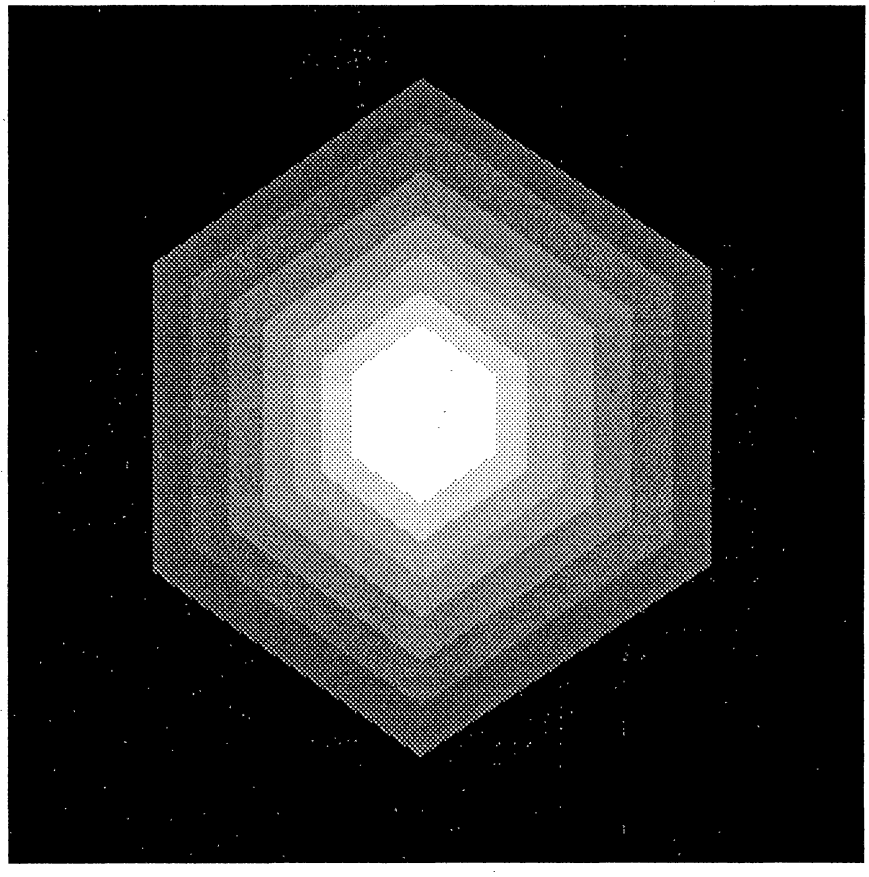
Forecasting Shifts in the Distribution of Taxable Wages in Unemployment Insurance Employer Tax Tables



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Division of Program Analysis and Evaluation

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TECHNICAL NOTE

The analysis contained in this paper was developed with the use of the New Jersey unemployment insurance employer tax table. In using the methodology developed to solve the taxable wage distribution problem, other states will need to make a translation to the specifics of their tax tables and financing systems.

EXECUTIVE SUMMARY

The purpose of this paper is to develop a methodology for forecasting the distribution of taxable wages among the reserve ratio categories in the New Jersey unemployment insurance employer tax table - a key component in forecasting trust fund tax receipts. New Jersey finances its unemployment trust fund through worker and employer taxes as well as interest payments. The worker tax is fixed by law; New Jersey is one of 33 states that uses the reserve ratio method to assign individual employer tax rates, which are determined by two factors. The first is the trust fund reserve ratio, which is computed by dividing the balance of the unemployment insurance trust fund as of March 31 by total taxable wages for the previous calendar year. This ratio determines which column of the tax table will be in effect for the following rate year (July 1 - June 30). Second, a reserve ratio for each individual employer is computed by dividing cumulative contributions minus cumulative benefits paid over the life of the firm (known as the reserve balance) by the firm's average annual taxable wages for the last three or five years, whichever is greater.

Since one purpose of the reserve ratio system is to discourage layoffs, the tax rate is inversely related to the reserve ratio category, i.e., the greater the extent to which contributions exceed benefits in proportion to wages, the lower the tax rate assignment and vice versa. The current tax table consists of six rate schedules and 28 reserve ratio categories and, hence, tax rates. Each rate schedule corresponds to a different level of trust fund reserves. New employers and those who did not make contributions in one of the last three years are assigned special rates.

Given this structural relationship between reserve ratio levels and tax rates, a sizable error in forecasting trust fund tax receipts occurs if shifts in the distribution of taxable wages among reserve ratio categories are not taken into account. These shifts alter the average tax rate and the yield from a given column of the tax table. Historically, the average tax rate projections for a given rate year have been based on its level under similar economic conditions in the past.

In order to arrive at a forecast of the distribution of taxable wages among reserve ratio categories, two models are developed and estimated in this study. The first allows for a forecast of a shift in the distribution of taxable wages among the rate categories of a given tax table when it is known that these categories will remain unchanged in the rate year for which a forecast is required. The second accomplishes the same task when the reserve ratio boundaries that correspond to a given tax rate change. An analysis of the estimation results and a description of the method of implementing and using the model are offered. In addition, the prospective forecasting ability of the models developed for both the constant and changing tax table scenarios is examined.

Chapter Two examines the distributional shifts which have occurred between Rate Years 1970-71 and 1990-91. Two indicators of these shifts are

developed. The first describes trends in the shares of taxable wages for the tax table categories that existed between Rate Years 1970-71 and 1987-88. The second consists of various measures of the shifting distribution of taxable wages among one percentage point-long reserve ratio categories, which must be used for forecasting purposes when the tax table categories change. The indicators in this second group consist of the mean and standard deviation of reserve ratios weighted by taxable wages.

An examination of these various indicators reveals several important points. Positive balance employers have consistently accounted for the bulk of taxable wages, reaching a sample period high of 91.6 percent of taxable wages in Rate Year 1989-90. Movements of taxable wages among the individual tax rate categories are complex and varied; as expected, recessions do seem to have an impact on the shares. Also, the distribution is quite concentrated, with the bulk of taxable wages falling in the 0.00 to 6.99 percent and 7.00 to 13.99 percent ranges. These two categories together comprise anywhere between 60 and 89 percent of taxable wages over the period studied. In addition, the distribution seems to maintain a relatively constant shape throughout the sample period studied. This is confirmed by the fact that the weighted standard deviation fluctuates slowly. Most importantly, despite its concentration and being slightly steeper to the right of the mean, the distribution closely resembles the normal distribution. The weighted mean fluctuates more than does the weighted standard deviation and exhibits a very discernible pattern of being impacted by recessions with a lag.

To solve the forecasting problem when it is known that the reserve ratio boundaries that correspond to a given tax table will remain the same in the rate year for which a forecast is required, Chapter Three specifies a series of one-equation models in which the dependent variable in each is the percentage of taxable wages in each of the tax rate categories that existed between Rate Years 1970-71 and 1987-88. The estimated equations (annual data) can then be used to forecast the respective shares. Multiplying the forecasted shares by the respective tax rates in effect in the forecast year and summing over the entire rate schedule yields a forecasted average tax rate.

The model developed is based on an analysis of the forces that result in an individual employer moving from one reserve ratio level to another and contains three independent variables-the New Jersey total unemployment rate (lagged one period), the taxable wage base and a binary variable for the status of the Extended Benefits Program, which has a value of zero when the trigger is "off" and one when the trigger is "on." The results reported for these regressions are quite encouraging, with all equations having F-values that are statistically significant at the 95 percent confidence level or better and R-squared terms ranging from 0.50 to 0.84. Although displaying some weak spots, particularly on the extended benefits trigger variable, the t-statistics support optimism for the model as a whole. An examination of the prospective forecasting ability of these estimated equations using an ex-post forecasting test

reveal a small difference between the ex-post forecasts and the actual data. Therefore, they should be able to forecast the shares and the consequent average tax rate with reasonable accuracy. Further research, however, should not be ruled out.

When the tax table categories change in the rate year for which a forecast is required, a different method is needed, since the tax table shares which comprise the dependent variables are then no longer a continous series. As a first step in developing an alternative, a Chi-Square goodness of fit test was applied to three rate years: 1970-71, 1978-79 and 1990-91 representing the first rate year, a mid-point and the final rate year of the sample. This was done in order to test the hypothesis that the distribution of taxable wages among the unit-long reserve ratio categories of the ES-204 data is normal-a reasonable hypothesis given the literature in this area and the observations noted in Chapter Two. For the current study with 72 reserve ratio classes, the critical value for the acceptance of the hypothesis of normality at the five-percent significance level is 90.53. The first two rate years have a Chi-Square statistic above that; the third is just slightly below; with values of 155.08, 158.67 and 88.28, respectively. The bulk of the deviation for the first two years is highly concentrated in a few reserve ratio categories. The third year is almost completely normal. Subsequent years should be tested to see if this high level of conformity to the normal distribution continues.

Next, the three-variable model developed for the constant tax table scenario was estimated, with the weighted mean reserve ratio and weighted standard deviations as dependent variables over the period consisting of Rate Years 1970-71 to 1990-91. The results for the weighted mean regression were excellent, with an R-squared of 0.94, high t-statistics and no first-order serial correlation. The weighted standard deviation result offers a bit more reason for concern, but given the complex nature of this variable, it is a reasonably good result in the context of the current study.

The estimated equations for the weighted mean reserve ratio and weighted standard deviation can be used to forecast these parameters. Once the distribution is shown to be normal, a standard normal mapping procedure, which is outlined in Appendix C, can then be used to allocate the forecasted parameters down to the level of the individual reserve ratios. These forecasted reserve ratios can in turn be aggregated to correspond to the boundaries of the new tax rate categories. Multiplying the shares by the tax rates that will be in effect in the forecast year and summing over the entire rate schedule yields a forecasted average tax rate. The accuracy of the ex-post forecasts using this second method is quite good. The error for the weighted mean reserve ratio and the weighted standard deviation ranges between 0.66 and 1.20. The difference between the actual average tax for Rate Year 1989-90 (2.06 percent) and the forecasted rate (2.04 percent) was 0.02 percentage points, while the difference was 0.16 percentage points for Rate Year 1990-91 (1.98 percent vs. 1.82 percent).

Chapter Five suggests areas that merit further research, including an examination of micro-level data to determine the extent to which firms tend to remain in a given tax rate category over an extended time period and, if so, whether the characteristics of firms at different reserve ratio levels can be identified.

I. Introduction

The purpose of this paper is to develop a methodology for forecasting the distribution of taxable wages among reserve ratio categories in the unemployment insurance employer tax table and, hence, trust fund tax receipts for New Jersey. The difficulty of doing so arises from the architecture of the financing system, the specifics of which are explained in the following paragraphs.

Historical data on the year-end balance in the New Jersey Unemployment Trust Fund are presented in Table 1, while data on average annual employer and worker tax rates are contained in Table 2. Figure 1 charts the average employer tax rate between Rate Years 1970-71 and 1990-91. Trust fund revenues are financed through a combination of worker and employer taxes.

There are several types of systems for assigning employer tax rates. Each is in some way based on an employer's previous experience with unemployment, i.e., its layoff experience. New Jersey is one of 33 states currently using the reserve ratio method, whereby employer tax rates are determined by two factors: the firm's individual reserve ratio and the trust fund reserve ratio. The trust fund reserve ratio is computed by dividing the balance of the unemployment trust fund on March 31 by total taxable wages for the previous calendar year:

$$\text{Trust Fund Reserve Ratio} = \frac{\text{Balance of Unemployment Trust Fund (March 31)}}{\text{Total Taxable Wages for All Employers (Previous Calendar Year)}}$$

This ratio determines which column of the tax table will be in effect for the following rate year (July 1 - June 30).

The reserve ratio for a firm is the ratio of its cumulative contributions minus cumulative benefits paid over the life of the firm (known as the reserve balance) to average annual taxable wages for the last three or five years, whichever is greater:

$$\text{Employer Reserve Ratio} = \frac{\text{Cumulative Contributions - Cumulative Benefits Charged}}{\text{Average Annual Taxable Wages (last three or five years, whichever is greater)}}$$ [1]

The current tax table consists of six columns and 28 reserve ratio categories and, thus, tax rates. (See Appendix A for the tax tables

TABLE 1

NEW JERSEY UNEMPLOYMENT INSURANCE TRUST FUND
YEAR-END BALANCE*
(MILLIONS OF DOLLARS)
1970-1990

Calendar Year	Fund Balance
1970	$440.8
1971	249.0
1972	119.1
1973	140.4
1974	29.9
1975	26.8
1976	16.6
1977	59.6
1978	146.0
1979	143.6
1980	156.0
1981	190.3
1982	97.4
1983	190.0
1984	500.0
1985	769.2
1986	1,259.8
1987	1,821.2
1988	2,364.5
1989	2,795.0
1990	2,987.1

* Cash Basis. Trust fund figures from 1975 to 1984 include federal advances under Title XII of the Social Security Act.

