2675	2652	2595	2501	81.13	64.15
1958	2210	2276	2343	2426	2524	2515	2717	2686	2612	2493	84.55	62.96
1959	2314	2400	2476	2567	2674	2670	2885	2858	2792	2686	81.15	63.98
1960	2379	2447	2516	2604	2708	2696	2911	2873	2784	2645	85.99	62.32
1961	2418	2474	2538	2625	2726	2708	2924	2878	2774	2615	89.18	61.23
1962	2483	2552	2622	2714	2822	2807	3031	2988	2890	2739	86.88	61.92

TABLE 2.--Estimates of the annual wage (in current dollars) in the $(t + n)^{th}$ year head ($n = 0, 1....9$) and the increments in the annual wage of (Δ_1 and Δ_2) expected in each current year from 1917 to 1962 in manufacturing in the United States.

	Expected Annual Wage in the Year										Expected Increment	
Year t	(t+0)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)	(t+9)	Δ_1	Δ_2
	MANUFACTURING											
1917	778	842	922	946	964	1022	1031	1066	1128	1270	160.49	73.03
1918	994	1095	1186	1211	1251	1315	1343	1401	1527	1657	155.74	71.67
1919	1156	1244	1334	1372	1422	1487	1533	1602	1716	1827	150.08	98.14
1920	1353	1457	1554	1598	1666	1734	1800	1886	2034	2131	144.88	108.23
1921	1141	1108	1172	1246	1272	1322	1381	1428	1364	1451	144.26	178.86
1922	1107	1130	1206	1261	1295	1352	1400	1454	1471	1574	148.24	136.73
1923	1225	1300	1389	1435	1488	1551	1607	1678	1778	1880	147.32	114.02
1924	1231	1270	1351	1408	1455	1515	1575	1641	1688	1782	145.27	139.14
1925	1254	1299	1382	1439	1488	1549	1610	1679	1736	1830	144.88	137.48
1926	1268	1311	1393	1451	1501	1562	1625	1695	1749	1840	144.32	140.72
1927	1272	1312	1393	1453	1502	1562	1627	1696	1746	1836	144.03	143.28
1928	1284	1327	1409	1468	1519	1580	1645	1716	1770	1860	143.81	142.61
1929	1288	1328	1410	1470	1521	1581	1647	1718	1769	1858	143.56	144.72
1930	1196	1203	1276	1341	1379	1435	1495	1553	1550	1641	144.65	157.49
1931	1073	1067	1136	1197	1224	1276	1325	1371	1343	1443	147.75	153.20
1932	878	843	903	963	970	1017	1047	1074	995	1107	152.26	151.40
1933	866	890	962	1003	1021	1074	1097	1132	1139	1265	155.68	110.16
1934	946	1002	1082	1118	1147	1205	1233	1280	1337	1462	154.87	97.19
1935	1035	1096	1179	1218	1254	1314	1351	1406	1475	1592	152.41	103.24
1936	1121	1183	1268	1311	1354	1415	1461	1523	1598	1707	149.34	111.66
1937	1239	1315	1403	1450	1504	1568	1625	1698	1798	1899	146.91	115.28
1938	1148	1154	1227	1289	1323	1378	1433	1487	1481	1576	146.08	152.94
1939	1229	1292	1379	1428	1479	1542	1599	1669	1751	1850	146.58	122.50
1940	1298	1359	1446	1500	1556	1619	1683	1759	1841	1934	144.36	131.36
1941	1533	1654	1757	1806	1890	1963	2046	2149	2331	2413	140.24	116.13
1942	1907	2083	2202	2257	2378	2461	2578	2719	2999	3058	131.59	119.37
1943	2240	2411	2535	2609	2754	2841	2993	3160	3449	3475	121.13	158.41

1944	2376	2487	2600	2700	2844	2925	3099	3266	3474	3474	113.84	213.91
1945	2298	2339	2435	2552	2677	2740	2922	3072	3171	3164	112.55	253.84
1946	2253	2303	2400	2512	2636	2709	2876	3023	3135	3134	114.42	242.54
1947	2557	2727	2855	2948	3016	3206	3392	3583	3887	3882	111.34	193.37
1948	2762	2906	3031	3143	3321	3411	3622	3824	4098	4069	103.66	233.59
1949	2802	2894	3008	3138	3310	3394	3615	3812	4011	3967	99.73	273.41
1950	3033	3192	3324	3447	3648	3743	3981	4207	4517	4465	96.15	252.34
1951	3294	3470	3609	3742	3965	4064	4329	4578	4925	4851	88.99	269.30
1952	3492	3653	3792	3940	4175	4275	4562	4824	5158	5063	82.12	300.99
1953	3664	3821	3961	4121	4368	4469	4775	5049	5386	5274	76.64	322.22
1954	3665	3767	3896	4072	4308	4403	4715	4981	5237	5112	73.75	359.83
1955	3936	4132	4285	4448	4722	4831	5161	5463	5871	5740	70.31	325.03
1956	4097	4262	4410	4592	4872	4979	5030	5640	6009	5856	63.75	363.69
1957	4243	4407	4557	4747	5038	5146	5513	5834	6208	6042	59.21	380.16
1958	4301	4438	4583	4785	5075	5181	5556	5878	6216	6038	56.03	404.70
1959	4590	4809	4976	5169	5495	5614	6012	6369	6841	6654	51.42	380.08
1960	4665	4818	4971	5188	5508	5620	6032	6384	6762	6553	45.64	433.81
1961	4802	4978	5138	5356	5690	5807	6231	6598	7017	6800	42.65	432.57
1962	5021	5229	5399	5620	5976	6099	6543	6932	7409	7178	37.60	434.33

TABLE 3.--Estimates of the annual wage (in current dollars) in the $(t + n)^{th}$ year ahead (n=0,1....9) and the increments in the annual wage of (Δ_1, Δ_2) expected in each current year from 1917 to 1962 in construction in the United States.

	Expected Annual Wage in the Year										Expected Increment	
Year t	(t+0)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)	(t+9)	Δ_1	Δ_2
1917	715	774	808	841	859	892	892	904	963	937	253.54	37.65
1918	835	918	960	1002	1036	1079	1095	1121	1184	1169	264.24	9.88
1919	949	1032	1081	1130	1172	1220	1247	1284	1353	1356	254.43	38.09
1920	1375	1605	1686	1773	1882	1978	2076	2167	2248	2265	344.88	-203.86
1921	1375	1420	1491	1561	1623	1687	1744	1819	1912	1999	182.95	238.60
1922	1252	1241	1301	1359	1398	1446	1479	1537	1627	1716	144.32	342.65
1923	1327	1404	1473	1543	1610	1677	1736	1809	1898	1965	214.63	151.45
1924	1448	1548	1625	1705	1786	1863	1939	2025	2118	2197	224.12	126.99
1925	1493	1561	1639	1718	1794	1869	1941	2030	2127	2225	192.26	214.60
1926	1609	1717	1798	1886	1979	2066	2156	2259	2360	2463	211.58	163.22
1927	1658	1732	1820	1909	1998	2083	2171	2276	2381	2503	182.88	242.25
1928	1658	1711	1798	1885	1969	2049	2133	2236	2343	2473	164.25	293.15
1929	1649	1698	1784	1870	1952	2032	2113	2215	2322	2452	161.42	300.76
1930	1701	1777	1868	1960	2053	2140	2232	2342	2449	2577	181.17	247.42
1931	1689	1737	1826	1914	1999	2081	2166	2272	2380	2517	157.64	311.39
1932	1405	1328	1394	1454	1486	1532	1564	1631	1733	1877	73.01	539.36
1933	1332	1345	1411	1475	1526	1583	1628	1696	1789	1881	158.04	306.13
1934	1332	1376	1444	1512	1570	1632	1685	1755	1846	1927	185.79	230.31
1935	1325	1366	1434	1500	1557	1619	1670	1739	1830	1911	183.59	236.23
1936	1414	1499	1574	1650	1725	1798	1867	1949	2041	2120	214.20	153.68
1937	1547	1654	1738	1824	1914	1998	2084	2181	2279	2370	222.14	133.61
1938	1668	1773	1864	1956	2055	2145	2241	2350	2453	2565	209.58	169.40
1939	1668	1721	1808	1896	1981	2062	2147	2251	2358	2490	163.59	295.07
1940	1697	1763	1853	1944	2034	2119	2209	2317	2425	2556	172.70	270.54
1941	1786	1881	1977	2075	2179	2274	2378	2498	2608	2743	189.62	225.38
1942	1939	2065	2172	2282	2405	2513	2638	2776	2891	3039	203.84	188.39

