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ABSTRACT

A study compared a Modified Area Skill Survey (MASS) with a Modified Industry/Occupation Matrix (MIOM) method of projecting manpower demand. The comparison was made with regard to the bias and precision of the estimates of the two projection methods on populations of varying size. To achieve the comparison, each method was applied to the same population and estimates of future employment were obtained. A survey of the population was conducted one year later to obtain actual employment. The results were then tabulated for each projection method and a comparison of the results made using a paired sign test on the precision estimates and a paired t-test on the estimates of future employment. The results of the bias and precision comparisons were not conclusively in favor of either projection technique. However, the cost involved in implementing the two techniques is so drastically different, it was concluded that the MIOM is more desirable for counties of all sizes. (Editor/JT)

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The Comparative Efficacy of Selected Manpower Demand Project Techniques on Diversified Populations

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TABLE OF CONTENTS

Chapter		Page
I.	Summary	1
II.	Introduction	2
III.	Experimental Design	4
IV.	Procedures for Comparing the Observed Biases of the Two Demand Projection Techniques	7
V.	Procedures for Comparing the Observed Precision of the Two Demand Projection Techniques	16
VI.	A Comparison of the Relative Cost of Implementing the Two Demand Projection Techniques	19
VII.	Conclusions	23
Appendix I	- The Modified Area Skill Survey	24
Appendix II	- The Modified Industry/Occupation Matrix	29
Appendix III	- Regression Estimates	30
Appendix IV	- Integration of Regression Estimates with Industry/Occupation Ratio Estimates	32
Bibliography		33

3

LIST OF TABLES

Table | Page

I. Stratification of Counties 4
II. Counties Included in the Sample 5
III. Selected Two-Digit SIC 6
IV. Employment Estimates vs. Actual Employment 8
V. Modified Area Skill Survey vs. Actual - SIC 13 10
VI. Modified Area Skill Survey vs. Actual - SIC 20 10
VII. Modified Area Skill Survey vs. Actual - SIC 49 11
VIII. Modified Area Skill Survey vs. Actual - SIC 52 11
IX. Modified Area Skill Survey vs. Actual - SIC 61 12
X. Modified Industry/Occupation Matrix - SIC 13 12
XI. Modified Industry/Occupation Matrix - SIC 20 13
XII. Modified Industry/Occupation Matrix - SIC 49 13
XIII. Modified Industry/Occupation Matrix - SIC 52 14
XIV. Modified Industry/Occupation Matrix - SIC 61 14
XV. Frequency Table for Modified Area Skill Survey 15
XVI. Frequency Table for Modified Industry/Occupation Matrix 15
XVII. Tabulation of Observed Mean Square Errors 17
XVIII. Estimated Cost by County by SIC for the Modified Industry/Occupation Matrix 20
XIX. Estimated Cost by County by SIC for the Modified Area Skill Survey 21
XX. Average Cost by County by SIC 22
XXI. Example of Sample Frame 25
XXII. Grouping Firms by Firm Size 25

4

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CHAPTER I

SUMMARY

The objective of this report was to compare a Modified Area Skill Survey (MASS) with a Modified Industry/Occupation Matrix (MIOM) method of projecting manpower demand. The comparison was made with regard to the bias and precision of the estimates of the two projection methods on populations of varying size. To achieve the comparison, each method was applied to the same population and estimates of future employment were obtained. A survey of the population was conducted one year later to obtain actual employment.

The results were then tabulated for each projection method and a comparison of the results made using a paired sign test on the precision estimates and a paired t-test on the estimates of future employment.

The results of the bias and precision comparisons were not conclusively in favor of either projection technique. However, the cost involved in implementing the two techniques is so drastically different, it was concluded that the MIOM is more desirable for counties of all sizes.

CHAPTER II

INTRODUCTION

In any society, the supply of labor and the demand for that supply is of vital concern. Recognizing this fact, it was specified in the Vocational Education Act of 1963 (P.L. 88-210) and in the 1968 Amendment (P.L. 90-576) that there be periodic evaluations of the state and local vocational education programs utilizing federal monies. Futhermore, vocational curriculum planning should be based on current and projected manpower needs and the resources available to meet these needs.

Vocational education administrators have come to assume, in recent years, that some type of manpower forecasting constitutes a part of their management tools. The drafters of the Vocational Education Act of 1963 (as amended in 1968) and later interpreters of the Act assumed, as a matter of course, that planning, with the improved use of labor market forecasting, could improve the performance of vocational education.[6,13,14,17]

Sommers[15] observes that vocational education reacts only sluggishly to industrial change, and a good part of this slow reaction can be attributed to inadequate data. Kidder[9] stated that none of the states were indicating cost of projected demand data and that no state model included estimated forecast errors. He stated in his research needs section:

> In a purely technical vein, more comparative analysis of the accuracy of alternative forecasting models must be done. To some extent, of course, these experiments depend on the willingness of public agencies to sponsor and fund research in forecasting. In the long run, such research should make possible some rationality in choosing a projection model, a result which could justify the initial expenditure.

If manpower training is to make its maximum contribution to the development of human resources, intensive efforts must be made to make available to each state the proper techniques for manpower projections and a systematic method for planning and implementing these programs. Oklahoma has been the leader among the states in utilizing the manpower supply and demand system in planning new programs. Consequently, thirty-eight states have visited Oklahoma for a closer observation of the system. Personnel of the Oklahoma State Department of Vocational and Technical Education have sponsored two national conferences in which manpower demand projections were the major topics discussed, and have assisted interested persons with all of the information that is available. There is one major question, however, that continues to go unanswered. What technique should be used to get projected manpower demand for a given population?