Source: 1990 New Jesey Department of Labor Annual Statistical Review

TABLE 2

AVERAGE ANNUAL CONTRIBUTION RATES
FOR EMPLOYERS AND EMPLOYEES[1]
(PERCENT)
1970-1990

Calendar Year	Average Employer Tax Rate (Percent)	Employee Tax Rate (Percent)
1970	2.10	0.25
1971	2.44	0.25
1972	2.59	0.25
1973	2.95	0.25
1974	3.07	0.25
1975	3.22	0.50
1976	3.29	0.50
1977	3.67	0.50
1978	3.66	0.50
1979	3.63	0.50
1980	3.49	0.50
1981	3.33	0.50
1982	3.24	0.50
1983	3.13	0.50
1984	3.19	0.50
1985	3.36	0.50
1986	3.06	0.50, 0.625[2]
1987	2.47	0.625
1988	2.18	0.625
1989	2.06	0.625,0.375[3]
1990	1.82	0.375,0.625[3]

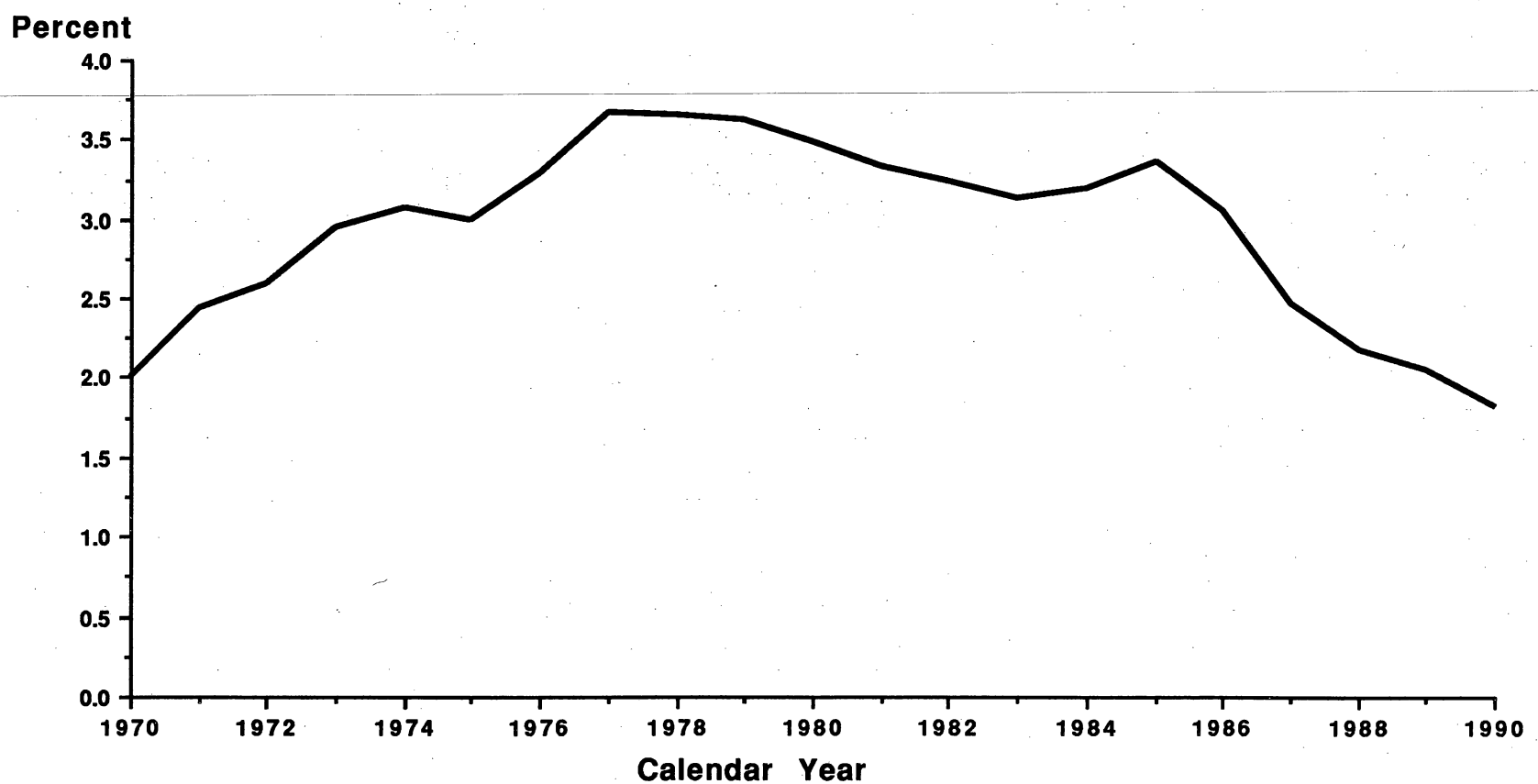
[1] Employer rate is the average rate paid over the year; worker rate is fixed by legislation.

[2] Rate increased to 0.625 percent effective July 1, 1986.

[3] Under the terms of the State Fiscal Year 1990 Appropriations Act, 40 percent of worker contributions collected between July 1989 and June 1990 or $100 million, whichever was greater, was transferred to the Uncompensated Care Offset Account.

Source: 1990 New Jersey Department of Labor Annual Statistical Review

Figure 1
Average Employer Tax Rate: 1970 - 1990*



* Rates are computed on taxable wages.

in effect over the course of the study period.) New employers and those that did not make contributions in one of the last three years are assigned special rates. For Rate Year 1990-91, column B of the table was in effect; individual employer rates ranged from 0.4 to 5.4 percent. As one purpose of the reserve ratio system is to discourage layoffs, the tax rate is inversely related to the reserve ratio category, i.e., the greater the extent to which contributions exceed benefits in proportion to wages, the lower the tax rate and vice versa.

This financing process and the solvency of the trust fund are of concern to Department of Labor administrators, legislators and others for whom accurate projections of both tax receipts and benefit payments are critical to evaluating the adequacy of the tax structure as well as a variety of legislative proposals impacting New Jersey's unemployment insurance program. The tool that has been developed for making such projections is the trust fund simulator, which is a computer based model utilizing assumptions about the future course of the economy to project trust fund tax receipts, benefit payments and month ending balances.

Given the structural relationship between reserve ratio levels and tax rates, a sizable error in forecasting trust fund tax receipts occurs if shifts in the distribution of taxable wages among reserve ratio categories are not taken into account in the simulator model. These shifts alter the average tax rate and, hence, the yield from a given column of the tax table.

An individual firm's reserve ratio changes for two possible reasons. First, if an increase or decrease in the number of layoffs occurs (thus affecting benefit charges) or if contributions rise or fall or voluntary contributions are made, then the difference between contributions and benefits (the numerator of the calculation) will change. Secondly, the size and wage composition of the firm's workforce affects the denominator of the reserve ratio formula.

To date, for the New Jersey trust fund simulator model average tax rates have been forecasted based on the rates that prevailed under similar economic conditions in the past. This paper lays out and empirically specifies two model designs. The first can be used to forecast the shift in the distribution of taxable wages among the rate categories of a given tax table when it is assumed that the rate categories will remain the same. The second design can be used for forecasting the shift in the distribution when the rate categories change.

Chapter Two, through the use of various indicators, describes the distributional shifts that these models will attempt to forecast.

Chapter Three specifies and empirically estimates a model for forecasting the distribution of taxable wages among the rate

categories of a tax table when it is assumed that they will not change. An analysis of the estimation results and a description of the method for implementing and using the model is offered.

Chapter Four specifies and empirically estimates a model to forecast the distribution of taxable wages among changing rate categories. The models' ability to forecast under the constant tax table scenario of Chapter Three and the changing tax table scenario of Chapter Four is examined as well.

Avenues for further research are discussed in Chapter Five.

II. DESCRIPTION OF HISTORICAL TRENDS: RATE YEARS 1970-71 TO 1990-91

This chapter describes the trends that the model designs contained in Chapters Three and Four will attempt to forecast. Section one focuses on the trends in the share of taxable wages for the tax rate categories common to all of the tax tables in use between Rate Years 1970-71 and 1987-88. Section two develops four indicators to show the shift in the distribution of taxable wages among the 72 smaller categories of the ES-204 data whose length is one percentage point long to be used for the analysis in Chapter Four.[2]

Shifts in Taxable Wages Among Tax Table Rate Categories: Rate Years 1970-71 to 1987-88

The ultimate goal of designing a model to forecast the shift in the distribution of taxable wages is to accurately forecast the average employer tax rate. Chapter Three specifies and estimates a series of one-equation models, with the dependent variable in each being the share of taxable wages in the reserve ratio categories common to each of the tax tables in effect between Rate Years 1970-71 and 1987-88.[3] What follows is a description of the trends in these tax table categories.

First, however, it is helpful to examine the breakout between positive and negative balance employers, which is shown in Table 3. As can be seen, positive balance employers have consistently accounted for the bulk of taxable wages. Their share declined steadily, however, from Rate Year 1970-71 to Rate Year 1977-78 when their share was 63.3 percent of taxable wages. This was followed by successive increases, with the exception of a slight pause in Rate Years 1981-82 and 1983-84 and was 91.6 percent in Rate Year 1989-90 prior to a slight drop to 91.2 percent in Rate Year 1990-91. The trend in the share held by negative balance employers was, of course, the opposite, rising to reach a sample-period high of 36.7 percent of taxable wages in Rate Year 1977-78 and then falling back and reaching a low point of 8.4 percent in Rate Year 1989-90, with a subsequent rise to 8.8 percent in Rate Year 1990-91.

TABLE 3

PERCENTAGE OF TAXABLE WAGES FOR
POSITIVE AND NEGATIVE BALANCE EMPLOYERS:
RATE YEARS 1970-71 to 1990-91

Rate Year	Percentage of Taxable Wages For Positive Balance Employers	Percentage of Taxable Wages For Negative Balance Employers
1970 - 71	85.6	14.4
1971 - 72	83.2	16.8
1972 - 73	78.6	21.4
1973 - 74	77.8	22.2
1974 - 75	79.4	20.6
1975 - 76	75.9	24.1
1976 - 77	66.9	33.1
1977 - 78	63.3	36.7
1978 - 79	65.5	34.5
1979 - 80	71.1	28.9
1980 - 81	74.9	25.1
1981 - 82	73.3	26.7
1982 - 83	76.5	23.5
1983 - 84	76.0	24.0
1984 - 85	77.6	22.4
1985 - 86	81.7	18.3
1986 - 87	85.1	14.9
1987 - 88	87.4	12.6
1988 - 89	89.7	10.3
1989 - 90	91.6	8.4
1990 - 91	91.2	8.8

Figure 2 graphs the percentage of taxable wages for the six tax table rate categories common to all of the tables in use between Rate Years 1970-71 and 1987-88. It begins with Rate Year 1971-72 and ends with Rate Year 1985-86, since the tax table that took effect on July 1, 1986 made drastic changes in both positive and negative balance categories. It should be noted that the category 3.00% to 10.99% was not a rate category per se but rather is constructed by adding the share of taxable wages for the eight smaller categories that comprised this portion of the tax table. (The values for this category have been scaled down by a factor of five in order to appear on the graph with the other categories).