1943	1945	2008	2111	2216	2323	[illegible]	2532	2664	[illegible]	[illegible]	[illegible]	342.23
1944	1966	2036	2141	2248	2358	2457	2572	2707	[illegible]	[illegible]	[illegible]	330.70
1945	2070	2179	2292	2408	2535	2647	2780	2929	[illegible]	3228	[illegible]	[illegible]
1946	2383	2590	2726	2870	3045	3190	3373	3561	[illegible]	3883	[illegible]	107.79
1947	2793	3053	3215	3388	3605	3780	4012	4245	4395	4631	245.11	86.06
1948	3143	3386	3758	3758	3997	4187	4446	4712	4880	[illegible]	199.18	215.84
1949	3266	3415	3597	3786	4009	4189	4439	4708	4888	5244	104.76	475.32
1950	3430	3601	3793	3994	4234	4427	4696	4983	5171	5544	109.51	464.34
1951	3677	3890	4099	4318	4587	4799	5100	5415	5612	6010	124.75	425.74
1952	3903	4113	4334	4567	3850	5074	5395	5732	5940	6376	101.83	491.11
1953	4190	4434	4673	4925	5238	5483	5836	6205	6425	6895	106.06	483.07
1954	4354	4549	4794	5052	5363	5608	5966	6346	6578	7092	48.47	642.43
1955	4540	4749	5006	5276	5604	5861	5238	6638	6878	7418	44.54	655.43
1956	4827	5088	5363	5654	6016	6297	6712	7144	7395	7962	63.97	605.85
1957	5094	5353	5644	5950	6330	6625	7063	7521	7786	8397	38.73	678.08
1958	5340	5596	5901	6221	6618	6925	7385	7867	8144	8796	14.49	747.31
1959	5690	6001	6327	6674	7109	7444	7947	8468	8759	9447	30.90	706.75
1960	5957	6239	6579	6938	7385	7728	8249	8794	9100	9842	-18.29	844.42
1961	6244	6542	6899	7276	7748	8109	8659	9234	9553	10336	-29.65	878.96
1962	6470	6748	7116	7505	7987	8356	8922	9517	9849	10676	-67.77	985.88

TABLE 4.--Extimates of the annual wage (in current dollars) in the $(t + n)^{th}$ year ahead (n.= 0, 1....9) and the increments in the annual wage of (Δ_1 and Δ_2) expected in each current year from 1917 to 1962 in Retail Trade in the United States.

	Expected Annual Wage in the Year										Expected Increment	
Year t	(t+0)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)	(t+9)	Δ_1	Δ_2
1917	510	554	594	635	669	689	709	747	776	794	99.62	53.79
1918	587	644	690	738	778	802	829	873	904	822	98.23	53.03
1919	662	720	767	816	859	886	917	963	997	1022	96.27	59.42
1920	940	1085	1162	1256	1333	1379	1442	1518	1551	1564	93.08	35.07
1921	940	970	1015	1057	1100	1138	1178	1223	1278	1332	87.72	98.53
1922	859	855	889	913	944	975	1002	1038	1095	1156	88.23	110.62
1923	908	958	1008	1058	1106	1144	1185	1236	1285	1330	89.49	84.82
1924	987	1051	1105	1163	1217	1260	1308	1365	1415	1461	88.04	84.22
1925	1016	1059	1109	1158	1207	1250	1294	1347	1403	1459	86.34	97.92
1926	1092	1156	1213	1272	1330	1377	1430	1490	1546	1600	85.30	93.21
1927	1123	1169	1221	1273	1326	1373	1424	1480	1542	1604	83.64	105.93
1928	1123	1156	1205	1250	1300	1346	1394	1447	1511	1578	83.05	113.01
1929	1092	1112	1156	1195	1240	1284	1327	1376	1441	1551	83.24	117.63
1930	1151	1209	1265	1323	1380	1430	1484	1544	1605	1665	83.47	101.75
1931	1144	1174	1223	1268	1317	1364	1412	1465	1531	1601	82.37	116.27
1932	959	913	937	944	966	999	1021	1050	1121	1204	83.67	142.27
1933	911	921	960	991	1028	1063	1095	1137	1194	1253	87.54	107.20
1934	911	941	985	1026	1068	1105	1141	1188	1241	1293	88.46	96.24
1935	907	935	979	1019	1061	1097	1133	1179	1232	1285	88.49	96.84
1936	965	1020	1072	1125	1176	1217	1261	1315	1367	1414	88.20	87.27
1937	1051	1119	1175	1236	1293	1339	1391	1450	1504	1553	86.54	87.68
1938	1130	1196	1254	1315	1374	1423	1478	1540	1598	1653	84.39	95.53
1939	1093	1110	1154	1192	1236	1280	1323	1371	1437	1507	83.10	119.08
1940	1110	1150	1200	1249	1300	1346	1395	1449	1511	1595	83.71	108.10
1941	1153	1204	1259	1313	1369	1418	1471	1529	1592	1654	83.11	105.57
1942	1215	1275	1333	1392	1453	1505	1563	1625	1689	1753	81.89	106.13

1943	1289	1355	1416	1479	1544	1600	1662	1729	1795	1863	80.23	109.25
1944	1392	1471	1538	1609	1680	1742	1813	1885	1945	2025	78.16	110.77
1945	1487	1564	1632	1704	1778	1844	1918	1993	2068	2146	75.57	120.11
1946	1712	1846	1934	2036	2133	2213	2311	2406	2482	2557	72.33	108.23
1947	1921	2051	2142	2246	2348	2437	2545	2645	2732	2824	66.68	128.42
1948	2067	2173	2260	2355	2455	2549	2658	2757	2857	2968	61.73	154.35
1949	2164	2251	2334	2423	2520	2617	2727	2824	2932	3057	58.31	173.21
1950	2244	2326	2408	2496	2593	2694	2806	2903	2017	2150	55.93	183.42
1951	2403	2519	2615	2721	2833	2943	2071	3182	3297	3430	53.39	177.96
1952	2483	2571	2659	2752	2858	2970	3094	3200	3326	3476	49.81	202.02
1953	2587	2682	2775	2875	2987	3104	3235	3346	3476	3629	47.59	205.53
1954	2663	2749	2840	2937	3048	3168	3301	3412	3547	3710	45.15	217.47
1955	2760	2856	2952	3054	3172	3296	3436	3553	3691	3857	43.07	220.35
1956	2847	2940	3037	3139	3258	3387	3530	3648	3792	3966	40.85	227.23
1957	2958	3062	3164	3274	3400	3534	3686	3810	3957	4135	38.28	232.82
1958	3059	3160	3264	3374	3502	3641	3796	3923	4076	4262	35.31	243.09
1959	3160	3263	3368	3481	3612	3756	3917	4046	4204	4398	32.93	251.08
1960	3243	3340	3445	3556	3688	3835	3998	4129	4293	4494	30.46	261.75
1961	3329	3428	3535	3649	3785	3935	4103	4237	4405	4612	28.32	267.87
1962	3429	3535	3646	3765	3906	4061	4236	4374	4546	4758	26.03	272.58

TABLE 5.--Estimates of the annual wage (in current dollars) in the $(t + n)^{th}$ year ahead (n = 0, 1....9) and the increments in the annual wage of (Δ_1 and Δ_2) expected in each current year from 1917 to 1962 in laundries in the United States.