Oklahoma has had an Occupational Training Information System (OTIS) since 1968. It was the first state to have an annual system for state-wide and substate planning regions of comprehensive and continued interfacing of supply and demand for vocational and technical education programs. The annual update system, with continued refinement, results in OTIS being a major manpower planning and budgeting tool.

Oklahoma started earlier than other states in gathering detailed manpower demand information by using the Area Skill Survey technique because it was thought to be the best method available at the time. The state, with a 2.7 million population, which includes considerable sparsely populated areas, is unique. The demand projection technique that fits Oklahoma, however, is not necessarily the technique that should be used in another state. Recently, there has been much progress made in manpower projection techniques. The U.S. Department of Labor and the Bureau of Labor Statistics (BLS) have made tremendous advancement in their BLS Occupational Matrix technique. At the present time, BLS states that the BLS Matrix is good for state-wide totals and for SMSA's of 250,000 or more in population, but it is still not known whether an Industry/Occupation Matrix or an Area Skill Survey provides estimates with more precision in terms of observed bias and mean square error.

The purpose of this study is to compare a Modified Area Skill Survey with a Modified Industry/Occupation Matrix in geographical regions of differing sizes. The comparison is based on the observed precision and bias of the projections as exhibited in a one-year projection.

CHAPTER III

EXPERIMENTAL DESIGN

To achieve the desired comparison, the 77 counties in Oklahoma were stratified into six population levels. (See Table I.)

TABLE I
STRATIFICATION OF COUNTIES

Level	Size	No. of Counties	No. in Sample
1	(0-10,000)	21	3
2	(10,000-30,000)	38	3
3	(30,000-70,000)	14	2
4	(70,000-150,000)	2	2
5	(150,000-310,000)	0	0
6	(310,000-630,000)	2	1

Three counties were randomly selected from the first two population levels, two counties from the third and fourth levels, no counties from the fifth level (since there are no counties in Oklahoma of this size), and one county from the sixth level. (See Table II.)

TABLE II
COUNTIES INCLUDED IN THE SAMPLE

Level	County
1	Dewey
1	Beaver
1	Pushmataha
2	Atoka
2	Logan
2	Caddo
3	LeFlore
3	Payne
4	Cleveland
4	Comanche
6	Oklahoma

In order that the comparison be representative of a wide range of industries, the industry types are grouped according to Standard Industrial Classification (SIC) (1) Goods Producing which includes SIC one-digit codes 1, 2, and 3 and (2) Services Producing which includes SIC codes 4, 5, 6, and 7. Two one-digit SIC codes were randomly selected from Goods Producing Industries and three were randomly selected from the Service Producing Industries. Within each of these five one-digit SIC codes, one two-digit SIC code was randomly selected for the application of the two methods. (See Table III.)

TABLE III
SELECTED TWO-DIGIT SIC CODES

Type	Code	Name
Goods	13	Crude Petroleum and Natural Gas
Goods	20	Food and Kindred Products
Service	49	Electricity, Gas and Sanitary Service
Service	52	Retail, Building Materials, Hardware, Farm Equip
Service	61	Credit Agencies other than Banks

CHAPTER IV

PROCEDURES FOR COMPARING THE OBSERVED BIASES OF THE TWO DEMAND PROJECTION TECHNIQUES

To achieve the desired comparison each projection method was used to obtain an estimate of the future employment for each of a specified number of occupations in each two-digit SIC in each county selected. Then a resurvey was conducted for the projection date to determine the actual employment. Thus, for each method of projection the following information was obtained for each occupation in each two-digit SIC in each county:

$\hat{Y}_{1hij}$ = the Modified Area Skill Survey projected employment for occupation h, county i, SIC j. (Refer to Appendix I, to see how MASS estimates were obtained.)

$\hat{Y}_{2hij}$ = The Modified Industry/Occupation Matrix projected employment for occupation h, county i, SIC j. (Refer to Appendices, II, III, and IV to see how MIOM estimates were obtained.)

In addition to the above, Y_{hij} (the actual employment for the projection date for occupation j) was obtained in order to make the bias and precision comparisons.

For each SIC and each projection method the above data was tabulated as shown in Table IV.

12

TABLE IV

EMPLOYMENT ESTIMATES VERSUS ACTUAL EMPLOYMENT

Size		1						2						3				4				6	
County		1		2		3		1		[illegible]		[illegible]		1		2		1		2		1	
		$\hat{Y}$	Y	$\hat{Y}$	Y	$\hat{Y}$	Y	$\hat{Y}$	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$\hat{Y}$	Y	$\hat{Y}$	Y	$\hat{Y}$	Y	$\hat{Y}$	Y	$\hat{Y}$	Y
Occupation = h	1																						
	2																						
	3																						
	.																						
	.																						
	.																						
*	n																						

* The value of n varies according to the number of occupations considered in a particular SIC.

Within each SIC in each county the data consisted of observations on a bivariate random sample $(\hat{Y}_1, Y_1), (\hat{Y}_2, Y_2), \ldots, (\hat{Y}_n, Y_n)$, where there were n pairs of observations. Within each pair $(\hat{Y}_h, Y_h)$ the difference was formed $D_h = \hat{Y}_h - Y_h$.