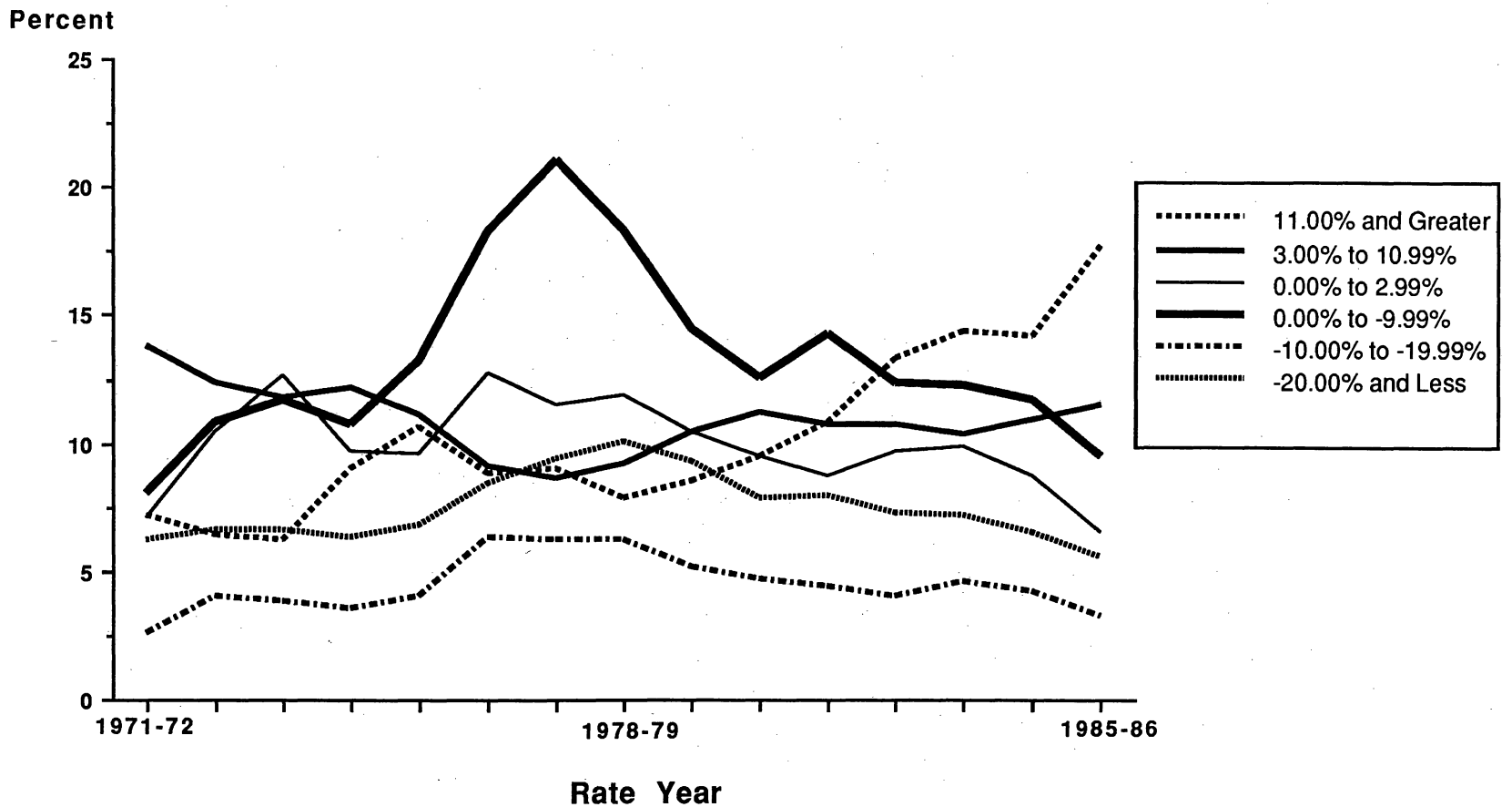
The patterns shown by the graph in Figure 2 are varied and complex. Clearly the two highest positive categories (11.00% and greater and 3.00% to 10.99%) behave in a distinctly different fashion from the other four. Subsequent to the 1973-75 recession, the two most positive categories declined in their share of taxable wages, with the 11.00 to 11.99% category falling, leveling off and then declining again, while the remaining four categories increased their share. Throughout the recovery period that lasted until the brief recession of 1980, the pattern became more complex. The two most positive categories continued to fall and reached a trough in Rate Years 1977-78 and 1978-79. Both increased steadily, although at varying rates, from these low points for the remainder of the recovery period. Of the four remaining categories, two (0.00% to -9.99% and -20.00% and over) continued their increase, reached a high point (one rate year apart) and then declined for the remainder of the recovery period. The lowest positive category (0.00% to 2.99%) exhibited several blips through Rate Year 1977-78 after which it declined steadily through the recession of 1981-82.

In the 1980s the highest positive category (11.00% and greater) continued a climb that began from its sample-period low point in Rate Year 1978-79 unaffected by the 1980 recession and only mildly so by the 1981-82 recession, when a slight decline occurred following Rate Year 1982-83. The 3.00 to 10.99% category exhibited a basically upward trend, although it does not seem to have been totally immune from the 1980 recession, since it exhibited a mild decline subsequent to Rate Year 1980-81 which continued to Rate Year 1983-84. Between Rate Years 1983-84 and 1985-86 it increased sharply. The other four categories continued the declines that they had begun at various points in the mid to late 1970s, although one (0.00% to - 9.99%) had a short but significant upturn immediately following Rate Year 1980-81.

The 0.00 to 2.99% category showed upward movement from Rate Year 1980-81 until Rate Year 1982-83 and has declined since then.

Figure 2

Percentage of Taxable Wages for Six Tax Table Categories: Rate Years 1971-72 to 1985-86



While the pattern for the aggregate positive and negative balance employers is clear, the fluctuations for the tax table categories are less consistent. The impact of economic downturns varies, with the changes following the 1973-75 recession being the most pronounced and unambiguous, with smaller effects after the recessions in 1980 and 1981-82.

Shifts in Taxable Wages Among Reserve Ratio Categories of the ES-204 Data

The data on taxable wage shares for given tax table categories are no longer useful for forecasting when these categories change. As will be seen in Chapter Four, the ES-204 data, which track the distribution of taxable wages among 72 reserve ratio categories whose length is one percentage point long (hereafter referred to as unit-long categories), provide an alternative. Using these data, this section develops and graphs four indicators which the model developed in Chapter Four will attempt to forecast:

1. The shift in the entire distribution
2. The weighted mean reserve ratio
3. The weighted standard deviation of reserve ratios

The Shift in the Distribution

Two methods were used to observe the shift in the entire distribution. First, a representative sample of three rate years was chosen for plotting all 72 reserve ratio categories against their percentage of taxable wages. Secondly, the ES-204 reserve ratio spectrum was divided into ten equal parts and the percentage of taxable wages for each part for each of the rate years in the study period was calculated.

Figure 3 illustrates the entire distribution for Rate Years 1970-71, 1984-85 and 1990-91 by plotting all 72 reserve ratio categories on the horizontal axis and the percentage of taxable wages in a given reserve ratio category for that rate year on the vertical axis. These three years were chosen to be representative of the entire sample period. The distribution retains a generally constant shape and seems to shift only its center point. The three graphs show the distribution to resemble somewhat a normal distribution, given the bell shaped middle, a somewhat symmetrical appearance (despite being steeper on the right) and the two tails on either end. However, it is a much more concentrated distribution than is the case for the normal, as is further illustrated by Table 4, which shows the distribution of taxable wages divided into ten equal groupings for eleven selected rate years, with the highest and lowest categories listed separately. Confirming the observations from Figure 3, it is clear that the distribution is quite concentrated, with the bulk of the activity occurring within the 0.00 to 6.99 and 7.00 to 13.99 percent reserve ratio boundaries.

Figure 3

Distribution of Taxable Wages by Reserve Ratio Category: Three Rate Years

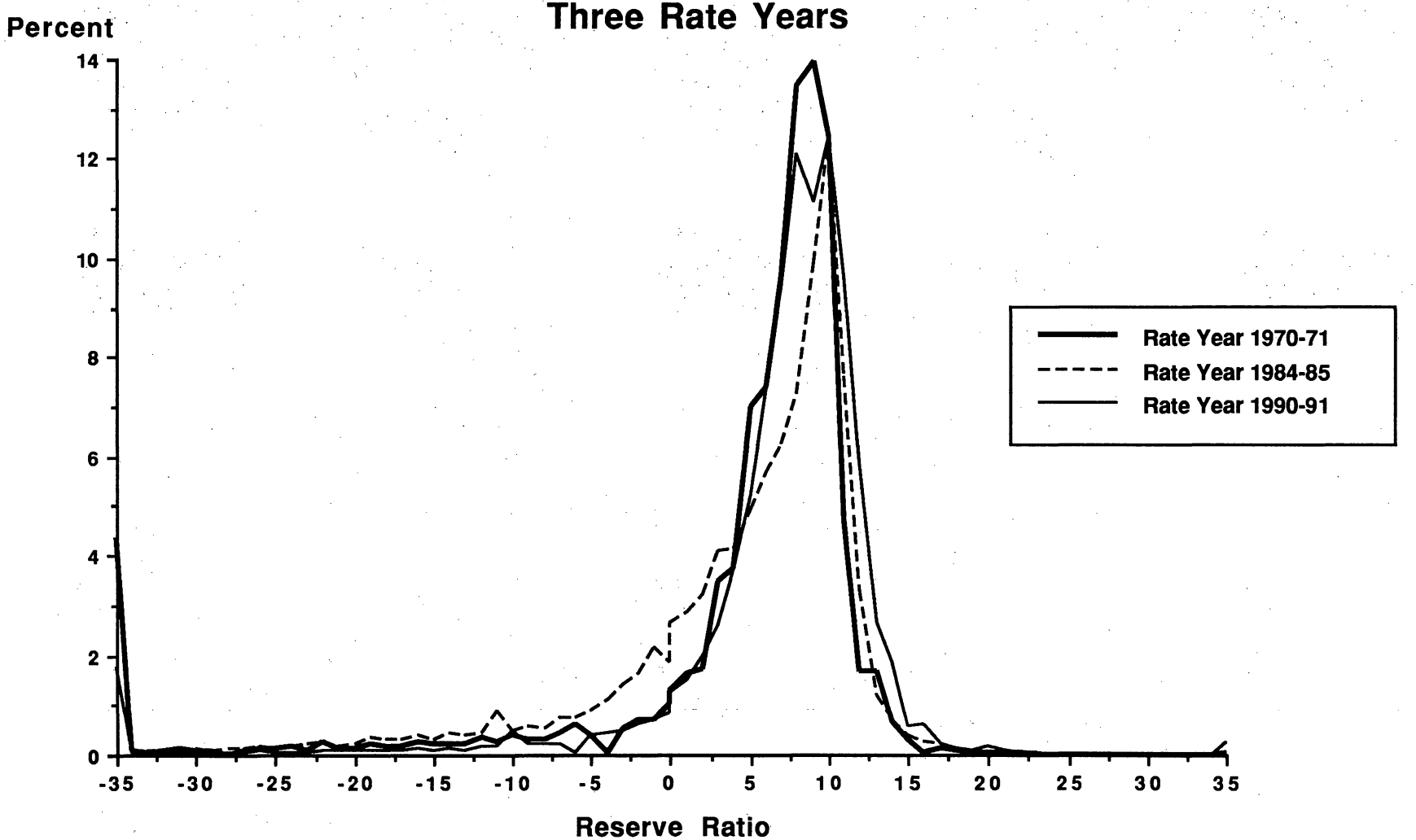


TABLE 4

DISTRIBUTION OF TAXABLE WAGES AMONG
RESERVE RATIO CATEGORIES
SELECTED RATE YEARS

Reserve Ratio	1970-71	1972-73	1974-75	1976-77	1978-79	1980-81	1982-83	1984-85	1986-87
28.0 to 34.99	0.04	0.05	0.06	0.04	0.03	0.03	0.04	0.03	0.04
21.0 to 27.99	0.14	0.15	0.12	0.15	0.14	0.15	0.14	0.15	0.17
14.0 to 20.99	1.57	1.34	1.37	2.01	1.83	1.39	1.67	1.82	3.11
7.0 to 13.99	57.59	40.84	43.73	31.84	29.18	41.90	46.24	47.96	61.46
0.0 to 6.99	26.17	36.14	34.08	32.86	34.23	31.37	28.33	27.61	20.26
-0.0 to - 6.99	4.44	9.24	9.02	14.41	14.20	9.64	9.72	9.80	5.90
-7.0 to -13.99	2.38	3.37	3.51	7.30	7.37	5.33	4.54	4.02	2.79
-14.0 to -20.99	1.43	2.45	1.93	3.21	3.35	2.56	2.28	2.33	1.53
-21.0 to -27.99	1.04	1.13	1.35	2.07	2.56	1.73	1.42	1.22	0.91
-28.0 to -34.99	0.78	0.77	0.76	1.34	1.32	1.01	0.91	0.7	0.63
-35.0 and Under	4.38	4.49	4.04	4.72	5.73	4.85	4.68	4.26	3.17
+35.0 and Over	0.04	0.04	0.03	0.04	0.06	0.03	0.03	0.03	0.03

TABLE 4 (cont'd.)