	Expected Annual Wage in the Year										Expected Increments	
Year t	(t+0)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)	(t+9)	Δ_1	Δ_2
1917	307	356	402	446	497	516	562	597	667	705	47.36	64.11
1918	392	453	501	550	604	626	675	710	781	818	43.83	67.90
1919	473	533	581	630	683	708	756	792	858	897	45.63	67.96
1920	776	913	970	1050	1124	1162	1230	1271	1347	1385	18.76	91.33
1921	776	809	856	897	941	972	1009	1051	1094	1136	61.72	61.75
1922	689	692	735	765	800	827	855	896	934	977	72.74	52.78
1923	742	793	841	890	938	970	1012	1054	1104	1145	53.69	66.74
1924	828	891	941	994	1045	1081	1125	1168	1218	1259	50.32	70.44
1925	860	904	953	999	1045	1080	1119	1162	1205	1247	58.46	65.35
1926	943	1005	1055	1109	1160	1198	1242	1286	1331	1373	52.49	70.79
1927	977	1022	1071	1119	1165	1203	1241	1286	1324	1367	59.96	66.20
1928	977	1011	1058	1102	1144	1182	1216	1261	1295	1339	64.78	62.88
1929	971	1003	1050	1093	1134	1172	1205	1251	1284	1328	65.54	62.26
1930	1008	1054	1104	1152	1198	1237	1275	1321	1357	1401	60.00	66.66
1931	1000	1031	1079	1121	1162	1201	1234	1280	1312	1356	66.26	62.23
1932	798	762	802	818	841	869	884	927	948	993	90.70	42.16
1933	746	761	806	841	879	909	940	982	1021	1063	68.64	56.51
1934	774	817	864	910	956	988	1027	1069	1116	1157	57.72	64.48
1935	802	845	893	938	984	1017	1056	1098	1144	1186	58.15	64.63
1936	839	885	933	980	1027	1061	1101	1144	1188	1230	57.43	65.72
1937	875	921	969	1016	1063	1098	1137	1181	1223	1266	58.12	65.82
1938	895	935	983	1029	1073	1109	1146	1190	1230	1273	60.70	64.37
1939	917	958	1006	1052	1097	1133	1170	1215	1254	1297	60.75	64.69
1940	932	971	1019	1064	1108	1144	1181	1225	1263	1306	61.97	64.09

1941	972	1019	1069	1117	1163	1202	1240	1285	1324	1367	59.03	66.76
1942	1058	1121	1173	1228	1278	1320	1362	1409	1448	1491	53.81	71.73
1943	1200	1283	1337	1400	1456	1503	1550	1598	1637	1681	48.03	77.99
1944	1349	1435	1490	1555	1610	1663	1709	1759	1792	1837	49.30	79.51
1945	1442	1509	1563	1622	1671	1725	1764	1816	1839	1885	58.66	74.56
1946	1570	1649	1705	1770	1821	1880	1921	1976	1996	2043	55.64	78.69
1947	1701	1782	1838	1904	1955	2018	2059	2115	2130	2177	57.21	79.72
1948	1780	1843	1898	1958	2004	2068	2102	2160	2165	2215	65.78	75.09
1949	1819	1868	1922	1978	2019	2084	2113	2172	2171	2221	72.05	71.40
1950	1844	1889	1942	1996	2036	2101	2128	2188	2184	2235	74.41	70.17
1951	1966	2044	2102	2169	2218	2289	2325	2386	2388	2438	62.51	80.33
1952	2009	2060	2115	2173	2214	2284	2312	2374	2365	2416	74.37	72.86
1953	2064	2120	2175	2235	2277	2349	2377	2440	2430	2482	73.50	74.33
1954	2085	2129	2184	2239	2277	2349	2374	2437	2422	2475	78.64	71.18
1955	2116	2164	2219	2276	2315	2388	2413	2477	2462	2514	77.70	72.28
1956	2209	2267	2325	2390	2433	2510	2541	2605	2592	2644	71.33	78.03
1957	2256	2312	2369	2430	2471	2549	2575	2641	2622	2675	76.42	75.41
1958	2355	2427	2486	2553	2597	2680	2710	2777	2758	2811	71.69	80.26
1959	2413	2471	2529	2592	2631	2714	2739	2808	2782	2836	78.38	76.58
1960	2502	2571	2630	2698	2740	2827	2854	2924	2897	2951	75.34	80.11
1961	2563	2622	2681	2746	2785	2873	2896	2967	2934	2990	80.24	77.71
1962	2630	2691	2751	2817	2856	2946	2970	3042	3007	3063	80.40	78.68

APPENDIX C

TABLE 1.-- Estimates of the unemployment rate (percentage) in the (t+n)th year ahead (n=0,1,2. . .9) expected in each current year from 1917 to 1962 in manufacturing in the United States.

	Expected Unemployment Rate in t^{th} Year										
Year t	(t+0)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)	(t+9)	(t+10)
1917	7.60	7.78	8.60	9.42	10.22	11.49	11.38	11.94	12.88	14.72	10.94
1918	.60	.45	1.47	3.27	5.51	7.92	8.26	8.78	10.80	13.37	6.55
1919	.60	2.31	4.53	6.59	8.35	10.55	11.25	12.93	14.73	17.72	9.88
1920	8.10	11.60	12.70	13.73	13.88	14.83	15.09	17.00	17.61	19.90	15.15
1921	21.20	24.87	23.67	22.65	20.49	19.47	18.60	19.69	18.45	19.04	20.77
1922	11.50	7.67	7.37	7.21	8.02	9.01	8.05	6.65	7.37	8.08	7.71
1923	2.70	.61	2.04	3.42	5.47	7.65	7.68	7.61	9.42	11.55	6.16
1924	7.70	10.28	11.34	12.35	12.73	13.81	13.99	15.54	16.28	18.48	13.87
1925	4.20	3.97	5.34	6.65	8.12	9.93	10.06	10.68	12.13	14.35	9.03
1926	1.20	1.63	3.61	5.46	7.33	9.54	10.02	11.12	12.94	15.66	8.59
1927	4.20	6.53	8.19	9.73	10.76	12.38	12.84	14.53	15.78	18.39	12.13
1928	6.10	7.70	8.94	10.12	10.94	12.33	12.53	13.78	14.82	17.08	12.03
1929	4.10	4.47	5.93	7.32	8.70	10.48	10.70	11.57	12.99	15.32	9.72
1930	14.90	18.64	18.57	18.55	17.47	17.39	17.08	18.63	18.27	19.70	18.25
1931	28.10	30.72	28.20	26.00	22.81	20.85	19.24	19.41	17.29	16.82	22.37
1932	41.50	42.10	37.00	32.50	27.33	23.52	20.47	18.88	15.04	12.50	25.48
1933	43.10	38.79	32.87	27.68	23.07	19.39	15.58	11.82	8.14	4.63	20.22
1934	37.00	30.60	25.53	21.11	17.92	15.31	11.77	7.55	4.89	1.87	15.17
1935	34.10	29.42	25.05	21.24	18.26	15.95	12.89	9.59	7.20	4.82	16.05
1936	28.40	23.51	20.11	17.19	15.24	13.79	11.21	8.20	6.63	4.96	13.43
1937	23.40	19.57	17.17	15.13	13.87	13.09	11.07	8.86	7.91	7.06	12.64