13

Then a test of the following hypothesis was made:

H_0: $M_D = 0$ assuming that the mean of the D_j is zero and that the D_j are normally distributed.

H_1: $M_D \neq 0$

The test statistic was given by:

$$T = \frac{\bar{D}}{s(\bar{D})} \quad \text{where} \quad \bar{D} = \frac{1}{n} \sum_{h=1}^{n} D_h$$

$$\text{and} \quad s^2(\bar{D}) = \frac{1}{n-1} \sum_{h=1}^{n} (D_h - \bar{D})^2$$

The results of the above tests for the Modified Area Skill Survey (MASS) are tabulated in Tables I through IX and for the Modified Industry/Occupation Matrix (MIOM) in Tables X through XIV.

TABLE V
Modified Area Skill Survey vs. Actual
SIC = 13 Sample Size: n = 25

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commanche	Oklahoma
Mean Deviation	[illegible]	-0.15	NA	NA	-0.24	0.12	NA	0.0	-0.48	NA	-2.72
Standard Deviation of the mean	[illegible]	0.269	NA	NA	0.145	0.145	NA	0.507	0.165	NA	11.169
Calculated t	0.50	0.584	NA	NA	1.66	0.83	NA	0.00	2.92	NA	0.24
Observed Significance Level	over 0.5	over 0.5	NA	NA	(0.1,0.2)	(0.4,0.5)	NA	over 0.5	(0.001,0.01)	NA	over 0.5

TABLE VI
Modified Area Skill Survey vs. Actual
SIC = 20 Sample Size: n = 24

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commanche	Oklahoma
Mean Deviation	0.04	NA	-0.04	NA	-0.25	-0.08	-0.67	-1.67	-1.25	-0.96	13.67
Standard Deviation of the mean	0.042	NA	0.141	NA	0.211	0.119	0.992	0.645	1.684	0.809	16.045
Calculated t	1.00	NA	0.30	NA	1.19	0.70	0.67	2.59	0.74	1.19	0.85
Observed Significance Level	(0.3,0.4)	NA	over 0.5	NA	(0.2,0.3)	(0.4,0.5)	over 0.5	(0.01,0.02)	(0.4,0.5)	(0.2,0.3)	(0.4,0.5)

TABLE VII
Modified Area Skill Survey vs. Actual
SIC = 49   Sample Size: n = 24

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commanche	Oklahoma
Mean Deviation	NA	0.125	-0.25	0.17	-0.125	0.17	-0.25	-0.167	0.54	-1.125	-21.292
Standard Deviation of the mean	NA	0.363	0.193	0.143	0.203	0.874	0.202	0.441	0.351	0.559	7.651
Calculated t	NA	0.34	1.30	1.16	0.62	0.19	1.24	0.38	1.54	2.01	2.78
Observed Significance Level	NA	over 0.5	(0.2,0.3)	(0.2,0.3)	over 0.5	over 0.5	(0.2,0.3)	over 0.5	(0.1,0.2)	(0.05,0.1)	(0.01,0.02)

TABLE VIII
Modified Area Skill Survey vs. Actual
SIC = 52   Sample Size: n = 24

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commancho	Oklahoma
Mean Deviation	0.04	-0.417	NA	0.21	0.125	0.04	-0.875	-0.375	-0.792	0.63	-8.29
Standard Deviation of the mean	0.141	0.481	NA	0.180	0.228	0.316	0.347	0.365	0.568	0.481	4.616
Calculated t	0.30	0.87	NA	1.16	0.55	0.13	2.52	1.03	1.39	1.30	1.80
Observed Significance Level	over 0.5	(0.3,0.4)	NA	(0.2,0.3)	over 0.5	over 0.5	(0.01,0.02)	(0.3,0.4)	(0.1,0.2)	(0.1,0.2)	(0.05,0.1)

TABLE IX
Modified Area Skill Survey vs. Actual
SIC = 61 Sample Size: n = 23

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commanche	Oklahoma
Mean Deviation	NA	NA	NA	0.09	-0.13	-0.04	0.39	0.04	0.35	0.09	-6.35
Standard Deviation of the mean	NA	NA	NA	0.060	0.114	0.194	0.265	0.255	0.359	0.503	10.820
Calculated t	NA	NA	NA	1.48	1.14	0.22	1.48	0.17	0.97	0.173	0.59
Observed Significance Level	NA	NA	NA	(0.2,0.3)	(0.2,0.3)	over 0.5	(0.1,0.2)	over 0.5	(0.3,0.4)	over 0.5	over 0.5

TABLE X
Modified Industry Occupation Matrix vs. Actual
SIC = 13 Sample Size: n = 25

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commanche	Oklahoma
Mean Deviation	0.44	-0.15	NA	NA	-0.24	0.04	NA	-0.44	-0.48	NA	-3.00
Standard Deviation of the mean	0.400	0.269	NA	NA	0.145	0.122	NA	0.575	0.165	NA	11.290
Calculated t	1.10	0.584	NA	NA	1.66	0.33	NA	0.77	2.92	NA	0.27
Observed Significance Level	(0.2,0.3)	over 0.5	NA	NA	(0.1,0.2)	over 0.5	NA	(0.4,0.5)	(0.001,0.01)	NA	over 0.5