Reserve Ratio	1988-89	1990-91
28.0 to 34.99	0.04	0.07
21.0 to 27.99	0.25	0.25
14.0 to 20.99	3.90	3.66
7.0 to 13.99	65.85	63.32
0.0 to 6.99	19.63	23.62
-0.0 to - 6.99	3.67	3.89
-7.0 to -13.99	2.09	1.59
-14.0 to -20.99	0.93	0.71
-21.0 to -27.99	0.68	0.51
-28.0 to -34.99	0.51	0.34
-35.0 and Under	2.41	1.78
+35.0 and Over	0.04	0.26

Trends in the Weighted Standard Deviation

In the next two sections two indicators are developed as a means of tracking the change in the aggregate distribution. They are the weighted mean of reserve ratios and the weighted standard deviation. The weighted mean of reserve ratios is calculated by multiplying the mid-point of each reserve ratio category by the absolute level of taxable wages in that reserve ratio category and then summing these values over all reserve ratio categories. The result is then divided by total taxable wages:

$$R_i = \frac{(R_j)\ (t_j)}{T}$$

Where:

R_i = weighted mean reserve ratio for rate year $_4$ i
R_j = the mid-point of reserve ratio category j
t_j = absolute level of taxable wages in reserve ratio category j
T = total taxable wages for the prior calendar year

The weighted standard deviation is, in turn, calculated by subtracting the weighted mean for each reserve ratio category from the mid-point of the category, squaring this result and multiplying by total taxable wages in that category. The results over all reserve categories are then summed and divided by total taxable wages for that rate year. The square root of this figure is then taken:

$$WSD_i = \sqrt{\frac{(R_j - R_i)^2\ t_j}{T}}$$

Where:

WSD_i = weighted standard deviation of reserve ratios for a given rate year i
R_j = the mid-point of reserve ratio category j
R_i = weighted mean of reserve ratios for rate year i
t_j = taxable wages for reserve ratio category j
T = total taxable wages for the prior calendar year

As shown in Table 5 and Figure 4, the weighted standard deviation ranges between 8.41 and 12.64. Prior to 1981-82 the weighted standard deviation fluctuated, but minimally. Since Rate Year 1981-82 there has been a steady but consistent drop to reach a sample period low point of 8.41 in Rate Year 1990-91.

TABLE 5

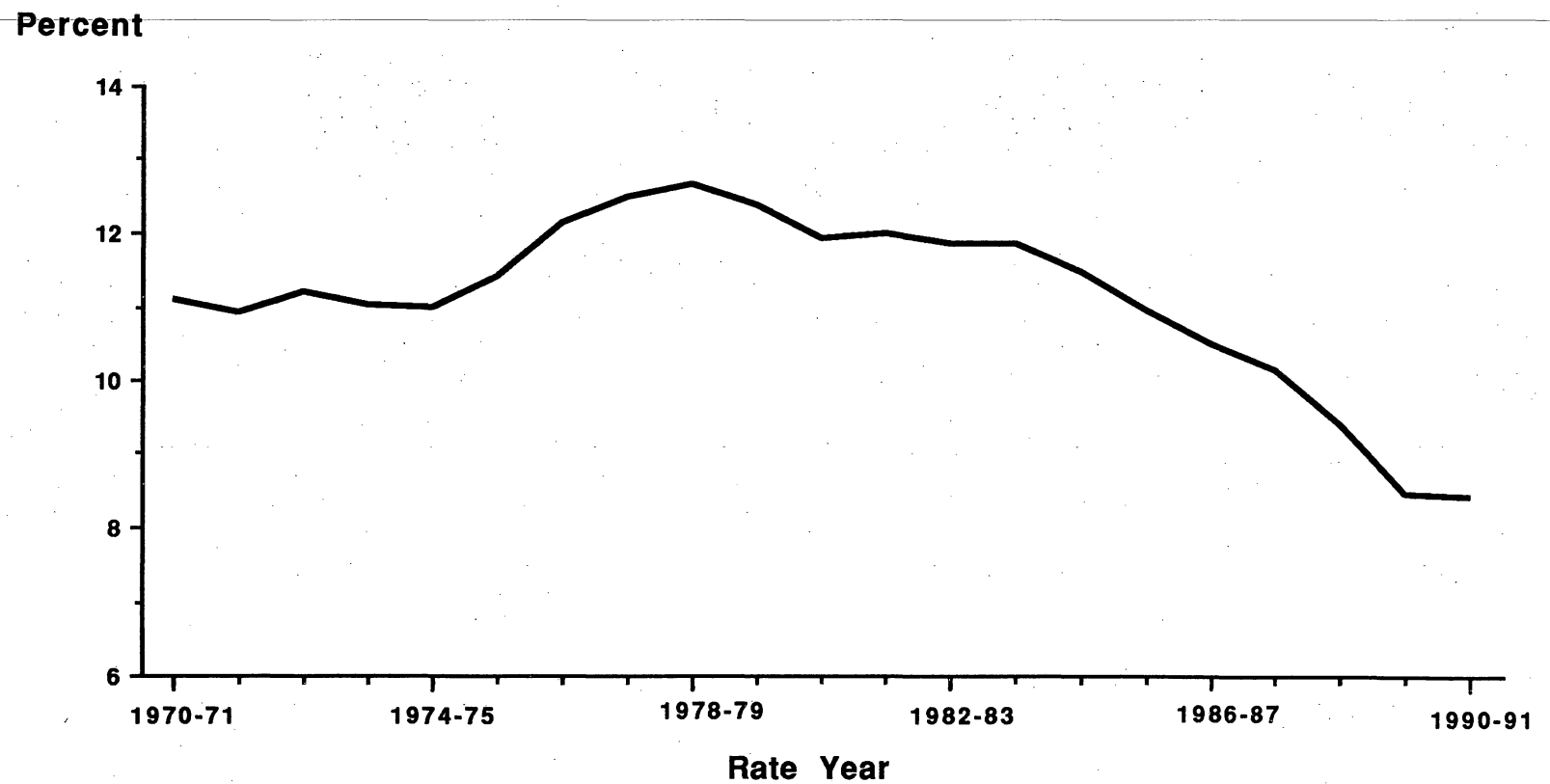
WEIGHTED MEAN RESERVE RATIO AND
WEIGHTED STANDARD DEVIATION*
RATE YEARS 1970-71 TO 1990-91

Rate Year	Weighted Mean	Weighted Standard Deviation
1970 - 71	4.34	11.10
1971 - 72	3.69	10.90
1972 - 73	2.45	11.19
1973 - 74	2.06	11.01
1974 - 75	2.84	11.00
1975 - 76	2.41	11.42
1976 - 77	0.32	12.13
1977 - 78	-0.25	12.50
1978 - 79	-0.40	12.64
1979 - 80	0.80	12.38
1980 - 81	1.82	11.94
1981 - 82	1.91	12.00
1982 - 83	2.60	11.85
1983 - 84	2.54	11.85
1984 - 85	3.10	11.49
1985 - 86	4.31	10.96
1986 - 87	5.44	10.49
1987 - 88	6.14	10.13
1988 - 89	6.70	9.39
1989 - 90	6.99	8.47
1990 - 91	6.90	8.41

* Weighted by taxable wages.

Figure 4

Weighted Standard Deviation of the Distribution of Taxable Wages By Reserve Ratio Category: Rate Years 1970-71 to 1990-91



Trends in the Weighted Mean Reserve Ratio

The weighted mean of reserve ratios fluctuates more than does the weighted standard deviation. As shown in Table 5 and Figure 5, however, there is a very discernible pattern. Beginning with Rate Year 1970-71, when it was 4.34, the weighted mean dropped steadily, reaching a trough of -0.40 in Rate Year 1978-79. Thereafter, except for a slight decline in Rate Year 1983-84, it continued to rise through Rate Year 1989-90, when it reached 6.99.

Since reserve ratios are cumulative, recessions would tend to be reflected in the weighted mean with a lag, which is precisely what occurred. After the mild 1969-70 recession, the weighted mean declined to 2.06 in Rate Year 1973-74, increased somewhat the next year and then dropped precipitously subsequent to the severe downturn of 1973-75. The ensuing recovery in the weighted mean was substantial up until Rate Year 1980-81 when the increase was slowed somewhat by the 1980s recessions. This slowing of the increase ended in Rate Year 1983-84. The somewhat surprising drop to 6.90 in Rate Year 1990-91 (from 6.99 in Rate Year 1989-90) indicates a quicker response to the recession that begin in July 1990 than had been the case for the past three recessions.

III. FORECASTING THE DISTRIBUTION OF TAXABLE WAGES AND THE AVERAGE TAX RATE - CONSTANT TAX TABLE SCENARIO

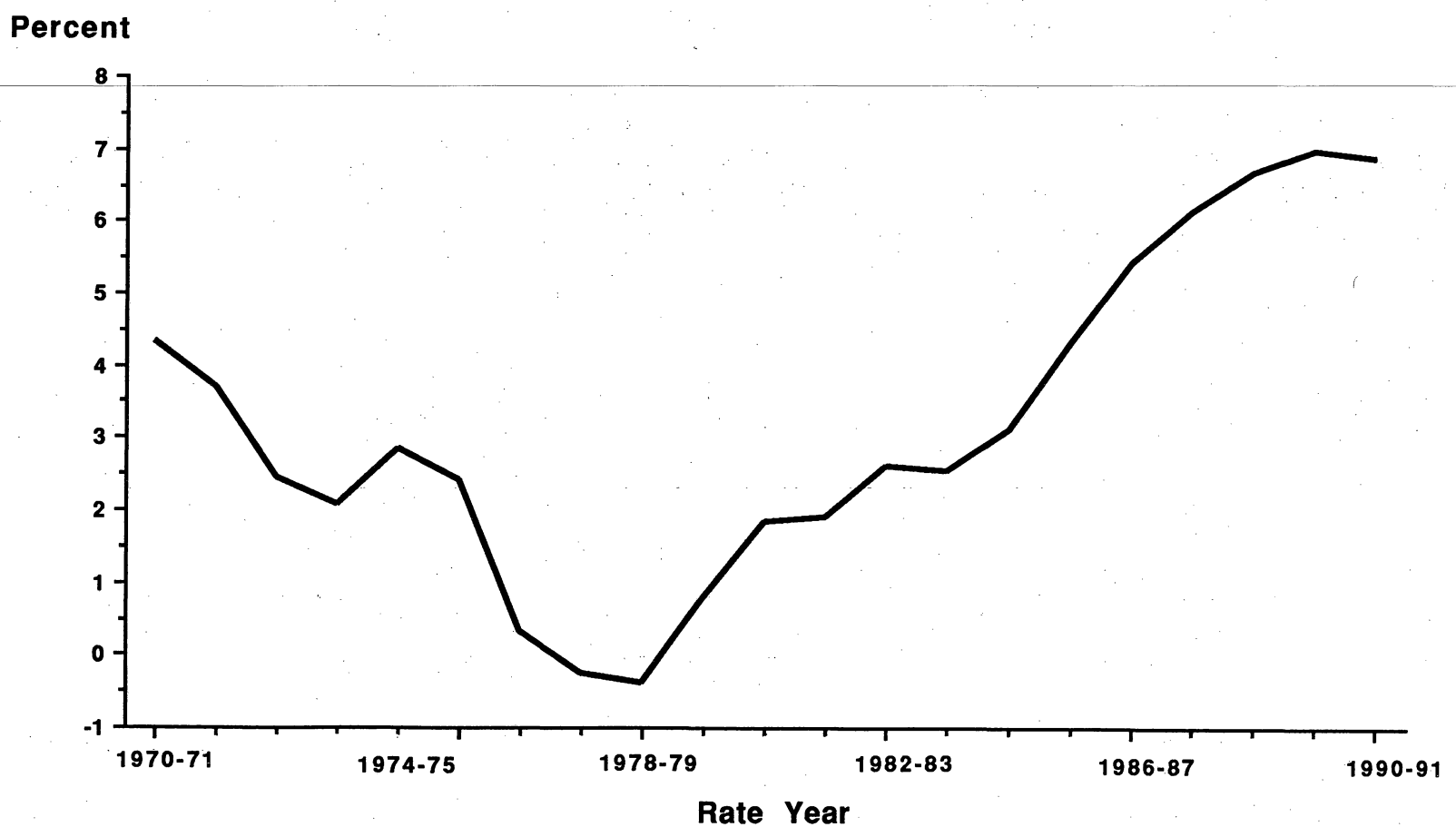
Model Specification

In developing the model, an exhaustive search of the professional economics literature was conducted to determine if previous work had produced any analytical or empirical evidence that could be of use in predicting the changing distribution of taxable wages among reserve ratio categories. Only Saffer (1980) directly addresses this problem, concluding that the distribution is approximately normal given the way a firm's experience factor is computed and the sizable number of covered firms.[5] Mr. Saffer also states that a firm's experience rating does not change quickly, since "in most states the experience is computed to account for the firm's history in the UI tax system."[6] Several major causes of shifts in the distribution of taxable wages among experience rating categories are identified:

1. Long-run structural changes in a state's economy. If a state is in a long-run economic decline, there will be a tendency for firms to shift toward the higher tax rate (or negative reserve ratio) end of the tax schedule.

2. Cyclical variations in economic activity.

Figure 5
Weighted Mean Reserve Ratio of the Distribution of Taxable Wages
By Reserve Ratio Category:
Rate Years 1970-71 to 1990-91



3. Changes in the taxable wage base. An increase in the taxable wage base will result in the trust fund experiencing a temporary increase in contributions, thus tending to push firms to lower tax rates until a new equilibrium is established.