1938	31.40	31.45	28.07	25.11	21.79	19.53	17.30	16.17	13.79	12.49	20.64
1939	28.10	24.20	20.97	18.18	16.11	14.64	12.20	9.64	8.03	6.56	14.50
1940	23.40	19.68	17.30	15.27	13.99	13.20	11.20	9.04	8.07	7.24	12.78
1941	15.10	11.26	10.32	9.59	9.78	10.24	8.95	7.31	7.52	7.75	9.19
1942	5.90	3.15	3.95	4.77	6.37	8.12	7.78	7.22	8.63	10.24	6.69
1943	1.00	.71	2.65	4.46	6.49	8.78	9.19	10.00	11.91	14.54	7.64
1944	.00	1.41	3.71	5.83	7.75	10.06	10.77	12.36	14.27	17.30	9.27
1945	1.00	3.05	5.23	7.25	8.89	11.01	11.71	13.50	15.22	18.21	10.45
1946	4.40	6.86	8.50	10.02	10.99	12.57	13.02	14.76	15.97	18.58	12.36
1947	4.20	5.27	6.79	8.22	9.46	11.17	11.47	12.63	13.98	16.40	10.60
1948	3.50	4.48	6.11	7.64	9.03	10.85	11.20	12.37	13.82	16.32	10.20
1949	7.20	9.34	10.45	11.50	12.04	13.22	13.39	14.80	15.64	17.83	13.14
1950	5.60	5.90	7.08	8.22	9.36	10.92	10.99	11.74	12.95	15.07	10.25
1951	3.30	3.68	5.28	6.79	8.31	10.21	10.50	11.43	12.96	15.39	9.40
1952	2.80	3.97	5.75	7.40	8.88	10.79	11.22	12.52	14.06	16.68	10.14
1953	2.50	3.80	5.64	7.36	8.86	10.81	11.28	12.66	14.23	16.90	10.17
1954	6.10	8.37	9.69	10.93	11.63	12.97	13.26	14.79	15.78	18.14	12.84
1955	4.20	4.60	6.04	7.41	8.77	10.53	10.75	11.63	13.03	15.35	9.79
1956	4.20	5.35	6.88	8.31	9.54	11.25	11.56	12.75	14.09	16.53	10.70
1957	5.00	6.34	7.75	9.07	10.13	11.71	11.97	13.19	14.40	16.76	11.26
1958	9.20	11.23	11.97	12.69	12.90	13.80	13.78	15.00	15.57	17.48	13.62
1959	6.00	5.60	6.64	7.66	8.84	10.39	10.35	10.77	11.98	13.94	9.57
1960	6.20	7.11	8.26	9.36	10.29	11.71	11.81	12.77	13.85	15.99	11.24
1961	7.70	8.89	9.81	10.70	11.31	12.49	12.50	13.47	14.32	16.30	12.28
1962	5.80	5.95	7.08	8.18	9.30	10.84	10.88	11.55	12.75	14.82	5.29

TABLE 2.--Estimates of the unemployment rate (percentage) in the (t+n)th year ahead (n=0,1,2. . .9) expected in each current year from 1917 to 1962 in construction in the United States.

	Expected Unemployment Rate in t^{th} Year										
Year t	(t+0)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)	(t+9)	(t+10)
1917	13.00	13.26	13.12	16.82	16.76	18.17	18.22	18.84	20.38	22.62	17.58
1918	3.40	1.83	4.21	7.40	10.25	13.58	13.93	14.51	17.39	20.96	11.56
1919	3.40	5.79	8.51	12.01	14.24	16.77	18.02	20.11	22.96	26.63	16.12
1920	13.70	18.73	18.79	22.90	21.89	22.23	23.31	25.69	27.70	29.35	23.33
1921	31.80	37.21	32.24	37.09	31.07	28.39	28.21	29.50	28.39	28.06	31.13
1922	18.30	12.77	10.66	14.11	13.52	15.22	13.55	11.62	12.47	13.80	13.08
1923	6.20	3.15	4.63	7.81	10.13	13.30	13.10	12.93	15.44	18.57	11.01
1924	13.20	16.94	17.04	21.03	20.36	21.03	21.86	23.79	25.26	27.57	21.65
1925	8.40	8.02	9.11	12.59	13.89	16.16	16.41	17.10	19.29	22.17	14.97
1926	4.20	4.73	7.07	10.46	12.76	15.53	16.30	17.62	20.38	23.69	14.30
1927	8.40	11.74	13.14	16.91	17.62	19.15	20.25	22.35	24.51	27.48	19.24
1928	10.90	13.15	13.76	17.54	17.74	19.08	19.74	21.26	23.08	25.66	19.00
1929	8.20	8.72	9.94	13.45	14.69	16.82	17.29	18.33	20.54	23.43	15.92
1930	23.00	28.43	25.92	30.43	26.81	25.56	26.04	27.94	28.05	28.98	27.57
1931	41.20	45.17	37.45	42.55	34.20	30.28	29.87	29.17	26.77	25.08	33.30
1932	59.60	60.78	47.66	53.26	40.31	33.97	30.75	28.54	23.60	19.18	37.50
1933	61.20	55.92	41.61	46.74	34.31	29.02	24.05	19.00	13.81	8.90	30.37
1934	53.50	44.58	32.34	36.91	27.22	23.90	18.83	13.22	9.19	5.40	23.51
1935	49.50	42.99	32.07	36.67	27.70	24.54	20.31	15.89	12.40	9.25	24.65
1936	41.50	34.60	25.88	30.13	23.41	21.63	17.91	13.88	11.51	9.49	20.94
1937	34.70	29.36	22.68	26.79	21.68	20.69	17.84	14.86	13.42	12.42	19.97