TABLE XI
Modified Industry Occupation Matrix vs. Actual
SIC = 20 Sample Size: n = 24

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commanche	Oklahoma
ean Deviation	0.04	NA	-0.21	NA	-0.25	0.00	-1.04	-1.875	-1.375	-1.375	16.75
tandard Deviation f the mean	0.042	NA	0.104	NA	0.211	0.104	1.059	0.679	1.632	0.803	17.112
alculated t	1.00	NA	2.01	NA	1.19	0.00	0.98	2.76	0.84	1.71	0.98
bserved Significance evel	(0.3,0.4)	NA	(0.05,0.1)	NA	(0.2,0.3)	over 0.5	(0.3,0.4)	(0.01,0.02)	(0.4,0.5)	(0.1,0.2)	(0.3,0.4)

TABLE XII
Modified Industry Occupation Matrix vs. Actual
SIC = 49 Sample Size: n = 24

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commanche	Oklahoma
ean Deviation	NA	0.167	-0.25	0.17	-0.125	-0.21	-0.25	-0.08	0.58	-1.125	-20.75
tandard Deviation f the mean	NA	0.389	0.193	0.143	0.203	0.832	0.202	0.434	0.380	0.559	7.633
alculated t	NA	0.43	1.30	1.16	0.62	0.25	1.24	0.19	1.53	2.01	2.72
bserved Significance evel	NA	over 0.5	(0.2,0.3)	(0.2,0.3)	over 0.5	over 0.5	(0.2,0.3)	over 0.5	(0.1,0.2)	(0.05,0.1)	(0.01,0.02)

TABLE XIII
Modified Industry Occupation Matrix vs. Actual
SIC = 52   Sample Size: n = 24

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commanche	Oklahoma
Mean Deviation	0.04	-0.46	NA	0.21	-0.04	-0.29	-0.92	-0.50	-0.792	0.54	-8.375
Standard Deviation of the mean	0.141	0.478	NA	0.180	0.175	0.338	0.340	0.371	0.568	0.500	4.806
Calculated t	0.30	0.96	NA	1.16	0.24	0.86	2.70	1.35	1.39	1.08	1.74
Observed Significance Level	over 0.5	(0.3,0.4)	NA	(0.2,0.3)	over 0.5	(0.3,0.4)	(0.01,0.02)	(0.1,0.2)	(0.1,0.2)	(0.2,0.3)	(0.05,0.1)

TABLE XIV
Modified Industry Occupation Matrix vs. Actual
SIC = 61   Sample Size: n = 23

County Size	I			II			III		IV		VI
County	Dewey	Beaver	Pushmataha	Atoka	Logan	Caddo	LeFlore	Payne	Cleveland	Commanche	Oklahoma
Mean Deviation	NA	NA	NA	-0.04	-0.13	-0.04	0.30	-0.04	0.39	-0.09	-3.74
Standard Deviation of the mean	NA	NA	NA	0.043	0.114	0.172	0.25	0.239	0.371	0.495	11.184
Calculated t	NA	NA	NA	1.02	1.14	0.25	1.19	0.18	1.06	0.176	0.33
Observed Significance Level	NA	NA	NA	(0.3,0.4)	(0.2,0.3)	over 0.5	(0.2,0.3)	over 0.5	(0.3,0.4)	over 0.5	over 0.5

The results of Tables V through IX are summarized in Table XV and the results of Tables X through XIV are summarized in Table XVI. Tables XV and XVI are frequency tables indicating, by county size, the number of times the projection method under consideration gave results which could not be declared biased when measured relative to their respective standard deviations via a paired t-test. A projection method for a county was declared to be significantly biased if the observed significance level was less than one-tenth (0.1).

TABLE XV

FREQUENCY TABLE FOR MODIFIED AREA SKILL SURVEY

County Size	I	II	III	IV	VI
Number of times no significant bias declared	8	13	7	7	3
Number of experiments	8	13	9	9	5

TABLE XVI

FREQUENCY TABLE FOR MODIFIED INDUSTRY/OCCUPATION MATRIX

County Size	I	II	III	IV	VI
Number of times no significant bias declared	7	13	7	7	3
Number of experiments	8	13	9	9	5

From the results of Tables XV and XVI, it is obvious that no differences can be detected between the two demand projection techniques when they are compared with respect to observed bias measured relative to their respective standard deviations. It is interesting to note, however, that as the county size increases each projection method has a greater tendency toward biased projections.

CHAPTER V

PROCEDURES FOR COMPARING THE OBSERVED PRECISION OF THE TWO DEMAND PROJECTION TECHNIQUES

In Chapter IV an evaluation of the two projection methods was based on the biases of the projections by comparing the occupational estimates with actual employment figures. It should be observed, however, that the declaration of a particular technique as biased for a given county size is a function of the variability of the biases. Thus, it is possible that a technique declared unbiased for a given SIC in a given county is not really a desirable projection method because of a large amount of variability in the mean bias of its estimates. Therefore, it is also important that the evaluation include a consideration of the precision associated with the bias estimates. Thus, the square roots of the mean square errors (variance plus squared bias)* of estimates from the MASS and MIOM were calculated for each projection method and tabulated for comparison in Table XVII.

*Refer to Appendix I to see how mean square errors were computed for the MASS and refer to Appendices II, III, and IV to see how they were computed for the MIOM.