A broader search followed a review of the Saffer paper. This included a search of the literature, which uncovered the importance of the degree of experience rating as a potential explanatory variable. As a concept which measures the extent to which employers actually pay for past layoffs, it seems an important variable to consider in modeling the dynamics of an experience rating system and the distribution of taxable wages by reserve ratio category.

The limited literature was of limited help. Consequently, the model that was developed and is described below was based on an analysis of the structure of the financing system in New Jersey.

If the tax table is to remain fixed, that is, if the reserve ratio categories in a given schedule do not change, a series of specified and estimated one-equation models serve as the appropriate forecasting tools. The dependent variable in each is the percentage of total taxable wages in a given tax rate category - a variable that arises from the fact that the tax rate categories in a given tax table represent an incentive structure to firms whose unemployment insurance taxes change as they migrate from category to category. The forecasted percentage achieved from the use of each equation can then be multiplied by the tax rate that will be in effect during the forecast year. Summing the results over all the tax rate categories of the schedule yields a forecasted average tax rate.

Since the current tax table took effect on July 1, 1986, insufficient data exist to achieve meaningful statistical results using the categories of that tax table as the objects of empirical analysis. Instead, the categories of the five tax tables that were in use between Rate Years 1970-71 and 1985-86 will be utilized. Since the shift in the share of taxable wages in one category is concurrent with a shift in the share of some combination of the others, it will be assumed that the same specification is appropriate for all of the one-equation models.

The key fact underlying the specification is that shares of taxable wages in the categories of a given tax table change as individual employers move from one reserve ratio category to another. Therefore, formulation of a model to explain shifts in these shares should be based on an analysis of what causes variations in an individual employer's reserve ratio which, as discussed in the introduction, can be traced to changes in contributions, benefit charges, average annual taxable wages or any combination of these factors.

The first step is to consider what factors directly influence these three components separately. For simplicity in analyzing these factors, all components of the reserve ratio formula will be treated as if they are calculated for the present rate year. The problem of specifying the lags, which arises from the fact that the numerator of the reserve ratio uses cumulative data while the denominator includes only the past three or five years, will be considered shortly.

For a given experience rated firm, contributions in a given rate year are a function of the size of the firm's workforce, the taxable wage base and the firm's current tax rate category:

(1) $C = (E, TWB, R)$

Where:

C = contributions in a given rate year for an experience rate firm

E = the firm's level of employment
TWB = the taxable wage base
R = the tax rate that the firm is assigned according to its current reserve ratio status

A firm's benefit payments are affected by the number of workers it lays off who qualify for benefit payments, their average duration of unemployment and the average weekly benefit amount that they receive.

(2) $B = (U, AWBA, D)$

Where:

B = benefit payments charged to a given experience rated employer's account in a given rate year
U = the number of workers the firm has laid off who qualify for benefit payments
AWBA = average weekly benefit amount
D = the average duration of unemployment of the workers that the firm has laid off

A given firm's taxable wages change from year to year with changes in the firm's level of employment as well as the taxable wage base. The taxable wage base, in turn, has been a function of the statewide average weekly wage since 1977. Prior to this, it was legislatively mandated.

(3) $TW = (E, TWB)$

TW = average annual taxable wages for a given experience rated firm for the past three or five years
E = the firm's level of employment over the past three or five years
TWB = the taxable wage base, which is 28 times the statewide average weekly wage in the second preceding calendar year

These three functional specifications reveal that four separate forces should be represented empirically in a model that seeks to predict shifts among the rate categories of a tax table. First, a variable is needed to represent changes in employment levels, which in turn affect both taxable wages and contributions. Secondly, variables representing the level and duration of unemployment, which impact benefit payments, must be incorporated into the specification. Finally, the taxable wage base, which affects the volume of taxable wages as well as contributions, must also be included. The inclusion of the average tax rate in a specification designed to forecast shares in a given tax rate category, however, presents problems of simultaneity which lead to biased and unreliable parametric estimates.

The specification of each of these four variables will be considered in turn. For each of the four, the available choices for empirically specifying the particular force will be outlined, along with the logic underlying the choice for the current study. How the particular variable affects all components and combinations in the reserve ratio formula will also be discussed in order to arrive at a theoretical prediction as to its influence on the dependent variable. Finally, the expected signs of the coefficients are indicated.

As mentioned, the functional specifications above treat the reserve ratio as if all components were calculated for a given rate year. Given the different time periods within the reserve ratio formula, however, the lag structure is complex and will not be treated theoretically in the current study, but rather empirically. Various lag specifications for each variable will be tested, with the ultimate choice based on the relative statistical significance of the coefficients of each as well as their contribution to the explanatory power of the equation.

The absolute level of unemployment has a definite negative relationship to the overall reserve ratio through its positive relationship to benefit payments. No prediction, on the other hand, can be made from a theoretical standpoint about the impact of the level of employment on the average reserve ratio since it is positively related to contributions, which has a positive relationship to the reserve ratio, and average annual taxable wages, which has a negative relationship to the reserve ratio. Given this uncertainty, some measure of the state unemployment rate, which would pick up changes in both the level of employment and unemployment, is probably the best choice for specification.

Two options exist as to the form of this variable-either the total unemployment rate (TUR) or the insured total unemployment rate (IUR) for New Jersey. The total unemployment rate is the number unemployed as a percentage of the total labor force (the number employed plus the number unemployed). The insured unemployment rate is the seasonally adjusted weekly average of weeks claimed under the Regular UI program as a percentage of the number of workers

covered by unemployment insurance. The IUR is more clearly related to the programmatic structure underlying the experience rating system and contains the total population of claimants and covered jobs, freeing it of the sampling variability found in the TUR. The main drawback to including it in the specification is that it reflects the elements in New Jersey's laws that govern eligibility for benefits, the strictness of disqualification provisions and penalties, etc. Since these are a function of legislation and policy decisions, the IUR is an inherently less predictable variable than the total unemployment rate, and is thus not as useful for the type of long-term forecasting that the trust fund simulator is designed to accomplish. In addition, it is a variant of the insured unemployment rate which governs the status of the Extended Benefits (EB) Program, which will be seen to be another relevant variable in the postulated model. The inclusion of two independent variables related in this manner creates a statistical problem which makes it more difficult to decipher the independent influence of each variable on the share of taxable wages in a given rate category. This adds a further element of uncertainty to a forecasting model. For these reasons, the total unemployment rate was selected as the appropriate independent variable.

An increase in the total unemployment rate leads to a rise in benefit payments relative to contributions and to average annual taxable wages, thus lowering the average reserve ratio. Therefore, the expected sign for the unemployment rate in the equations designed to forecast the share of taxable wages for the higher reserve ratio categories should be negative, with the expected sign for the lower reserve ratio equations being positive. No clear prediction can be made as to where the precise transition from one sign to another occurs.

The duration of unemployment affects benefit payments exclusively and thus has an unequivocally negative relationship to the overall reserve ratio. Many factors affect the average duration of unemployment, including labor market and general economic conditions. When the EB program is triggered "on," however, the potential duration of benefit collections and, hence, the potential draw on the unemployment insurance trust fund rise markedly. The average duration of unemployment as an independent variable probably does not account for any unique variance in the distribution of employers that is not accounted for by the total unemployment rate, whereas the triggering "on" of the EB program would have a larger effect on those firms with a higher propensity towards layoffs, which are more likely to be in the higher tax rate (i.e., lower reserve ratio) categories. Therefore, a binary variable for the status of the EB trigger will be included in the specification, with a value of zero for rate years in which the program was triggered "off" and a value of one for those in which it was "on." The lower reserve ratio category regressions should show a positive sign on the EB trigger variable, with the higher reserve ratio regressions showing a negative sign.

The impact of the taxable wage base variable is best considered under two scenarios, one assuming a constant level of employment and the second a changing level. In a constant level of employment scenario, an increase in the taxable wage base increases contributions immediately, but, as noted by Saffer, average annual taxable wages are affected more slowly. Consequently, a reasonable hypothesis is for a positive correlation between the taxable wage base and the average reserve ratio. The sign on the coefficients of the higher reserve ratio categories should be positive, while the sign for the lower reserve ratio categories should be negative.

In the second scenario, where the level of employment varies, the outcome is more difficult to predict. However, the inclusion of the New Jersey total unemployment rate (lagged one period) completely accounts for this; accordingly, this variable in a regression equation with the TUR measures the impact of the taxable wage base holding constant the level of employment.

Data and Results

The dependent variable data in all of the one-equation models were calculated by summing the percentage of taxable wages in the corresponding ES-204 reserve ratio categories. The data relating to the status of the Extended Benefits Program, the taxable wage base and the average annual total unemployment rate for New Jersey were taken from the Statistical Appendix to the New Jersey Department of Labor's 1990 Annual Report.

Prior to the testing of this three-variable framework, a larger equation, with as many as seven independent variables, was tested. The variables that were included in that model that are not currently being tested include the maximum tax rate (as an empirical representation of the degree of experience rating) and a dummy variable for the national business cycle, which was assigned a value of zero when the national economy was in a recovery and one during recessions. This framework yielded inconsistent results when tested in the various rate category equations.

In a number of equations with high R^2 terms, the t-statistics of either some or all of the coefficients revealed that they were statistically insignificant. Generally speaking, the results for this framework suggested that it suffered from a good deal of multicollinearity.[7]

Table 6 reports the results of testing the postulated model for each of 13 tax rate categories. Five of these were in effect between Rate Years 1970-71 and 1985-86, while the remaining eight were in use between Rate Year 1970-71 and Rate Year 1987-88.

The reading of results from a regression equation is straightforward. The following is an example of how the regression equation results

TABLE 6

DETERMINANTS OF SHIFTS IN THE DISTRIBUTION OF
TAXABLE WAGES FOR THE TAX TABLE CATEGORIES
IN EFFECT BETWEEN RATE YEARS 1970 - 1971 AND 1987 - 1988[1]

Tax Table Category	New Jersey Total Unemployment Rate (Lagged One Period)	Extended Benefits Trigger (0=off; 1=on)	Taxable Wage Base ($000)	Constant	Number of Observations	Mean of Dependent Variable	R^2/ Adjusted R^2	F-Statistic	Standard Error of the Regression	Durbin Watson Statistic
11.00% and greater (Rate Years 1970-71 to 1985-86)[2]	-0.45 (-1.76)	-1.36 (-1.37)	1.60 (7.15)**	4.72 (4.72)**	16	10.21	0.84/0.81	21.74	1.40	1.40
10.00% to 10.99% (Rate Years 1970-71 to 1987-88)	-0.73 (-2.30)	-2.12 (-1.66)	1.15 (4.77)**	7.96 (4.08)**	18	8.67	0.80/0.74	16.72	1.89	1.80
9.00% to 9.99% (Rate Years 1970-71 to 1987-88)	-0.63 (-2.29)	-2.72 (-2.45)**	0.22 (1.44)	14.22 (8.35)**	18	9.27	0.67/0.59	9.27	1.65	1.20
8.00% to 8.99% (Rate Years 1970-71 to 1987-88)	-0.58 (-2.53)*	-1.84 (-1.99)	-0.49 (-2.83)*	17.66 (12.50)**	18	9.20	0.73/0.67	12.69	1.37	1.07
7.00% to 7.99% (Rate Years 1970-71 to 1987-88)	-0.05 (0.27)	-1.23 (-1.79)	-0.62 (-4.82)**	12.32 (11.73)**	18	7.80	0.68/0.62	10.13	1.02	1.06
6.00% to 6.99% (Rate Years 1970-71 to 1987-88)	-0.20 (-1.19)	0.18 (0.27)	-0.30 (-2.34)*	9.61 (9.33)**	18	6.50	0.50/0.40	4.66	1.00	1.13

[1] T-STATS in parentheses under coefficients

TABLE 6 (cont.)