1938	45.70	45.99	36.70	41.69	32.68	28.77	26.39	24.79	21.79	19.34	30.90
1939	41.20	35.79	27.28	31.64	24.77	22.73	19.38	15.94	13.60	11.66	22.63
1940	34.70	29.48	22.81	26.93	21.81	20.79	17.96	15.03	13.60	12.59	20.11
1941	23.30	17.85	14.35	18.00	16.03	16.91	14.88	12.64	12.79	13.41	15.21
1942	10.70	6.74	6.88	10.16	11.40	14.02	13.28	12.46	14.35	16.81	11.79
1943	3.90	3.41	5.74	9.03	11.38	14.61	15.17	16.12	18.93	22.45	13.00
1944	2.30	4.21	7.19	10.61	13.21	16.02	17.25	19.22	22.23	26.04	15.11
1945	3.90	6.88	9.50	18.07	15.07	17.40	18.75	21.02	23.80	27.41	16.99
1946	8.60	12.12	13.48	17.27	17.90	19.36	20.48	22.63	24.76	27.71	19.52
1947	8.40	9.92	11.17	14.80	15.80	17.69	18.37	19.78	21.96	24.88	17.15
1948	7.60	9.00	10.46	14.05	15.28	17.33	18.05	19.47	21.75	24.79	16.69
1949	11.90	14.75	15.11	18.98	18.81	19.88	20.60	22.27	23.94	26.40	20.08
1950	10.70	11.45	11.99	15.64	16.13	17.81	18.15	19.11	20.96	23.54	17.20
1951	6.00	6.04	7.83	11.25	13.14	15.72	16.24	17.26	19.77	23.01	14.47
1952	5.50	7.36	9.44	12.95	14.72	17.02	17.89	19.73	22.30	25.65	16.35
1953	6.10	8.32	10.26	13.86	15.37	17.50	18.52	20.35	22.83	26.10	17.01
1954	10.50	13.60	14.39	18.22	18.39	19.63	20.52	22.38	24.25	26.91	19.81
1955	9.20	10.14	11.12	14.73	15.60	17.48	17.97	19.11	21.17	23.97	16.81
1956	8.30	10.81	11.80	15.46	16.22	17.97	18.58	19.92	21.97	24.77	16.80
1957	9.80	11.81	12.70	16.42	16.96	18.53	19.22	20.72	22.69	25.43	18.28
1958	13.70	16.09	15.92	19.62	19.24	20.10	20.58	21.96	23.39	25.58	20.30
1959	12.00	12.34	12.48	16.15	16.35	17.90	18.04	18.76	20.44	22.82	17.26
1960	12.20	13.29	13.44	17.18	17.21	18.57	18.87	19.86	21.51	23.88	18.20
1961	14.10	15.60	15.25	19.09	18.54	19.51	19.76	20.78	22.16	24.26	19.44
1962	12.00	12.17	12.30	15.96	16.19	17.77	17.87	18.53	20.21	22.59	9.97

TABLE 3.--Estimates of the unemployment rate (percentage) in the (t+n)th year ahead (n=0,1,2. . .9) expected in each current year from 1917 to 1962 in retail trade in the United States.

	Expected Unemployment Rate in t^{th} Year										
Year t	(t+0)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)	(t+9)	(t+10)
1917	6.40	6.55	7.05	7.53	8.05	8.51	8.86	9.01	9.63	10.71	8.43
1918	2.10	1.41	2.60	3.71	5.08	6.39	6.94	7.03	8.30	9.92	5.71
1919	2.10	3.17	4.54	5.76	6.90	7.89	8.74	9.56	10.74	12.51	7.76
1920	6.60	8.80	9.49	10.07	10.27	10.33	11.02	11.99	12.49	13.72	10.91
1921	14.70	17.09	16.36	15.66	14.44	13.14	13.24	13.73	13.09	13.19	14.44
1922	8.70	6.28	6.11	6.04	6.52	7.07	6.79	5.74	6.15	6.70	6.38
1923	3.30	1.97	2.88	3.75	5.01	6.24	6.58	6.33	7.46	8.86	5.45
1924	6.40	8.06	8.72	9.30	9.61	9.80	10.42	11.18	11.73	12.94	10.20
1925	4.30	4.16	5.02	5.81	6.73	7.58	8.05	8.20	9.15	10.51	7.25
1926	2.40	2.65	3.88	5.00	6.19	7.29	7.97	8.43	9.61	11.26	6.92
1927	4.30	5.80	6.82	7.72	8.42	8.98	9.73	10.57	11.43	12.92	9.15
1928	5.40	6.40	7.17	7.87	8.44	8.91	9.49	10.05	10.78	12.07	9.02
1929	4.20	4.45	5.36	6.19	7.08	7.88	8.42	8.76	9.68	11.09	7.66
1930	10.80	13.19	13.15	13.08	12.53	11.87	12.27	13.03	12.94	13.58	12.85
1931	18.90	20.63	19.08	17.66	15.81	13.95	13.60	13.53	12.34	11.79	15.38
1932	27.10	27.57	24.43	21.62	18.53	15.56	14.36	13.22	10.93	9.12	17.26
1933	28.10	25.48	21.83	18.65	15.81	13.24	11.42	8.95	6.66	4.45	14.05
1934	24.40	20.44	17.31	14.64	12.62	10.89	9.12	6.36	4.65	2.66	10.99
1935	22.60	19.70	17.00	14.69	12.83	11.21	9.77	7.56	6.05	4.60	11.49
1936	19.00	15.93	13.86	12.11	10.90	9.89	8.70	6.67	5.67	4.71	9.83
1937	16.00	13.65	12.19	10.96	10.17	9.52	8.69	7.16	6.55	6.07	9.44
1938	20.00	21.00	18.93	17.08	15.11	13.22	12.43	11.57	10.16	9.20	14.30
1939	18.90	16.50	14.52	12.83	11.54	10.43	9.36	7.61	6.60	5.71	10.57

1940	16.00	13.69	12.23	11.01	10.21	9.56	8.73	7.22	6.60	6.13	9.49
1941	10.90	8.50	7.94	7.52	7.62	7.81	7.36	6.16	6.27	6.51	7.30
1942	5.30	3.58	4.08	4.61	5.58	6.56	6.67	6.13	6.99	8.07	5.81
1943	2.30	2.11	3.32	4.42	5.70	6.89	7.50	7.79	9.00	10.63	6.37
1944	1.60	2.46	3.90	5.19	6.44	7.55	8.41	9.17	10.43	12.25	7.31
1945	2.30	3.62	4.99	6.20	7.26	8.17	9.05	9.96	11.10	12.86	8.14
1946	4.30	5.84	6.87	7.77	8.46	9.01	9.77	10.63	11.48	12.98	9.20
1947	4.20	4.90	5.86	6.72	7.54	8.26	8.88	9.40	10.31	11.75	8.18
1948	4.30	5.06	6.01	6.86	7.66	8.35	8.98	9.51	10.40	11.83	8.30
1949	5.80	6.90	7.61	8.25	8.74	9.13	9.69	10.26	10.93	12.18	9.30
1950	5.80	6.29	6.94	7.53	8.11	8.60	9.06	9.39	10.08	11.28	8.59
1951	3.70	3.66	4.63	5.52	6.53	7.47	8.00	8.25	9.26	10.71	7.11
1952	3.10	3.77	4.92	5.95	6.97	7.88	8.58	9.16	10.22	11.81	7.70
1953	3.00	3.89	5.08	6.15	7.15	8.03	8.78	9.46	10.52	12.15	7.91
1954	5.20	6.68	7.54	8.30	8.84	9.25	9.94	10.70	11.44	12.80	9.50
1955	4.30	4.66	5.56	6.38	7.24	8.00	8.56	8.93	9.84	11.23	7.82
1956	4.10	4.77	5.75	6.62	7.47	8.21	8.83	9.35	10.27	11.72	8.11
1957	4.50	5.35	6.28	7.10	7.85	8.49	9.12	9.68	10.54	11.95	8.48
1958	6.70	7.94	8.51	9.01	9.33	9.54	10.07	10.63	11.17	12.30	9.83
1959	5.80	5.92	6.53	7.10	7.73	8.29	8.69	8.86	9.57	10.73	8.16
1960	5.90	6.41	7.05	7.63	8.18	8.66	9.11	9.44	10.12	11.30	8.66
1961	7.20	8.00	8.43	8.82	9.11	9.33	9.73	10.08	10.57	11.59	9.52
1962	6.30	6.34	6.85	7.34	7.89	8.39	8.73	8.84	9.48	10.57	5.05

TABLE 4.--Estimates of the unemployment rate (percentage) in the (t+n)th year ahead (n=0,1,2. . .9) expected in each current year from 1917 to 1962 in laundries in the United States.