TABLE XVII

TABULATION OF OBSERVED MEAN SQUARE ERRORS

County Size	I		II		III		IV		VI	
Projection Method	MASS	MIOM	MASS	MIOM	MASS	MIOM	MASS	MIOM	MASS	MIOM
	0.36	0.39	0.06	0.05	0.28	0.26	0.37	0.38	10.91	11.21
	0.27	0.27	0.15	0.15	0.21	0.21	0.37	0.40	8.85	8.77
	0.49	0.49	0.19	0.19	1.00	1.08	1.70	1.66	16.30	17.47
	0.04	0.04	0.19	0.17	0.39	0.39	0.19	0.19	11.18	11.31
	0.32	0.41	0.87	0.83	0.26	0.24	0.59	0.60	4.93	5.11
	0.14	0.14	0.12	0.10	0.44	0.43	0.50	0.50		
	0.20	0.20	0.14	0.12	0.73	0.78	0.61	0.61		
	0.14	0.11	0.31	0.34	0.51	0.58	0.83	0.85		
			0.12	0.12	0.37	0.39	0.50	0.51		
			0.20	0.20						
			0.22	0.22						
			0.15	0.15						
			0.23	0.18						

Procedures for the comparison of variances from several samples are based on the assumption of independent samples, which is not a valid assumption in this case since the bias estimates for each projection technique are functions of the actual employment. A non-parametric comparison procedure also seems unwarranted due to the fact that variances (and hence precision estimates) differing by small amounts relative to their actual sizes cannot be validly differentiated on an ordinal scale. For the above reasons the precision comparisons were made subjectively by considering the relative sizes of the estimates within each SIC.

For county size I a comparison within pairs of the square roots of the mean square errors indicates that neither projection method is better than the other. Similar results are obtained for county sizes II, III, IV, and VI indicating that the two techniques do not differ noticeably with respect to the precision of their respective estimates.

Although this comparison does not provide an absolute measure of the two techniques with regard to the validity of the bias comparison in Chapter IV, it does provide justification for a comparison between the bias results for the MASS and MIOM. That is, as stated in Chapter IV, there is no evidence to suggest a difference in the two demand projection techniques based on the bias of their estimates.

CHAPTER VI

A COMPARISON OF THE RELATIVE COST OF IMPLEMENTING THE TWO DEMAND PROJECTION TECHNIQUES

A comparison of the average cost of the two projection methods was readily available since each method was used on exactly the same experimental units during the same time period. The costs involved in the MASS consisted mainly of the personnel costs (e.g., for the salaries of personnel involved in the collection, analysis and reporting of data) and the non-personnel costs (e.g., for travel, lodging, materials, etc.). Similarly the costs involved in the MIOM consisted of the personnel and non-personnel costs involved in obtaining the staffing pattern and regression estimates. In both cases the cost by SIC by county was estimated by weighting according to the number of elements (firms or occupations as the case requires) in the SIC and county. (Refer to Tables XVIII and XIX for the estimates at the SIC by county level.)

The obvious cost advantage of the MIOM should be interpreted with care. The costs of this method pre-supposes an existing data base from which to develop staffing pattern ratios which is not strictly the case within the scope of this research project. Hence, the data base was developed from the MASS. The total cost, therefore, of the MIOM should more properly include the cost of developing the data base (i.e., the cost of the MASS).

If, on the other hand, as the results of the survey indicate, short run projections from a staffing pattern model are not significantly different from employer forecasts, then this should hold true for projections from any staffing pattern data base. Thus, the current availability of census based Industry/Occupation matrices for all states, SMSA's and selected areas, would indicate that an MIOM approach using these matrices would be the most preferred method, since their developmental costs have already been met. This would be particularly true until there has been developed an alternative staffing pattern data base from some other source such as the Department of Labor's Occupational Employment Statistics (OES) Program.

TABLE XVIII
ESTIMATED COST BY COUNTY
BY SIC FOR THE MODIFIED INDUSTRY/OCCUPATION MATRIX

SIC / County	13	20	49	52	61	Total
Dewey	$14.57	$ 1.71	NA	$ 7.71	NA	$ 23.99
Beaver	$ 9.43	NA	$ 6.86	$ 8.57	NA	$ 24.86
Pushmataha	NA	$ 1.71	$ 1.71	$ 3.43	NA	$ 6.85
Atoka	NA	NA	$ 3.43	$ 8.57	$ 5.14	$ 17.14
Logan	$12.00	$ 1.71	$ 5.14	$ 8.57	$ 6.86	$ 34.28
Caddo	$18.85	$ 5.14	$ 8.57	$29.99	$ 6.86	$ 69.41
LeFlore	$ 3.43	$ 9.43	$10.28	$12.85	$ 8.57	$ 44.56
Payne	$39.42	$17.14	$10.28	$31.70	$19.71	$118.25
Cleveland	$26.56	$13.71	$ 5.14	$39.42	$24.85	$109.68
Comanche	$ 1.71	$20.57	$ 5.14	$40.27	$35.13	$102.82
Oklahoma	$54.83	$20.57	$29.14	$58.27	$39.41	$202.22