Tax Table Category	New Jersey Total Unemployment Rate (Lagged One Period)	Extended Benefits Trigger (0=off; 1=on)	Taxable Wage Base ($000)	Constant	Number of Observations	Mean of Dependent Variable	R^2/ Adjusted R^2	F-Statistic	Standard Error of the Regression	Durbin Watson Statistic
5.00% to 5.99% (Rate Years 1970-71 to 1987-88)	0.01 (-0.11)	-0.76 (-1.80)	-0.44 (-5.53)**	8.81 (13.52)**	18	5.53	0.75/0.69	13.80	0.63	1.53
4.00% to 4.99% (Rate Years 1970-71 to 1987-88)	-0.06 (-0.55)	1.37 (3.42)*	-0.17 (-2.25)*	5.15 (8.42)**	18	4.68	0.71/0.65	11.43	0.59	1.71
3.00% to 3.99% (Rate Years 1970-71 to 1987-88)	0.17 (1.94)	0.68 (1.90)	-0.19 (-2.94)*	3.51 (6.47)**	18	3.94	0.68/0.61	10.09	0.52	2.37
0.00% to 2.99% (Rate Years 1971-72 to 1985-86)	0.32 (1.58)	2.83 (3.03)*	-0.49 (2.50)	8.06 (5.75)**	15	9.94	0.69/0.61	7.87	1.13	2.53
0.00% to 9.99% (Rate Years 1971-72 to 1985-86)	1.54 (3.86)*	2.68 (1.47)	-0.87 (-2.29)	5.10 (1.86)	15	13.27	0.70/0.61	8.21	2.22	1.43
-10.00% to 19.99% (Rate Years 1971-72 to 1985-86)	0.44 (3.51)*	1.11 (1.92)	-0.22 (-1.57)	1.57 (1.69)	15	4.49	0.69/0.60	8.06	0.70	2.07
-20.00% and less (Rate Years 1971-72 to 1985-86)	0.64 (4.80)**	0.73 (1.20)	-0.36 (-2.84)*	4.40 (4.82)**	15	7.46	0.75/0.68	11.11	0.74	1.56

* Coefficient is statistically significant at the 95 percent confidence level.
** Coefficient is statistically significant at the 99 percent confidence level.

in Table 6 should be interpreted, using as an example reserve ratio category 11.00% and over:

1. A one-unit increase in the total unemployment rate for New Jersey in year i would, on average, result in a 0.45 percentage point decrease in taxable wages in the 11.00% and greater reserve ratio category in year i + 1, statistically controlling for (i.e., holding constant) the impacts of the EB trigger and the taxable wage base.

2. If the EB program were triggered "on," it would, on average, lead to a 1.36 percentage point decrease in taxable wages in this rate category, statistically controlling for the impact of the total unemployment rate and the taxable wage base.

3. A one thousand dollar increase in the taxable wage base would, on average, result in a 1.6 percentage point increase in taxable wages, statistically controlling for the impacts of the total unemployment rate and the EB trigger.

The reported F-statistics indicate that each regression is statistically significant at the 95 percent confidence level or better. The explanatory power of the equations, as measured by the multiple correlation coefficient (R^2) term, varies between a low of 50 percent and a high of 84 percent, indicating that the postulated model does a reasonably good job of statistically explaining the variation in the percentage of taxable wages among the categories of the tax table.

A problem which is often found in time series analysis is serial correlation, which means that the error terms are not independent, normal, random variables but are positively or negatively correlated over time. Among the several consequences of serial correlation is the diminished reliability of the t and F- tests. The Durbin-Watson statistic shown in Table 6 for all the reported regressions is the commonly used indicator of serial correlation. Using this test, all of the equations were shown either to have no serial correlation or to be in the indeterminate range for either positive or negative serial correlation.

The t-tests for the significance of the various coefficients support optimism regarding the usefulness of the model, with a few troublesome spots. Of the 13 reported equations, the total unemployment rate lagged one period was statistically significant at the five-percent level or better in six. Of the seven that were not significant at the five percent level, four were smaller, unit-long categories. Moreover, with the exception of the 11.00% and greater category, the signs were as expected-negative for the lower tax rate categories and positive for the higher categories.

The t-tests for the extended benefits trigger variable did not reveal quite the same level of confidence as was revealed for the total unemployment rate. In only four of the equations did this variable have a significance level of 95 percent or higher (with some others being reasonable, however). It is possible that this variable affects the firms in some rate categories differently than others. Its removal from the specification is not warranted, however, because, as will be seen, it is statistically significant at the 95 percent level in an equation for the weighted mean of reserve ratios. With one exception (rate category 6.00 to 6.99 percent), the pattern of the signs was as expected, with the lower reserve ratio categories having a positive sign.

The taxable wage base variable shows a significant impact in nearly all regressions results. Interestingly, in the two highest reserve ratio (lowest tax rate) regressions, the coefficient is much higher than for all the others. The sign for the three highest reserve ratio categories is positive while all others are negative. The increase in employer contributions that results from an increase in the taxable wage base does appear to shift the wage distribution to the low tax rate (i.e., high reserve ratio) portion of the schedule, as postulated.

Analysis and Implementation

Despite the limitations noted, these estimated equations represent an advancement over what little previous work has been done in this area, since they begin to identify what variables shift the distribution of taxable wages within a given schedule of the tax table. However, the model should be periodically reestimated, as relationships can potentially change in degree and kind over time.

Once forecasts of the status of the EB trigger, the state's total unemployment rate and the taxable wage base are made, the equations can be used directly to forecast the respective shares of taxable wages among the reserve ratio categories of the current tax table. If the tax table changes, the model can be estimated to forecast the shift in the percentage of taxable wages in the new tax rate categories. A number of years are required, however, in order to have enough data to have a statistically valid estimation. The problem of forecasting reserve ratio category shifts for New Jersey's current rate table in this interim period is addressed in the next chapter.

IV. FORECASTING THE DISTRIBUTION AND THE AVERAGE TAX RATE: THE CHANGING TAX TABLE SCENARIO

Model Specification

When the reserve ratio categories in a given tax table change as they did with the implementation of the current tax table on July

1, 1986, forecasting the shifting distribution of taxable wages until enough time has elasped to have data for a statistically valid reestimation of the model developed in Chapter Three is a troublesome problem.

One possible method would be to simply estimate the model developed in Chapter Three with the share of taxable wages in the categories of the current, post-1986 tax table as the dependent variables over the period covering Rate Years 1970-71 to 1987-88. This procedure, however, ignores the fact that these reserve ratio categories did not exist as tax table categories until the last two years of this period.

Such an experiment was conducted and on the whole, the results from applying the model to these reserve ratio categories were weaker than those reported in Table 6. For example, whereas the F-statistics in all of the Table 6 equations were statistically significant at the 95 percent level or better, the results of this experiment showed two equations that were not, thus invalidating the model as an explanatory tool for these reserve ratio categories.

Generally speaking, it appears inappropriate to use rate categories that weren't really in existance over the sample period as the objects of empirical analysis. Another method is clearly called for to forecast the distributional shift in the period following the conclusion of one tax table but before enough data have accumulated to reestimate the Chapter Three model with the rate categories of the new tax tables as dependent variables.

The availability of ES-204 data, which, as seen in Chapter Two, tracks the distribution of taxable wages in a group of 72 unit-long reserve ratio categories, allows for such an alternative method. Once a forecast of the shift in the distribution of taxable wages among these categories is obtained, they can then be summed to correspond to the tax rate categories of a restructured tax table. This involves a three-step procedure. First, a forecast of the parameters of the distribution discussed in Chapter Two, the weighted mean reserve ratio and the weighted standard deviation, must be made. Secondly, a forecast of the distribution itself, that is, what theoretical distribution it will most likely resemble in the rate year for which a forecast is required, must also be made. Having accomplished these two tasks, a forecast of small parts of the distribution down to the individual reserve ratio level can be made, which can then be summed to the boundaries of the new tax table categories to yield a forecasted share of taxable wages in these new categories. As with the above mentioned experiment, this procedure also abstracts from the incentive effects of the tax table categories, although it is preferable in that it does not assume that a particular tax rate structure was in existence when in fact it was not. The specification of the equation used to forecast the weighted mean reserve ratio and the weigthed standard deviation will be identical to that in the previous chapter.

The expected signs of the variables in the weighted mean equations are as follows:

1. An increase in the New Jersey total unemployment rate should lower the weighted mean reserve ratio of experience rated firms with a consequent negative sign for this parameter.

2. The EB trigger should lower the weighted mean due to the potentially sharp increase in benefit payments. The expected sign is negative.

3. For a given level of employment the taxable wage base should increase the weighted mean, since it results in a rise in the level of contributions for all experience rated firms; its long-run impact, however, is ambiguous.

As will be discussed, an absolute prediction of the signs on the weighted standard deviation equations requires a framework not developed in this paper. As for a forecast of the distribution, a commonly used method to test the fit of an observed distribution to a known theoretical distribution is the Chi-Square test.[8]

Given the analysis of the taxable wage distribution problem in the paper by Henry Saffer and the observations made in Chapter Two, the most reasonable hypothesis to test is that the distribution is normal. Also, given the observed slow changing nature of the distribution, which Mr. Saffer discusses as well, it is reasonable to assume that, in most instances, the distribution will not deviate dramatically from the normal distribution from rate year to rate year. For forecasting purposes, then, the distributional character of the most current rate year can be reasonably assumed to be that of the next few.

A problem, however, with the use of this distribution procedure is the implicit assumption that the distributional character (normal, lognormal, etc.) is not affected by a change in tax table categories. Not enough data were available to examine this issue, since only one major change to the tax table occurred, at the tail end of the observation period. Given the observed slowly changing nature of the distribution, this is not sufficient for gauging any measurable impact. When data do become available, this is an important issue for future study.

Data and Results

The data on the weighted mean reserve ratio and weighted standard deviation that were presented in Chapter Two were calculated from the ES-204 experience rating reports. The results of testing the

model developed in Chapter Three on these two variables are shown in Table 7.

With an R^2 of 0.94, high t-statistics and no apparent statistical problems such as serial correlation, the model did very well in explaining the variation in the weighted mean. The signs on all three variables were as postulated. The extended benefits trigger, a slightly troubling variable in the regressions to explain the variation in the shares in individual rate categories, appears to be quite well placed in a model designed to forecast the weighted mean and thus justifies previous assertions of the correctness of keeping the extended benefits trigger variable in the postulated model.

The results for the weighted standard deviation equation offer a bit more reason for concern. The Durbin-Watson statistic is in the indeterminate range. The t-statistic on the extended benefits trigger variable is not significant at the customary 95 percent level but on the other hand isn't low enough to remove this variable from the equation. Therefore, both equations should forecast the weighted mean and the weighted standard deviation for the overall distribution of taxable wages with reasonable accuracy.

An equally encouraging result emerged upon examining the distribution itself. The Chi-Square test was applied to three rate years - 1970-71, 1978-79 and 1990-91, which fall, respectively, at the beginning, the mid-point and the end of the sample period.

As explained in Appendix B, the Chi-Square statistic is calculated by squaring the difference between the observed and expected percentage for each reserve ratio category dividing by the expected percentage and summing over all reserve ratio categories. To test whether this calculated sum allows acceptance of the null hypothesis of normality, it is compared against a critical sum in a table showing the cumulative distribution of the Chi-Square. A calculated Chi-Square greater than the critical value rejects the null hypothesis of normality. For the current study with the 72 reserve ratio classes, the critical value for the acceptance of the hypothesis at the five percent significance level is 90.53. The first two years have a Chi-Square statistic above that; the third slightly below; with values of 155.08, 158.67 and 88.28, respectively. The bulk of the deviation for the first two years is highly concentrated in a few reserve ratio categories. For Rate Year 1970-71 the bulk of the deviation is between reserve ratio categories 7.00 to 7.99% and 10.00 to 10.99%, which contribute 105.68 points to the Chi-Square statistic, or 68 percent of the total. In Rate Year 1978-79 the single category -35.00% and under contributes 93.09 points to the Chi-Square statistic, or 59 percent of the total. Rate Year 1990-91 has a distribution that is almost perfectly normal. It is worth paying attention to the next few years to see if this remains the case.

TABLE 7

DETERMINANTS OF SHIFTS
IN THE WEIGHTED MEAN AND WEIGHTED STANDARD DEVIATION
OF ES-204 RESERVE RATIO CATEGORIES:
RATE YEARS 1970-71 to 1990-91

Explanatory Variables And Regression Statistics	Weighted Mean	Weighted Standard Deviation
New Jersey Total Unemployment Rate (Lagged one period)	-0.52 (-6.00)**	0.36 (6.39)**
Status of Extended Benefits Trigger (0 = off; 1 = on)	-1.54 (-3.77)*	0.35 (1.29)
Taxable Wage Base ($000)	0.36 (6.23)**	-0.20 (-5.43)*
Constant	4.96 (7.82)**	9.97 (23.81)**
R^2	0.94	0.90
Adjusted R^2	0.93	0.88
F-statistic	84.95	51.98
Durbin - Watson Statistic	1.77	1.19
Number of Observations	21	21
Degrees of Freedom	17	17

** Coefficient is statistically significant at the 95 percent confidence level.

*** Coefficient is statistically significant at the 99 percent confidence level.

Analysis and Implementation

Once forecasts of the total unemployment rate, the status of the extended benefits program and the taxable wage base are made, the equations presented in Table 7 should do an acceptable job of forecasting the weighted mean and the weighted standard deviation. Given the tested assumption of the normality of the distribution, the procedure outlined in Appendix B for fitting a normal distribution to a grouped frequency distribution should be followed to allocate the forecast down to the level of the unit-long reserve ratio categories, keeping in mind the likelihood of a small, highly concentrated area of the spectrum. Once again, it should be noted that since the use of regression estimations for forecasting assumes the stability of relationships through time, the model should be periodically reestimated.