	Expected Unemployment Rate in t^{th} Year										
Year t	(t+0)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)	(t+9)	(t+10)
1917	4.90	4.98	5.32	5.64	6.04	6.46	6.46	6.67	7.21	7.91	6.30
1918	1.90	1.34	2.13	2.86	3.87	4.90	5.06	5.31	6.30	7.25	4.34
1919	1.90	2.63	3.59	4.44	5.27	6.05	6.42	7.05	8.00	9.18	5.85
1920	5.10	6.70	7.20	7.36	7.79	7.88	8.11	8.74	9.22	10.15	8.16
1921	10.60	12.31	11.85	11.43	10.61	9.78	9.58	9.81	9.50	9.78	10.52
1922	6.50	4.74	4.55	4.44	4.82	5.33	4.91	4.46	4.82	4.99	4.79
1923	2.80	1.80	2.37	2.91	3.83	4.80	4.81	4.87	5.73	6.50	4.18
1924	4.90	6.06	6.54	6.96	7.21	7.42	7.60	8.12	8.63	9.51	7.56
1925	3.40	3.25	3.83	4.35	5.05	5.76	5.85	6.11	6.87	7.71	5.42
1926	2.20	2.37	3.20	3.95	4.81	5.65	5.89	6.34	7.26	8.31	5.31
1927	3.40	4.41	5.14	5.78	6.31	6.79	7.07	7.67	8.40	9.44	6.78
1928	4.20	4.91	5.46	5.94	6.38	6.79	6.95	7.40	8.03	8.92	6.75
1929	3.40	3.55	4.17	4.72	5.38	6.03	6.17	6.51	7.27	8.16	5.77
1930	7.90	9.61	9.63	9.63	9.28	8.90	8.92	9.36	9.44	10.04	9.42
1931	13.50	14.79	13.76	12.84	11.58	10.36	9.84	9.73	9.02	8.86	11.20
1932	19.10	19.50	17.36	15.48	13.35	11.39	10.27	9.47	7.98	6.98	12.42
1933	19.80	17.98	15.43	13.22	11.28	9.64	8.10	6.61	5.07	3.59	10.10
1934	17.20	14.38	12.16	10.26	8.91	7.89	6.41	4.83	3.68	2.35	7.87
1935	16.00	13.97	12.07	10.44	9.19	8.20	6.95	5.69	4.70	3.65	8.32
1936	13.00	11.44	9.94	8.67	7.87	7.30	6.22	5.11	4.47	3.69	7.10
1937	11.50	9.80	8.74	7.85	7.34	7.03	6.20	5.38	5.03	4.59	6.88
1938	14.90	15.02	13.60	12.34	10.99	9.77	8.95	8.40	7.51	6.98	10.40
1939	13.50	11.78	10.36	9.16	8.30	7.66	6.67	5.69	5.05	4.37	7.67
1940	11.50	9.84	8.79	7.90	7.39	7.06	6.24	5.44	5.08	4.66	6.93
1941	8.00	6.26	5.81	5.46	5.57	5.84	5.30	4.74	4.88	4.87	5.41
1942	4.10	2.81	3.11	3.42	4.15	4.96	4.82	4.69	5.38	5.93	4.36

1943	2.10	1.94	2.75	3.48	4.40	5.32	5.52	5.88	6.83	7.83	4.88
1944	1.60	2.17	3.16	4.04	4.94	5.81	6.17	6.77	7.77	8.96	5.53
1945	2.10	3.01	3.96	4.80	5.57	6.28	6.66	7.33	8.25	9.43	6.14
1946	3.50	4.58	5.30	5.93	6.44	6.89	7.17	7.78	8.50	9.54	6.90
1947	3.40	3.85	4.51	5.09	5.70	6.29	6.49	6.92	7.66	8.61	6.12
1948	3.50	4.02	4.67	5.24	5.83	6.39	6.58	7.03	7.76	8.70	6.25
1949	5.10	6.01	6.42	6.79	7.04	7.24	7.39	7.82	8.31	9.13	7.35
1950	5.00	5.20	5.53	5.84	6.21	6.59	6.61	6.84	7.37	8.07	6.47
1951	3.10	2.83	3.44	4.00	4.77	5.55	5.65	5.89	6.70	7.55	5.15
1952	2.60	3.01	3.80	4.51	5.26	5.99	6.24	6.72	7.59	8.62	5.75
1953	2.40	2.97	3.81	4.57	5.34	6.07	6.36	6.91	7.79	8.88	5.86
1954	4.00	5.08	5.72	6.27	6.69	7.06	7.30	7.87	8.52	9.50	7.11
1955	3.80	4.14	4.71	5.23	5.78	6.33	6.47	6.84	7.53	8.41	6.16
1956	3.20	3.47	4.13	4.73	5.41	6.06	6.24	6.64	7.42	8.35	5.83
1957	3.40	3.98	4.66	5.25	5.84	6.41	6.62	7.09	7.83	8.80	6.28
1958	4.60	5.42	5.91	6.34	6.69	7.02	7.17	7.61	8.18	9.04	7.04
1959	4.30	4.52	4.99	5.41	5.90	6.38	6.46	6.76	7.38	8.18	6.22
1960	4.10	4.40	4.91	5.37	5.88	6.39	6.49	6.83	7.48	8.31	6.23
1961	4.90	5.50	5.91	6.27	6.60	6.92	7.01	7.37	7.90	8.68	6.91
1962	4.30	4.39	4.84	5.25	5.75	6.27	6.33	6.59	7.21	7.98	3.89

APPENDIX D

TABLE 1.--Present Value of the Expected Future Income Stream in the Remaining Years of Life of 25 Year Old Worker in Various Occupations in the U. S. 1917-62.

Year	Farming	Manufacturing	Construction	Laundries	Retail Trade
	Present Value (in current dollars)	Present Value (in current dollars)	Present Value (in current dollars)	Present Value (in current dollars)	Present Value (in current dollars)
1917	19,381	27,278	27,412	13,007	17,909
1918	20,706	32,779	32,039	14,504	18,988
1919	21,810	33,790	32,077	15.443	20,465
1920	23,962	35,472	41,661	20,063	26,206
1921	11,917	24,733	28,213	17,618	20,923
1922	16,812	30,938	32,971	18,089	21,866
1923	19,754	36,643	41,080	20,309	25,439
1924	19,394	32,960	38,843	20,975	25,704
1925	19,193	35,617	42,118	22,047	26,843
1926	19,731	36,187	45,997	23,620	28,820
1927	19,616	35,027	43,512	23,862	28,473
1928	19,582	35,240	42,790	23,767	28,194
1929	19,779	35,754	43,576	23,652	27,502
1930	18,064	29,963	38,703	23,152	27,351
1931	14,453	26,218	34,334	22,388	25,781
1932	13,015	21,862	25,105	18,760	20,969
1933	15,199	26,843	32,616	20,430	24,174
1934	19,016	33,606	40,715	23,445	27,835
1935	19,171	34,340	39,184	23,442	27,111
1936	20,528	38,994	46,772	25,590	30,740
1937	22,527	43,026	52,242	26,888	33,568
1938	21,282	36,150	47,218	26,360	33,367
1939	21,507	41,981	50,890	27,660	33,133
1940	22,575	44,730	54,415	28,518	35,035
1941	25,946	53,391	61,603	30,046	37,182
1942	32,049	65,574	70,689	32,775	40,210
1943	37,625	72,871	68,058	35,902	42,261
1944	40,288	74,213	68,448	39,247	45,065
1945	41,789	70,505	71,550	41,217	47,073
1946	43,827	70,454	82,666	44,733	54.148
1947	47,559	83,199	98,431	48,770	60,535
1948	50,168	86,339	104,816	49,680	62,340
1949	48,112	80,595	96,338	48,428	61,487