TABLE XIX
ESTIMATED COST BY COUNTY
BY SIC FOR THE MODIFIED
AREA SKILL SURVEY

County \ SIC	13	20	49	52	61	[illegible]
Dewey	$ 564.98	$ 66.47	NA	$ 299.10	NA	$ [illegible]
Beaver	$ 365.57	NA	$ 265.87	$ 332.34	NA	$ [illegible]
Pushmataha	NA	$ 66.47	$ 66.47	$ 132.93	NA	$ [illegible]
Atoka	NA	NA	$ 132.93	$ 332.34	$ 199.40	$ [illegible]
Logan	$ 465.27	$ 66.47	$ 199.40	$ 332.34	$ 265.87	$1, [illegible]
Caddo	$ 731.15	$199.40	$ 332.34	$1,163.19	$ 265.87	$2, [illegible]
LeFlore	$ 132.93	$365.57	$ 398.81	$ 498.52	$ 332.34	$1, [illegible]
Payne	$1,528.77	$664.68	$ 398.81	$1,229.66	$ 764.38	$4, [illegible]
Cleveland	$1,030.25	$531.74	$ 199.40	$1,528.77	$ 963.79	$4, [illegible]
Comanche	$ 66.47	$797.62	$ 199.40	$1,562.00	$1,362.59	$3, [illegible]
Oklahoma	$2,126.99	$797.62	$1,129.97	$2,259.91	$1,528.78	$7, [illegible]

The results of Tables XVIII and XIX are summarized in Table XX which lists the average cost for each technique by SIC by county size. The results of Table XX suggest overwhelmingly that the MIOM is more economical than the MASS when a comparison is based only on the cost of implementing a projection method.

TABLE XX
AVERAGE COST BY
COUNTY BY SIC

County Size / Method / SIC	I		II		III		IV		VI	
	MASS	MIOM	MASS	MIOM	MASS	MIOM	MASS	MIOM	MASS	MIOM
13	$ 465.28	$ 12.00	$ 598.21	$ 15.43	$ 830.85	$ 21.43	$ 548.36	$ 14.14	$2126.99	$54.83
20	$ 66.47	$ 1.71	$ 132.94	$ 3.43	$ 515.13	$ 13.29	$ 664.68	$ 17.14	$ 797.62	$20.57
49	$ 166.17	$ 4.29	$ 221.56	$ 5.71	$ 398.81	$ 10.28	$ 199.40	$ 5.14	$1129.97	$29.14
52	$ 254.79	$ 6.57	$ 609.29	$ 15.71	$ 864.09	$ 22.28	$1545.39	$ 39.85	$2259.91	$58.27
61	NA	NA	$ 243.71	$ 6.29	$ 548.36	$ 14.14	$1163.19	$ 29.99	$1528.78	$39.41

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

The conclusions reached in this report are based on the following assumptions, the validity of which cannot be determined from the available data.

(1) The counties selected are representative of the county sizes in which they are classified.

(2) The results of a comparison in Oklahoma are representative of other states similar in population and industry distribution.

(3) A change in economic conditions has similar effects on projections from both techniques.

(4) The SIC selected are representative of all industry classifications.

Conclusions

(1) Based on the data obtained, the statistical tests performed and the subjective comparison made in Chapters IV, V, and VI, when making short-range (one-year) projections of employment, there seems to be sufficient evidence to indicate that regardless of county size the MASS and MIOM are equivalent with regard to the accuracy of their projections.

(2) The study revealed that the cost of the MIOM is significantly lower than the MASS.

Recommendations

(1) Because of the drastic difference in the cost of implementing the two demand projection techniques, a method similar to the Modified Industry/Occupation Matrix (MIOM) is recommended as the better method to the two tested.

(2) It is recommended that a state utilize the MIOM with staffing pattern dates that have precise geographic detail.

APPENDIX I

THE MODIFIED AREA SKILL SURVEY

SURVEY PHILOSOPHY

Occupational demand totals obtained from the Area Skill Survey are "based on individual employers' forecasts of their projected needs in selected occupations, taking into account expansion, or contraction, of employment in their establishments." (1)

The Sample Frame

The sampling frame for the survey is based on tabulations of tax units reported in the Unemployment Insurance Program. A separate frame is made for each two-digit Standard Industrial Classification (SIC) code in each county. The establishments in each two-digit SIC code in each geographical region are listed in descending order by employment size (Table XXI). For this array a cumulative employment total is calculated. From the grand cumulative total the midpoint of the total employment is obtained.

All establishments which comprise the upper fifty percent of employment are classified in group I. Then the midpoint of employment in the lower fifty percent of employment is determined as the point between the third and fourth quartile. All firms which comprise the third quartile are classified in group II and those in the fourth quartile are classified in group III. All of the establishments in group I are included in the survey. Of the remaining firms in the industry, approximately twenty percent and five percent samples are selected from group II and III, respectively. (See Table XXII.)

TABLE XXI

EXAMPLE OF SAMPLE FRAME

Size of Firm	No. of Firms	No. of Employees
0-3	141	250
4-9	56	338
10-19	36	508
20-49	37	1,196
50-99	18	1,286
100-249	8	1,300
250-499	1	292
500 & over	1	1,400
	298	6,570

TABLE XXII

GROUPING OF FIRMS BY FIRM SIZE

Group	Size of Firm	No. of Firms	No. in Sample
I	83 or more	13	13
II	32-82	34	6
III	0-32	251	13

Survey Procedures and Survey Instructions

Once the scope of the survey is determined a letter is sent to all employers covered by the survey. The letter includes the purpose of the survey, instructions to the employer on how to complete the questionnaire and job descriptions.