How Well Do The Models Perform?

Tables 8 through 11 illustrate the results of an ex-post forecasting test for the models developed in Chapters Three and Four. Each of the four tables contains a predicted and actual value of the various dependent variables - either the percentage of taxable wages in the tax rate categories in Tables 8 and 9 or the weighted mean reserve ratio and weighted standard deviation in Tables 10 and 11. These predicted values were derived in the following manner:

1. To test the model's potential to forecast the rate category shares (Tables 8 and 9), it was reestimated for Rate Year 1970-71 through Rate Year 1983-84. The actual values of the three independent variables for calendar year 1984 were then inputted into these reestimated equations in order to calculate the predicted value of the tax rate category shares for Rate Year 1984-85. This process was then repeated for Rate Year 1985-86 with actual calendar year 1985 independent variable data.

2. To test the model's potential to forecast the weighted mean reserve ratio and weighted standard deviation (Tables 10 and 11), it was reestimated for the period 1970-71 to 1985-86. Actual values of the independent variables for calendar year 1986 were then entered into these reestimated equations to yield a predicted value of the weighted mean reserve ratio and the weighted standard deviation for Rate Year 1986-87. This process was then repeated with calendar year 1987 independent variable data to yield a predicted value of the weighted mean reserve ratio and weighted standard deviation for Rate Year 1987-88.

In Tables 8 and 9, the forecasted average tax rate is arrived at by multiplying the forecasted shares for each of the tax rate categories by the respective rates in the tax schedule in effect for that rate year. These products are then summed over the rate schedule and divided by the sum of the predicted shares.

In Tables 10 and 11, on the other hand, the forecasted average tax rate is calculated by fitting a normal distribution to the 72 ES-204 reserve ratio categories with the forecasted weighted mean reserve ratio and weighted standard deviation. The values of the taxable wage percentages distributed among the 72 categories are then summed in groups that correspond to the new tax table categories, i.e., those in effect since July 1, 1986. These calculated shares are then multiplied by the appropriate tax rates. Finally, the products are summed to yield a forecasted average tax rate for Rate Years 1986-87 and 1987-88.

Table 8 shows that for Rate Year 1984-85, the model underestimates the actual shares for the positive categories and overestimates the share for the negative categories. For Rate Year 1985-86 (Table 9) the model was less consistent over the range of the tax schedule. On average, the results were better in Rate Year 1984-85, with the average difference between the forecasted and actual rate category shares being 0.99 percentage points. In 1985-86, this average difference widened to 1.66 percentage points.

The forecast error for the average tax rate exhibited the opposite trend. For Rate Year 1984-85, the predicted average tax rate (3.77 percent) overestimated the actual (3.19 percent), while for Rate Year 1985-86 the predicted average tax rate (3.12 percent) underestimated the actual (3.25 percent) by only 0.13 percentage points.

Tables 10 and 11 show that the model has the potential to predict the weighted mean reserve ratio and the weighted standard deviation quite well, with errors ranging between 0.66 and 1.20 for Rate Years 1989-90 and 1990-91, respectively. Consequently, the ex-post forecast of the average tax rate based on the previously outlined standard normal mapping procedure was also favorable when compared with actual data. For Rate Year 1989-90 there was an error of only 0.02 percentage points, while for Rate Year 1990-91 it was 0.16 percentage points.

As mentioned previously, forecasting can be further improved by studying the pattern of the heavy area of concentration in a few categories that emerges through time and appears to be the only difference between the observed distribution and a completely normal distribution.

V. SUGGESTIONS FOR FURTHER RESEARCH

As mentioned in Chapter Three, previous research on the problem of forecasting shifts in taxable wages among the rate levels of a given tax table is virtually non-existent. The estimated equations presented in Chapters Three and Four are a promising start toward a solution to this problem, which has central importance for ensuring

TABLE 8

Comparison of Actual and Predicted Values For
Tax Rate Category Shares of Taxable Wages
Rate Year 1984-85

Rate Category	Predicted Value	Actual Value	Difference (Predicted Minus Actual)
11.00% and Over	13.64	14.14	-0.50
10.00% to 10.99%	10.02	12.46	-2.44
9.00% to 9.99%	8.79	9.89	-1.10
8.00% to 8.99%	6.81	7.27	-0.46
7.00% to 7.99%	5.82	6.23	-0.41
6.00% to 6.99%	5.48	5.69	-0.21
5.00% to 5.99%	4.42	4.93	-0.51
4.00% to 4.99%	4.01	4.15	-0.14
3.00% to 3.99%	3.47	4.10	-0.63
.00% to 2.99%	9.41	8.73	+0.68
-.00% to -9.99%	14.52	11.65	+2.87
-10.00% to 19.99%	5.06	4.27	+0.79
-20.00% and Under	8.55	6.48	+2.07
Average Tax Rate	3.77%	3.19%	+0.58

TABLE 9

Comparison of Actual and Predicted Values For
Tax Rate Category Shares of Taxable Wages
Rate Year 1985-86

Rate Category	Predicted Value	Actual Value	Difference (Predicted Minus Actual)
11.00% and Over	16.29	17.71	-1.42
10.00% to 10.99%	16.23	11.98	+4.25
9.00% to 9.99%	14.88	12.99	+1.89
8.00% to 8.99%	10.23	8.36	+1.87
7.00% to 7.99%	6.32	6.50	-0.18
6.00% to 6.99%	5.52	5.64	-0.12
5.00% to 5.99%	5.37	4.69	+0.68
4.00% to 4.99%	1.64	3.80	-2.16
3.00% to 3.99%	1.67	3.44	-1.77
.00% to 2.99%	3.68	6.55	-2.87
-.00% to -9.99%	7.40	9.44	-2.04
-10.00% to -19.99%	3.10	3.30	-0.20
-20.00% and Under	7.67	5.60	+2.07
Average Tax Rate	3.12%	3.25%	-0.13

TABLE 10

Comparison of Actual and Predicted Values For
The Weighted Mean Reserve Ratio
And Weighted Standard Deviation
Rate Year 1989-90

Variable	Predicted Value	Actual Value	Difference (Predicted Minus Actual)
Weighted Mean Reserve Ratio	7.65	6.99	+0.66
Weighted Standard Deviation	9.45	8.47	+0.98
Average Tax Rate	2.04%	2.06%	-0.02

TABLE 11

Comparison of Actual and Predicted Values For
The Weighted Mean Reserve Ratio And
Weighted Standard Deviation
Rate Year 1990-91

Variable	Predicted Value	Actual Value	Difference (Predicted Minus Actual)
Weighted Mean Reserve Ratio	8.10	6.90	+1.20
Weighted Standard Deviation	9.28	8.41	+0.87
Average Tax Rate	1.82%	1.98%	-0.16

the accuracy of trust fund projections. Some low t-stats and low R^2 terms, however, suggest that the same set of predictor variables might not be appropriate for forecasting shifts into and out of all reserve ratio categories and tax liability levels. Some variables might not have a uniform impact on all employers.

To further explore this possibility, an analysis of firm level data should be conducted to address the following questions:

1. Does the reserve ratio and hence the tax liability for an individual experience rated firm change over the course of time dramatically or, as postulated in previous writings, does it remain at or near a particular reserve ratio level for extended periods? The literature on steady state behavior would be of use in this regard.

2. If it is indeed found that reserve ratios for individual experience rated firms remain at or near a certain level, is there a particular set of characteristics that can be attributed to firms at different levels that bear a logical relationship to those levels? Along with this, the predictability of the negative versus the positive balance employers should be explored.

Examining these issues with firm level data will provide useful insight to improve the specification of the equations that showed weaker results in the current study.

Finally, the forecasting of the weighted standard deviation is an issue that itself warrants further consideration, particularly regarding the theoretically appropriate signs of the coefficients on the independent variables. As an indicator that reflects the relative dispersions of employer reserve ratios, its forecasting framework might also have a basis in steady state theory.

FOOTNOTES

[1] Before 1976, the wage base was legislatively determined. It was $3,600 for 1970 and 1971, $4,200 from 1972 to 1974 and $4,800 for 1975. Since 1976, the taxable wage base has been set at 28 times the Statewide average weekly wage paid to workers subject to the tax.

[2] The ES-204 is a federally mandated report submitted on an annual basis to the U.S. Department of Labor that contains a variety of data on wages, benefits, contributions and reserve ratios.

[3] The reader should note that the choice of sample period for each of the tax table categories was a matter of the tax table structures that were in existence between Rate Years 1970-71 and 1987-88. There were actually six tables between Rate Years 1970-71 and 1987-88. Many categories, such as those between 3.00% and 3.99% and 10.00% and 10.99% were common to all of these tax tables. Others came into use and went out of existence at various points in the sample period. For descriptive analysis in this chapter, and for regression analysis in Chapter Three, the period chosen for each tax table category reflects the time for which it was actually in use.

[4] The highest and lowest categories among the 72 are open ended: - 35.0% and under and + 35.0% and over.

[5] Saffer, Henry, "The Financing System: An Econometric Model", Unemployment Compensation: Studies and Research, National Commission on Unemployment Compensation, July 1980, p. 922.

[6] Saffer, Henry, "The Effects of Experience Rating on the Unemployment Rate", Unemployment Compensation: Studies and Research, National Commission on Unemployment Compensation, July 1980, p. 425.

[7] Multicollinearity is a statistical problem, which, in part, indicates a weak model. It results from the inclusion of two or more independent variables that move in tandem with each other over the course of the sample period to such a degree that the independent influence of each of the variables on the dependent variable is impossible to decipher.

[8] For an explanation of how the Chi-Square test is carried out, the reader should refer to Appendix B.

APPENDIX A

UNEMPLOYMENT INSURANCE TAX TABLES IN EFFECT BETWEEN RATE YEARS 1970-71 and 1990-91

New Jersey Unemployment Insurance Program

TAX TABLE NO. 3

July 1, 1961 - June 30, 1971

Employer Reserve Ratio[1]	Unemployment Trust Fund Reserve Ratio[2]					
	12.5% and Over	10% to 12.49%	7%to 9.99%	4% to 6.99%	2.5% to 3.99%	2.49% and Under
Positive Reserve Ratio	**Employer Contribution Rates**					
11.00% and over	0.4	0.4	0.4	0.7	1.0	2.8
10.00% to 10.99%	0.4	0.4	0.7	1.0	1.3	2.8
9.00% to 9.99%	0.4	0.7	1.0	1.3	1.6	2.8
8.00% to 8.99%	0.7	1.0	1.3	1.6	1.9	2.8
7.00% to 7.99%	1.0	1.3	1.6	1.9	2.2	2.8
6.00% to 6.99%	1.3	1.6	1.9	2.2	2.5	2.8
5.00% to 5.99%	1.6	1.9	2.2	2.5	2.8	2.8
4.00% to 4.99%	1.9	2.2	2.5	2.8	3.1	3.1
3.00% to 3.99%	2.2	2.5	2.8	3.1	3.4	3.4
.00% to 2.99%	2.5%	2.5%	2.8%	3.1%	3.4%	3.4%
Deficit Reserve Ratio[3]	3.0	3.3	3.6	3.9	4.2	4.2
New Employer Rate[4]	2.8	2.8	2.8	2.8	2.8	2.8

[1] Employer's reserve balance (contributions minus benefits) as a percentage of employer's average annual taxable payroll for the last three or five calendar years, whichever is higher.

[2] Fund balance as of March 31 as a percentage of aggregate taxable wages in the Prior calendar year.

[3] Deficit Reserve Ratio = Cumulative benefits charged exceed cumulative contributions paid.

[4] New Employer Rate applies until there have been three full or partial consecutive calendar years of coverage under the unemployment

New Jersey Unemployment Insurance Program

TAX TABLE NO. 4

JULY 1, 1971 - December 31, 1972

Employer Reserve Ratio[1]	Unemployment Trust Fund Reserve Ratio[2] 12.5% & over	10% to 12.49%	7% to 9.99%	4% to 6.99%	2.5% to 3.99%	2.49% & Under
			Employer Contribution Rates			
Positive Reserve Ratio						
11.00% and over	0.4%	0.4%	0.4%	0.7%	1.0%	2.8%
10.00% to 10.99%	0.4	0.4	0.7	1.0	1.3	2.8
9.00% to 9.99%	0.4	0.7	1.0	1.3	1.6	2.8
8.00% to 8.99%	0.7	1.0	1.3	1.6	1.9	2.8
7.00% to 7.99%	1.0	1.3	1.6	1.9	2.2	2.8
6.00% to 6.99%	1.3	1.6	1.9	2.2	2.5	2.8
5.00% to 5.99%	1.6	1.9	2.2	2.5	2.8	2.8
4.00% to 4.99%	1.9	2.2	2.5	2.8	3.1	3.1
3.00% to 3.99%	2.2	2.5	2.8	3.1	3.4	3.4
.00% to 2.99%	2.5	2.5	2.8	3.1	3.4	3.4
Deficit Reserve Ratio						
- .00% to - 9.99%	3.1	3.4	3.7	4.0	4.3	4.3
-10.00% to -19.99%	3.4	3.7	4.0	4.3	4.6	4.6
-20.00% and Over	3.7	4.0	4.3	4.6	4.6	4.6
New Employer Rate[3]	2.8	2.8	2.8	2.8	2.8	3.4

[1] Employer's reserve balance (contributions minus benefits) as a percentage of employer's average annual taxable payroll for the last three or five calendar years, whichever is higher.