1950	47,129	89,805	104,231	49,377	52,124
1951	54,824	96,593	114,879	52,518	68,013
1952	43,242	96,662	113,541	51,477	67,300
1953	53,068	99,288	119,062	52,087	68,914
1954	50,680	94,572	115,824	51,516	68,725
1955	53,255	108,038	127,518	53,787	73,821
1956	55,560	108,491	134,298	55,237	74,706
1957	55,698	106,382	131,470	54.143	73,879
1958	54,756	100,797	128,844	54,047	72,617
1959	57,062	112,438	141,632	55,150	75,330
1960	55,655	106,899	139,271	55,119	74,091
1961	54,164	105,479	138,592	54,183	72,806
1962	56,423	117,827	155,543	57,271	78,303

Source: See formulas for present values given in the Metholology chapter. For data on estimates of expected annual wages and unemployment rates see Appendix A and B respectively, for interest rate and expectancy of life, see Chapter III.

TABLE 2.--Index of present value of the expected future income stream for a 25 year old worker with the present value in 1917 as the basis in various occupations in the U. S., 1917-62.

Year	Farming: Index of Present Value 1917 = 100	Manufacturing: Index of Present Value 1917 = 100	Construction: Index of Present Value 1917 = 100	Laundries: Index of Present Value 1917 = 100	Retail Trade: Index of Present Value 1917 = 100
1917	100.00	100.00	100.00	100.00	100.00
1918	106.82	120.14	116.88	111.51	106.02
1919	112.52	123.84	117.02	118.73	114.27
1920	123.62	130.00	151.98	154.25	146.33
1921	61.48	90.65	102.92	135.45	116.83
1922	86.73	113.39	120.28	139.07	122.09
1923	101.91	134.30	149.86	156.14	142.04
1924	100.05	120.80	141.70	161.26	143.52
1925	99.02	130.54	153.65	169.50	149.88
1926	101.79	132.63	167.80	181.59	160.92
1927	101.20	128.37	158.73	183.45	158.98
1928	101.02	129.15	156.10	182.72	157.43
1929	102.04	131.04	158.97	181.84	153.56
1930	93.19	109.81	141.19	177.99	152.72
1931	74.56	96.09	125.25	172.12	143.95
1932	67.14	80.12	91.58	144.23	117.08
1933	78.41	98.38	118.98	157.07	134.98
1934	98.10	123.17	148.53	180.25	155.42
1935	98.90	125.86	142.94	180.22	151.37
1936	105.90	142.91	170.62	196.74	171.64
1937	116.22	157.69	190.58	206.72	187.43
1938	109.79	132.49	172.25	202.66	186.31
1939	110.95	153.86	185.65	212.65	185.00
1940	116.46	163.94	198.51	219.25	195.62
1941	133.86	195.68	224.73	230.99	207.61
1942	165.34	240.33	257.87	251.98	224.52
1943	194.11	267.07	248.28	276.02	235.97
1944	207.85	271.99	249.70	301.73	251.63
1945	215.59	258.40	261.01	316.88	262.84
1946	226.10	258.21	301.57	343.91	302.35
1947	245.36	304.92	359.08	374.95	338.01
1948	258.82	316.43	382.37	381.94	348.09
1949	248.21	295.38	351.44	372.32	343.32

1950	243.14	329.14	380.23	379.62	291.04
1951	282.84	354.01	419.08	403.76	379.76
1952	274.68	354.27	414.20	395.76	375.78
1953	273.78	363.89	434.34	400.45	384.80
1954	261.46	346.61	422.53	396.06	383.74
1955	274.74	395.96	465.19	413.52	412.19
1956	286.63	397.62	489.92	424.67	417.14
1957	287.35	389.89	479.60	416.26	412.52
1958	282.49	369.42	470.02	415.52	405.47
1959	294.38	412.09	516.67	424.00	420.62
1960	287.12	391.78	508.06	423.76	413.70
1961	279.43	386.58	505.58	416.56	406.53
1962	291.09	431.84	567.42	440.31	437.22

Source: See Table I of this Appendix.

TABLE 3.--Present Value of the Expected Future Income Stream in the Remaining Years of Life of a 45 Year Old Worker in Various Occupations in the U. S. 1917-62.

Year	Farming Present Value (in current dollars)	Manufacturing Present Value (in current dollars)	Construction Present Value (in current dollars)	Laundries Present Value (in current dollars)	Retail Trade Present Value (in current dollars)
1917	13,479	18,516	17,747	8,888	12,173
1918	14,726	23,176	21,553	10,220	13,235
1919	15,732	24,107	21,819	11,065	14,470
1920	17,908	26,220	31,565	15,575	20,064
1921	7,884	17,693	20,157	13,568	15,731
1922	11,976	22,204	22,152	13,481	15,822
1923	13,700	25,745	27,870	14,793	18,091
1924	13,398	22,865	26,900	15,472	18,526
1925	13,156	24,728	28,532	16,169	19,150
1926	13,574	25,088	31,892	17,506	20,829
1927	13,419	24,204	29,651	17,609	20,412
1928	13,404	24,404	28,781	17,487	20,105
1929	13,670	24,846	29,355	17,449	19.528
1930	12,275	20,461	26,642	17,247	19,884
1931	9,202	17,580	23,186	16,602	18,519
1932	7,981	14,055	14,946	13,352	14,215
1933	9,171	17,220	20,149	14,267	16,272
1934	11,608	21,421	24,978	16,089	18,352
1935	11,895	22,284	24,160	16,240	17,973
1936	12,541	25,036	29,518	17,514	20,443
1937	13,360	28,551	34,302	18,764	23,014
1938	13,242	22,983	30.965	18,365	22,930
1939	13,395	27,582	32,114	19,287	22,120
1940	14,156	29,367	34,561	19,814	23,602
1941	16,869	36,235	39,893	20,946	25,191
1942	21,458	45,143	46,016	22,749	27,000
1943	25,836	50,263	42,260	25,185	28,456
1944	27,714	50,189	42.463	27,620	30,502
1945	28,744	46,404	45,489	28,917	31,856
1946	29,865	45,850	55,017	31,303	37,301
1947	32,237	55,503	65,932	33,781	41,142
1948	34,583	57,719	69,755	34,580	42,384
1949	33,426	53,818	62,058	34,043	42,128

1950	30,601	61,232	67,810	34,706	35,662
1951	38,922	66,376	76,132	37,319	47,045
1952	38,172	67,186	76,120	36,877	47,003
1953	38,160	69,315	80,997	37,519	48,504
1954	36,264	65,422	77,577	37,122	48,399
1955	37,965	75,624	84,923	38,502	51,737
1956	40,021	75,808	91,094	39,878	52,605
1957	41,566	77,247	92,791	40,330	54,107
1958	41,277	73,692	91,862	40,827	53,766
1959	43,377	83,586	102,442	41,733	56,015
1960	42,725	79,706	101,306	42,276	55,702
1961	41,977	79,838	102,288	41,957	55,398
1962	43,709	88,705	112,581	44,138	59,229

Source: See formulas for present values given in the Methology chapter. For data on estimates of expected annual wages and unemployment rates see Appendix A and B respectively, for interest rate and expectancy of life, see Chapter III.