The establishments surveyed within each SIC are asked to supply information on: (1) current total employment by occupation excluding trainees, (2) expected employment by occupation for one year hence, (3) expected employment for three years hence, and (4) expected employment for five years hence. Definition of pertinent occupations and detailed instructions are provided with each questionnaire in an attempt to remove ambiguities so that respondents will complete the questionnaires as accurately as possible.

Nonresponse Follow-Up Procedures

All surveyed establishments which have not responded within two weeks of the requested date are contacted by mail, consisting of a follow-up letter reminding the employer of the importance of the skill survey and emphasizing the need for cooperation if valid results are to be obtained. The follow-up letter is accompanied by a duplicate copy of the questionnaire in the event the original was misplaced. If there is no response within two weeks after the first follow-up, a personal visit is made to all nonresponding establishments in group I and a telephone contact made to all nonrespondents in groups II and III. Those establishments which have not responded within five weeks after the requested date are considered "nonrespondents" in tabulating and analyzing the data.

Estimation Procedures

The modified Area Skill Survey estimates are combined ratio estimates based on the notation described below:

LIST OF SYMBOLS

X_{ij} — Benchmark Employment for SIC j, county i.

N_{ijk} — Total number of establishments in size class k (as indicated by the sampling frame), SIC j, county i.

n_{ijk} — Number of establishments sampled from size class k, SIC j, county i.

x_{ijkl} — Total employment reported by establishment l in size class k, SIC j, county i.

y_{hijkl} — Employment in occupation h, reported by establishment l in size class k, SIC j, county i.

$\hat{Y}_{hijk}$ — Estimated employment in occupation h, SIC j, county i.

Estimates at the SIC Level

The combined ratio estimate of the employment in occupation h, SIC j, county i is given by:

$$\hat{Y}_{hij} = X_{ij} \left[\frac{\sum_{k=1}^{3} \left[N_{ijk} \; \bar{y}_{hijk.} \right]}{\sum_{k=1}^{3} \left[N_{ijk} \; \bar{x}_{ijk.} \right]} \right] = X_{ij} \hat{R}_{hij}$$

where

$$\bar{y}_{hijk.} = \frac{1}{N_{ijk}} \sum_{l=1}^{n_{ijk}} y_{hijkl}$$

$$\bar{x}_{ijk.} = \frac{1}{N_{ijk}} \sum_{l=1}^{n_{ijk}} x_{ijkl}$$

An estimate of the precision (mean square error) of $\widehat{Y}_{ij}$ was obtained from the data by:

$$\widehat{MSE(\hat{Y}_{ij})} \doteq \frac{\sum_{h=1}^{n} (\hat{Y}_{hij} - Y_{hij})^2}{n-1}$$

where Y_{hij} = the actual 1975 employment in occupation h, SIC j, county i.

APPENDIX II

THE MODIFIED INDUSTRY/OCCUPATION MATRIX

Matrix Philosophy

Dempsey (4) states that the "preparation of occupational projections through a matrix approach, requires two basic inputs, namely a set of industry/occupation staffing patterns for a target year, and a corresponding set of industry employment projections." The matrix approach considered in this study uses staffing patterns obtained via an Area Skill Survey* and industry employment projections are based primarily on a simple linear regression of industry employment against time.

Using the same symbols listed in Appendix I the ratio estimate (or staffing ratio) of the employment in occupation h, industry j, in county i is given by:

$$\hat{R}_{hij} = \frac{\sum_{k=1}^{3}\left[N_{ijk}\ \bar{y}_{hijk}\right]}{\sum_{k=1}^{3}\left[N_{ijk}\ \bar{x}_{ijk}\right]}$$

*The use of an Area Skill Survey to obtain the desired staffing patterns was decided upon as the only means of achieving a valid comparison of the basic methodology of the two techniques since the occupational definitions of the OES survey used by BLS are in most cases different from those of the Area Skill Survey. Furthermore, there are no definitions available for the occupations which currently comprise the BLS Industry/Occupations Matrix. For a complete description of the OES surveys refer to the OES Survey Operation Manual Chapter 1 (11).

APPENDIX III

REGRESSION ESTIMATES*

Philosophy

A least squares procedure is used to determine the historical relationship that has existed between local employment and one or more explanatory variables: national employment, time, or state employment. This relationship is described as a simple algebraic equation called a "regression equation." Using simple linear regression, with time as the independent variable, the assumption is made that employment is a linear function of time and that the historical linear relationship observed in the past will continue in the future.

ESTIMATION PROCEDURES

When one explanatory variable is used the regression equation is of the form:

$Z = A + BX + e$

where Z represents the dependent variable or in this case local employment.

X represents an independent variable or in this case time.

A and B are constants to be estimated by least squares.

e is an error term, or residual.

The estimated local employment results from least squares and is given by:

$$\hat{Z} = a + bX$$

where $\hat{Z}$ is the calculated estimate of Z

and where a + b are the calculated estimates of A + B, respectively.

*The explanation given in this chapter is taken from "The Use of Regression Analysis for Projecting State and Area Wage and Salary Industry Employment for the Interim Occupational Manpower Projection Project."

The least squares procedure provides values of a and b resulting in a straight line which minimizes the squared distances between Z (the observed values of local employment) and $\hat{Z}$ (the calculated values of local employment). The general form for an equation containing more than one independent variable is:

$$Z = A + B_1 X_1 + B_2 X_2 + \ldots + B_n X_n + e$$

where Z is the dependent variable;

X_1 is the ith independent variable

A, B_1, B_2, . . ., B_n are constants to be estimated

e is an error term.