[2] Fund balance as of March 31 as a percentage of aggregate taxable wages in the prior calendar year.

[3] New employer rate applies until there have been three full or partial consecutive calendar years of coverage under the unemployment compensation law.

New Jersey Unemployment Insurance Program

TAX TABLE NO. 5

JANUARY 1, 1973 - JUNE 30, 1975

Employer Reserve Ratio[1]	Unemployment Trust Fund Reserve Ratio[2] 12.5% & over	10% to 12.49%	7% to 9.99%	4% to 6.99%	2.5% to 3.99%	2.49% & Unde
			Employer Contribution Rates			
Positive Reserve Ratio						
11.00% and over	0.4%	0.4%	0.4%	0.7%	1.0%	1.2%
10.00% to 10.99%	0.4	0.4	0.7	1.0	1.3	1.6
9.00% to 9.99%	0.4	0.7	1.0	1.3	1.6	1.9
8.00% to 8.99%	0.7	1.0	1.3	1.6	1.9	2.3
7.00% to 7.99%	1.0	1.3	1.6	1.9	2.2	2.6
6.00% to 6.99%	1.3	1.6	1.9	2.2	2.5	3.0
5.00% to 5.99%	1.6	1.9	2.2	2.5	2.8	3.4
4.00% to 4.99%	1.9	2.2	2.5	2.8	3.1	3.7
3.00% to 3.99%	2.2	2.5	2.8	3.1	3.4	4.1
.00% to 2.99%	2.5	2.5	2.8	3.1	3.4	4.1
Deficit Reserve Ratio						
- .00% to - 9.99%	3.1	3.4	3.7	4.0	4.3	5.2
-10.00% to -19.99%	3.4	3.7	4.0	4.3	4.6	5.5
-20.00% and Over	3.7	4.0	4.3	4.6	4.6	5.5
New Employer Rate[3]	2.8	2.8	2.8	2.8	2.8	3.4

[1] Employer's reserve balance (contributions minus benefits) as a percentage of employer's average annual taxable payroll for the last three or five calendar years, whichever is higher.

[2] Fund balance as of March 31 as a percentage of aggregate taxable wages in the prior calendar year.

[3] New employer rate applies until there have been three full or partial consecutive calendar years of coverage under the unemployment compensation law.

New Jersey Unemployment Insurance Program

TAX TABLE NO. 6

JULY 1, 1975 - June 30, 1984

Employer Reserve Ratio[1]	Unemployment Trust Fund Reserve Ratio[2] 12.5% & over	10% to 12.49%	7% to 9.99%	4% to 6.99%	2.5% to 3.99%	2.49% & Under
	Employer Contribution Rates					
Positive Reserve Ratio						
11.00% and over	0.4%	0.4%	0.4%	0.7%	1.0%	1.2%
10.00% to 10.99%	0.4	0.4	0.7	1.0	1.3	1.6
9.00% to 9.99%	0.4	0.7	1.0	1.3	1.6	1.9
8.00% to 8.99%	0.7	1.0	1.3	1.6	1.9	2.3
7.00% to 7.99%	1.0	1.3	1.6	1.9	2.2	2.6
6.00% to 6.99%	1.3	1.6	1.9	2.2	2.5	3.0
5.00% to 5.99%	1.6	1.9	2.2	2.5	2.8	3.4
4.00% to 4.99%	1.9	2.2	2.5	2.8	3.1	3.7
3.00% to 3.99%	2.2	2.5	2.8	3.1	3.4	4.1
.00% to 2.99%	2.5	2.5	2.8	3.1	3.4	4.1
Deficit Reserve Ratio						
- .00% to - 9.99%	3.4	3.7	4.0	4.3	4.6	5.5
-10.00% to -19.99%	3.7	4.0	4.3	4.6	4.9	5.9
-20.00% and under	4.0	4.3	4.6	4.9	5.2	6.2
New Employer Rate[3]	2.8	2.8	2.8	2.8	2.8	3.4

[1] Employer's reserve balance (contributions minus benefits) as a percentage of employer's average annual taxable payroll for the last three or five calendar years, whichever is higher.

[2] Fund balance as of March 31 as a percentage of aggregate taxable wages in the prior calendar year.

[3] New employer rate applies until there have been three full or partial consecutive calendar years of coverage under the unemployment compensation law.

New Jersey Unemployment Insurance Program

TAX TABLE NO. 7

JULY 1, 1984 - JUNE 30, 1986

Employer Reserve Ratio[1]	Unemployment Trust Fund Reserve Ratio[2] 12.5% & over	10% to 12.49%	7% to 9.99%	4% to 6.99%	2.5% to 3.99%	2.49% & Under	10% Solvency Tax[3]
				Employer Contribution Rates			
Positive Reserve Ratio:							
11.00% and over	0.4%	0.4%	0.4%	0.7%	1.0%	1.2%	1.3%
10.00% to 10.99%	0.4	0.4	0.7	1.0	1.3	1.6	1.8
9.00% to 9.99%	0.4	0.7	1.0	1.3	1.6	1.9	2.1
8.00% to 8.99%	0.7	1.0	1.3	1.6	1.9	2.3	2.5
7.00% to 7.99%	1.0	1.3	1.6	1.9	2.2	2.6	2.9
6.00% to 6.99%	1.3	1.6	1.9	2.2	2.5	3.0	3.3
5.00% to 5.99%	1.6	1.9	2.2	2.5	2.8	3.4	3.7
4.00% to 4.99%	1.9	2.2	2.5	2.8	3.1	3.7	4.1
3.00% to 3.99%	2.2	2.5	2.8	3.1	3.4	4.1	4.5
.00% to 2.99%	2.5	2.5	2.8	3.1	3.4	4.1	4.5
Deficit Reserve Ratio							
- .00% to - 9.99%	3.4	3.7	4.0	4.3	4.6	5.5	6.1
-10.00% to -19.99%	3.7	4.0	4.3	4.6	4.9	5.9	6.5
-20.00% and under	4.0	4.3	4.6	4.9	5.2	6.2	6.8
New Employer Rate[4]	2.8	2.8	2.8	2.8	2.8	3.4	3.7

[1] Employer's reserve balance (contributions minus benefits) as a percentage of employer's average annual taxable payroll for the last three or five calendar years, whichever is higher.

[2] Fund balance as of March 31 as a percentage of aggregate taxable wages in the prior calendar year.

[3] If the trust fund is in a deficit position on March 31 of any year, an additional 10% solvency tax will be triggered on as of July 1 of that year.

[4] New employer rate applies until there have been three full or partial consecutive calendar years of coverage under the unemployment compensation law.

New Jersey Unemployment Insurance Program

TAX TABLE NO. 8
(EFFECTIVE JULY 1, 1986)

Employer Reserve Ratio[1]	Unemployment Trust Fund Reserve Ratio[2] 10% and over	7.00% to 9.99%	4.00% to 6.99%	2.50% to 3.99%	2.49% to 0.00%	10% Solvency Tax[3]
Positive Reserve Ratio:	**Employer Contribution Rates**					
17% and over	0.3%	0.4%	0.5%	0.6%	1.2%	1.3%
16.00% to 16.99%	0.4	0.5	0.6	0.6	1.2	1.3
15.00% to 15.99%	0.4	0.6	0.7	0.7	1.2	1.3
14.00% to 14.99%	0.5	0.6	0.7	0.8	1.2	1.3
13.00% to 13.99%	0.6	0.7	0.8	0.9	1.2	1.3
12.00% to 12.99%	0.6	0.8	0.9	1.0	1.2	1.3
11.00% to 11.99%	0.7	0.8	1.0	1.1	1.2	1.3
10.00% to 10.99%	0.9	1.1	1.3	1.5	1.6	1.8
9.00% to 9.99%	1.0	1.3	1.6	1.7	1.9	2.1
8.00% to 8.99%	1.3	1.6	1.9	2.1	2.3	2.5
7.00% to 7.99%	1.4	1.8	2.2	2.4	2.6	2.9
6.00% to 6.99%	1.7	2.1	2.5	2.8	3.0	3.3
5.00% to 5.99%	1.9	2.4	2.8	3.1	3.4	3.7
4.00% to 4.99%	2.0	2.6	3.1	3.4	3.7	4.1
3.00% to 3.99%	2.1	2.7	3.2	3.6	3.9	4.3
2.00% to 2.99%	2.2	2.8	3.3	3.7	4.0	4.4
1.00% to 1.99%	2.3	2.9	3.4	3.8	4.1	4.5
0.00% to 0.99%	2.4	3.0	3.6	4.0	4.3	4.7
Deficit Reserve Ratio:						
- 0.00% to - 2.99%	3.4	4.3	5.1	5.6	6.1	6.7
- 3.00% to - 5.99%	3.4	4.3	5.1	5.7	6.2	6.8
- 6.00% to - 8.99%	3.5	4.4	5.2	5.8	6.3	6.9
- 9.00% to -11.99%	3.5	4.5	5.3	5.9	6.4	7.0
-12.00% to -14.99%	3.6	4.6	5.4	6.0	6.5	7.2
-15.00% to -19.99%	3.6	4.6	5.5	6.1	6.6	7.3
-20.00% to -24.99%	3.7	4.7	5.6	6.2	6.7	7.4
-25.00% to -29.99%	3.7	4.8	5.6	6.3	6.8	7.5
-30.00% to -34.99%	3.8	4.8	5.7	6.3	6.9	7.6
-35.00% and under	5.4	5.4	5.8	6.4	7.0	7.7
New Employer Rate[4]	2.8	2.8	2.8	3.1	3.4	3.7

[1] Employer's reserve balance (contributions minus benefits) as a percentage of employer's average annual taxable payroll for the last three or five calendar years, whichever is higher.

[2] Fund balance as of March 31 as a percentage of aggregate taxable wages in the prior calendar year.

[3] If the trust fund is in a deficit position on March 31 of any year, an additional 10% solvency tax will be triggered on as of July 1 of that year.

[4] New employer rate applies until there has been three full or partial consecutive calendar years of coverage under the unemployment compensation law.

APPENDIX B

IMPLEMENTATION OF THE CHI-SQUARE TEST

Implementation of the Chi-Square Test

The Chi-Square test provides a test of the discrepancy between an observed and an expected frequency distribution. It answers the question, How does an observed distribution fit a known theoretical distribution?

In this paper it is hypothesized that the distribution of taxable wages among the 72 reserve ratio categories of the ES-204 report conforms to the normal distribution. To test the hypothesis, two sets of values are initially needed - the observed distribution, taken from the ES-204 data, and the expected distribution if the distribution of taxable wages by reserve ratio categories is normal. In order to arrive at this second set of numbers, it is necessary to fit the normal distribution to the 72 reserve ratio categories. The process of fitting a normal distribution to a range of frequency classes is as follows:

A. All standard tables of the normal distribution are for the distribution with a mean equal to 0 and a standard deviation equal to 1.

Consequently, to use a table of the normal distribution a rescaling is necessary. The rescaled measurement is given by the the relation

$$Z = \frac{X - U}{WSD}$$

Where X = true upper class limit of each reserve ratio category
U = weighted mean of reserve ratios for the given rate year
WSD = weighted standard deviation for the given rate year

Calculate this Z statistic for each of the 72 reserve ratio categories.

B. From a table that shows the area under a standard normal graph from 0 to Z, read the probability of a value less than Z. Call this value A. For Z negative use 0.5-A; for Z positive use 0.5 + A. (Note: For most values of Z, linear interpolation is required).

C. The probabilities of values lying in successive reserve ratio categories are calculated by subtracting successive cumulative probabilities which should then be multiplied by 100.

With data for the expected and observed frequency distribution, the Chi-Square test is carried out as follows:[1]

1. Calculate for each reserve ratio class the quantity:
$(Oi - Ei)^2 / Ei$ - ((observed-expected))^2 / expected

2. The test criterion is

$$X^2 = \sum_{L=1}^{72} (Oi - Ei)^2 / Ei$$

D. The degrees of freedom of the Chi-Square statistic where both U and sigma are known is the number of frequency classes minus one. A value of X^2 greater than the critical value at a given confidence level causes rejection of the null hypothesis of conformity to the hypothesized distribution (at whatever confidence level is desired for the test.)