TABLE 4.--Index of present value of the expected future income stream for a 45 year old worker with the present value in 1917 as the basis in various occupations in the U. S., 1917-62.

Year	Farming	Manufacturing	Construction	Laundries	Retail Trade
	Index of Present Value 1917 = 100	Index of Present Value 1917 = 100	Index of Present Value 1917 = 100	Index of Present Value 1917 = 100	Index of Present Value 1917 = 100
1917	100.00	100.00	100.00	100.00	100.00
1918	109.24	125.15	121.44	114.99	108.71
1919	116.70	130.18	122.94	124.49	118.86
1920	132.84	141.59	177.86	175.23	164.81
1921	58.48	95.54	113.58	152.65	129.21
1922	88.84	119.89	124.82	151.67	129.96
1923	101.63	139.02	157.04	166.44	148.60
1924	99.39	123.47	151.57	174.08	152.17
1925	97.59	133.53	160.77	181.92	157.30
1926	100.71	135.48	179.70	196.96	171.09
1927	99.54	130.70	167.07	198.12	167.66
1928	99.43	131.78	162.17	196.75	165.14
1929	101.40	134.17	165.41	196.32	160.40
1930	91.06	110.49	150.12	194.05	163.33
1931	66.26	94.93	130.65	186.79	152.12
1932	59.20	75.90	84.22	150.22	116.76
1933	68.03	92.99	113.53	160.52	133.66
1934	86.11	115.67	140.74	181.02	150.74
1935	88.24	120.33	136.13	182.72	147.63
1936	93.03	135.19	166.33	197.05	167.92
1937	106.52	154.18	193.28	211.11	189.04
1938	98.23	124.11	174.48	206.62	188.35
1939	99.36	148.94	180.95	217.00	181.69
1940	105.01	158.58	194.74	222.93	193.87
1941	125.13	195.67	224.79	235.66	206.92
1942	159.18	243.77	259.29	255.95	221.78
1943	191.65	271.42	238.12	283.36	233.74
1944	205.58	271.02	239.27	310.75	250.54
1945	213.22	250.58	256.32	325.35	261.67
1946	221.54	247.59	310.60	352.19	306.39
1947	239.13	299.72	371.51	380.07	337.94
1948	256.54	311.68	393.05	389.06	348.14
1949	247.95	290.62	349.68	[illegible]	346.04

1950	227.00	330.65	382.09	390.48	292.93
1951	288.72	358.43	428.98	419.88	386.43
1952	283.16	362.80	428.91	414.90	386.08
1953	283.07	374.30	456.39	422.13	398.41
1954	269.01	353.28	437.12	417.66	397.55
1955	281.62	408.37	478.52	433.19	424.97
1956	296.88	409.34	513.29	448.67	432.10
1957	308.34	417.13	522.85	453.75	444.43
1958	306.19	397.94	517.61	459.34	441.63
1959	321.77	451.36	577.23	469.54	460.11
1960	316.93	430.41	570.83	475.65	457.54
1961	311.39	431.13	576.36	472.06	455.04
1962	324.23	479.01	634.36	496.60	486.51

Source: See Table 3 of this Appendix.

APPENDIX E

TABLE 1.--Number of farm operators by age group in the U.S., 1920-1960.

Year	Farm Operators by age						
	Total	<25	25-34	35-44	45-54	55-64	65+
	(thousands)						
1920	6,448	388	1,305	1,608	1,502	1,007	592
1930	6,289	384	1,085	1,504	1,512	1,103	701
1940	6,097	244	992	1,207	1,491	1,198	865
1950	5,379	175	844	1,266	1,234	1,066	794
1960	3,933	65	428	858	1,047	851	683

TABLE 2.--Estimates of survived rural farm males by age group in the U.S., 1920-1970.

	Survived rural farm males, by age						
	<25	25-34	35-44	45-54	55-64	65+	Total
1920	3,550,739	2,710,803	1,916,836	1,561,069	1,060,309	872,325	11,671,721
1930	3,999,328	2,830,686	1,997,559	1,678,902	1,212,110	1,023,083	12,741,668
1940	3,655,637	2,957,363	1,726,781	1,581,299	1,268,264	1,186,034	12,375,378
1950	3,166,545	3,009,880	2,007,682	1,585,848	1,365,880	1,422,825	12,558,660
1960	2,428,833	1,878,456	1,341,396	1,385,594	1,114,093	1,230,730	9,379,102
1970	1,887,082	1,234,141	684,012	943,536	948,985	1,089,571	6,787,327

Source: Johnston, E. W. The Supply of Farm Operators, unpublished Ph.D. thesis submitted to the Department of Agricultural Economics (Raleigh, North Carolina: North Carolina State University, 1963. Appendix B--Table 1.

APPENDIX F

Refer to the equations 9-13 on page

Let $A = \frac{W_M}{W_F^2}$; $B = \frac{W_L}{W_F^2}$; $C = \frac{1}{W_F}$

The equations (9-13) can be written in a matrix notation.

$$\begin{bmatrix} 1 & -b_1 & -b_1 & 0 & 0 \\ 0 & 1 & 0 & -b_2 & 0 \\ 0 & 0 & 1 & 0 & -b_3 \\ A & 0 & 0 & 1 & 0 \\ B & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ C \\ 0 \end{bmatrix}$$

This matrix of coefficients can be reduced to a manageable form as follows for easy calculation of the determinant

$$\begin{bmatrix} 1 & -b_1 & -b_1 & 0 & 0 \\ 0 & 1 & 0 & -b_2 & 0 \\ 0 & 0 & 1 & 0 & -b_3 \\ 0 & Ab_1 & Ab_1 & 1 & 0 \\ 0 & Bb_1 & Bb_1 & 0 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ C \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & -b_1 & -b_1b_2 & 0 \\ 0 & 1 & 0 & -b_2 & 0 \\ 0 & 0 & 1 & 0 & -b_3 \\ 0 & 0 & Ab_1 & (1+Ab_1b_2) & 0 \\ 0 & 0 & Bb_1 & Bb_1b_2 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ C \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 & -b_1b_2 & -b_1b_3 \\ 0 & 1 & 0 & -b_2 & 0 \\ 0 & 0 & 1 & 0 & -b_3 \\ 0 & 0 & 0 & (1+Ab_1b_2) & Ab_1b_3 \\ 0 & 0 & 0 & Bb_1b_2 & 1+Bb_1b_3 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ C \\ 0 \end{bmatrix}$$

The determinant of the matrix of coefficients

$$D = (1 + Ab_1b_2)\,(1 + Bb_1b_3) - ABb_1^2b_2b_3$$

$$= 1 + b_1b_2A + b_1b_3B$$

$D > 0$ since $b_1 < 0$; $b_2 < 0$: $A < 0$; $B < 0$

$$X_4 = \frac{1}{D}\, C\, (1 + Bb_1b_3) > 0$$

since $C > 0$; $B > 0$, $b_1 < 0$, $b_3 < 0$

$$X_5 = \frac{1}{D}\,(-CBb_1b_2)$$

$$= \frac{1}{D}\, CBb_1b_2 < 0$$

since $D > 0$, $C > 0$, $B > 0$, $b_1 < 0$, $b_2 < 0$

$$X_2 + X_3 = \left[\frac{b_2 + b_1b_3\dfrac{W_L}{W_F^2} - b_1b_3\dfrac{W_L}{W_F^2}}{D}\right] = \frac{b_2}{D} < 0$$

since $D > 0$, $b_2 < 0$