The regression equations considered for this type of project are of the following forms:

$$Z = A_1 + B_1 (X_1) \quad (1)$$

$$Z = A_2 + B_2 (X_2) \quad (2)$$

$$Z = A_3 + B_{31} (X_1) + B_{32} (X_2) \quad (3)$$

where Z is state or local employment by SIC

X_1 is time

X_2 is national employment

The equation chosen depends upon a statistical test of the relationship between the three variables Z, X_1 and X_2 by considering simple correlations, standard errors of regression coefficients and employment estimates, multiple R-SQRD, F-Ratio, serial correlation and standard errors of the forecasts.

For this particular study only equation (1) was used because information on national employment was not available at the time the projections were made. Data on total employment for 1966 through 1973 was gathered for each county at the two-digit SIC level and this information used to obtain the desired regression estimates. Thus, for each of the five two-digit SIC in each of the eleven counties the following was computed:

$$\hat{Z}_{ij} = \text{Regression estimate of total employment in SIC j, county i.}$$

APPENDIX IV

INTEGRATION OF REGRESSION ESTIMATES WITH MODIFIED INDUSTRY/OCCUPATION RATIO ESTIMATES

Philosophy

The assumption is made that occupational staffing patterns within a detailed two-digit SIC level do not change drastically over short time periods and that total occupational employment for these SIC can be described using simple linear or multiple linear regression.

ESTIMATION PROCEDURES

The occupational estimates for each two-digit SIC for each county are obtained by multiplying each occupational ratio by the regression estimate of total employment for the appropriate two-digit SIC and county.

LIST OF SYMBOLS

$\hat{Y}_{hij}$ Estimated employment in occupation h, county i, SIC j.

$\hat{Z}_{ij}$ Regression estimate of total employment in county i, SIC j.

$\hat{R}_{hij}$ Ratio estimate of employment in occupation h, county i, SIC j.

Estimates at the Industry Level

An estimate of the employment in occupation h, county i, industry j is given by:

$$\hat{Y}_{hij} = \hat{R}_{hij} Z_{ij}$$

An estimate of the precision of Y_{hij} was obtained from the data by:

$$\widehat{MSE\ (Y_{ij})} \doteq \frac{\sum_{h=1}^{n}(\hat{Y}_{hij} - Y_{hij})^2}{n-1}$$

Bibliography

(1) "An Experiment with Occupational Needs Projection Techniques." Milwaukee, Wisconsin: Project Vision, Wisconsin State Employment Service, A Division of the Department of Industry, Labor and Human Relations, p. 33.

(2) Cochran, William G. Sampling Techniques. 2nd edition. New York: John Wiley and Sons, Inc., 1963.

(3) Cycle Seven Report - Occupational Training Information System. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education, p. iii.

(4) Dempsey, Richard. "State and Local Labor Market Manpower Projections Program--An Evaluation of the Past and a Look Ahead.: Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics, 1974.

(5) Evaluation of the Occupational Training Information System (OTIS). Silver Spring, Maryland: Macro System, Inc., U.S. Department of Commerce, 1974.

(6) Evans, Rupert N., et al. Education for Employment: The Background and Potential of the 1968 Vocational Education Amendments. Policy Papers in Human Resources and Industrial Relations. No. 14. Ann Arbor, Michigan: Institute of Labor and Industrial Relations, The University of Michigan-Wayne State University, and Washington, D.C.: National Manpower Policy Task Force. 1969. 128 pp.

(7) Handbook on Employment Security Job Market Research Methods - Area Skill Survey. Washington, D.C.: Bureau of Employment Security, Bulletin E-252 November, 1965.

(8) Kempthorne and Folks. Probability, Statistics and Data Analysis.

(9) Kidder, David E., "Manpower Forecasting for Vocational-Technical Education." Information Series No. 54 VT -14-492 ERIC Clearinghouse on Vocational and Technical Education. The Center for Vocational and Technical Education. The Ohio State University, Columbus, Ohio (1972), pp. 51, 54.

(10) Kish, Leslie. Survey Sampling. New York: John Wiley and Sons, 1965.

(11) OES Survey Operation Manual. 2nd edition. Washington D.C.: U.S. Department of Labor, BLS, December, 1974.

(12) Ray, Der. Sampling Theory. New York: McGraw-Hill, 1968.

(13) Rumpf, Edwin L. "The Planning Job Ahead." American Vocational Journal, Vol. 44 (April, 1969), pp. 24-26.

(14) Ruskin, Arnold M. "The Use of Forecasting in Curricular Planning." Educational Record, Vol. 52 (Winter, 1971), pp. 60-64.

(15) Sommers, Gerald G. "The Response of Vocational Education To Labor Market Changes." Vocational Education. Report of a conference sponsored by the Brookings Institution. Published as a supplement to the Journal of Human Resources, Vol. 3 (1968), pp. 32-58.

(16) Standard Industrial Classification Manual. Washington, D.C.: Statistical Policy Division, Office of Management and Budget, 1972.

(17) Warfield, Benjamin B. "The 90th Congress and Vocational Education." The Bulletin of the National Association of Secondary School Principals, Vol. 53, no. 334 (February, 1969), pp. 59-66.