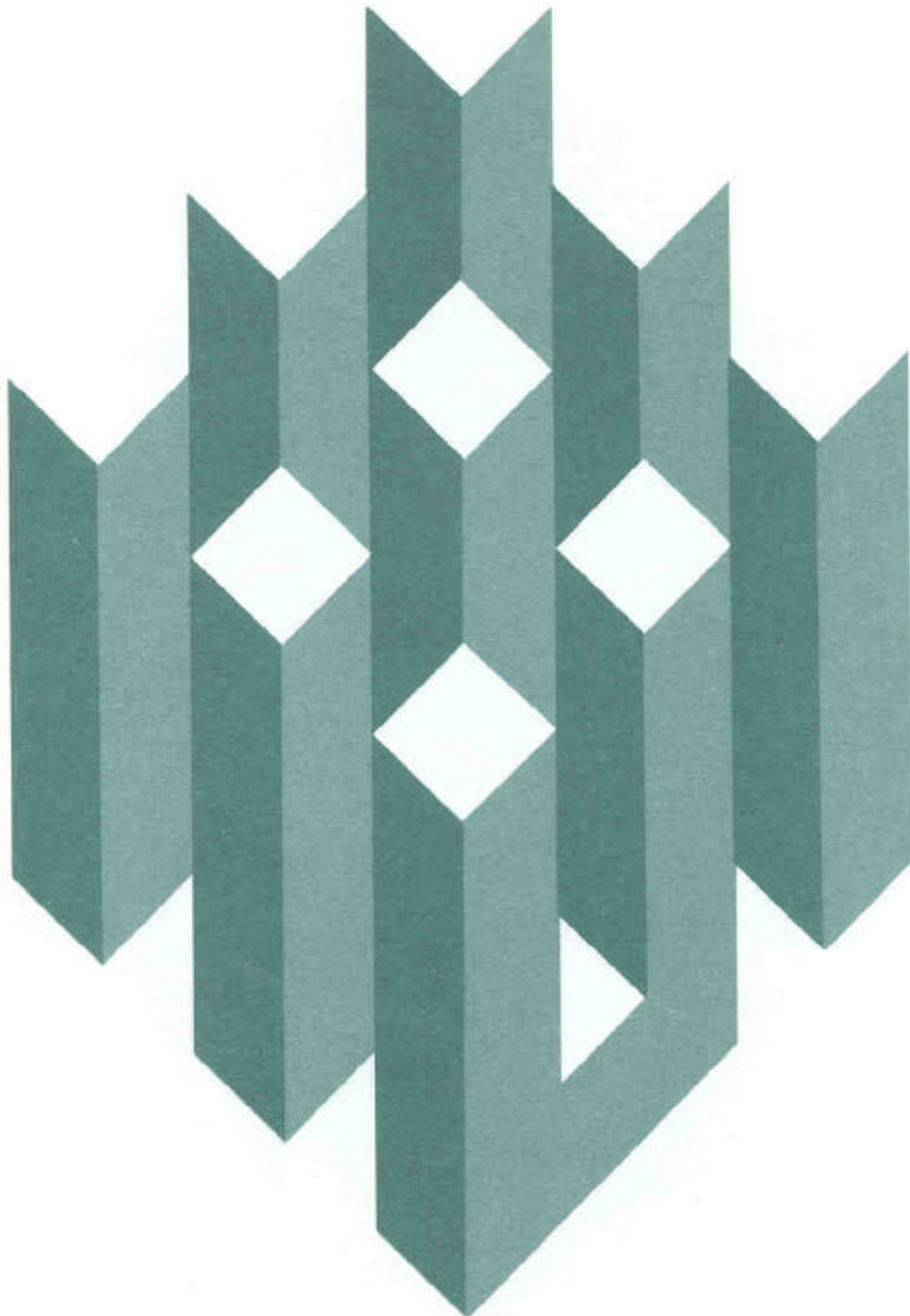


The Impact of Unemployment Insurance Benefits on Local Economies — Tucson



Unemployment Insurance
Occasional Paper 79-2

U.S. Department of Labor
Employment and Training Administration



The Impact of Unemployment Insurance Benefits on Local Economies — Tucson



U.S. Department of Labor
Ray Marshall, Secretary

Employment and Training Administration
Ernest G. Green, Assistant Secretary for
Employment and Training

Unemployment Insurance Service
1979

This report was prepared under a contract with the Employment and Training Administration, U.S. Department of Labor. Researchers undertaking such projects under Government sponsorship are encouraged to express their own judgments. Interpretations or viewpoints stated in this document do not necessarily represent the official position or policy of the Department of Labor. The University of Arizona produced the report. The principal investigators are Arthur T. Denzau, Ronald L. Oaxaca (Project Director), Department of Economics, University of Arizona; Carol A. Taylor, Division of Economic and Business Research, University of Arizona.

The investigators wish to acknowledge the helpful cooperation extended to them by Al Leister of the Research and Report Section, Unemployment Insurance Bureau of the Arizona Department of Economic Security.

The UIOP Series presents research findings and analyses dealing with unemployment insurance issues. Papers are prepared by research contractors, staff members of the unemployment insurance system, or individual researchers. Manuscripts and comments from interested individuals are welcomed. All correspondence should be sent to UI Occasional Paper Series, Unemployment Insurance Service, Patrick Henry Building, Room 7326, 601 D Street, N W., Washington, D.C. 20013.



<u>TEXT</u>	PAGE
I. INTRODUCTION	1
II. PRIVATE WAGE AND SALARY EMPLOYMENT AND SALES	5
III. UI IMPACTS ON SELECTED ECONOMIC VARIABLES	15
IV. INTERINDUSTRY COMPARISONS OF UI CONTRIBUTIONS AND INDUCED EMPLOYMENT AND SALES	24
V. SUMMARY AND CONCLUSION	29
 <u>APPENDIX</u>	 34
I. INTRODUCTION	35
II. ESTIMATION OF THE EFFECT OF UI PAYMENTS ON ANNUAL SALES BY INDUSTRY	36
A. <u>The Sales/Employment Ratio Method</u>	36
B. <u>The Shortrun Labor Cost Method</u>	39
C. <u>The Geometric Mean Method</u>	40
III. ESTIMATION OF THE AVERAGE, MARGINAL, AND LAGGED EFFECTS OF UI PAYMENTS	41
IV. ESTIMATION OF UI ELASTICITIES	47
V. ESTIMATION OF LABOR COST PER WORKER	49
VI. ESTIMATION OF SALES AND SALES/EMPLOYMENT RATIOS	50
<u>Construction</u>	52
<u>Manufacturing</u>	54
<u>Trade</u>	55
<u>Service</u>	56
<u>Transportation, Communication and Utilities and Finance, Insurance, and Real Estate</u>	56

<u>APPENDIX</u>	PAGE
VII. ESTIMATION OF UI EFFECTS ON SALES TAX REVENUES	57
<u>Construction</u>	57
<u>Retail Sales</u>	58
VIII. UI PAYMENTS AND LABOR FORCE PARTICIPATION	58
IX. CALCULATION OF THE EFFECTS OF UI PAYMENTS ON THE SIZE OF THE LABOR FORCE AND UNEMPLOYMENT	72
Selected References	75

TEXT

1	The Effects of UI Benefits on Nonagricultural, Nonmining, Private Wage and Salary Employment and Sales in Pima County	7&8
2	Absolute and Percentage Changes in Employment and Sales per Unit of UI Benefits for the Nonagricultural, Nonmining, Private Wage and Salary Sector of Pima County	10&11
3	Cumulative Effects of 1975 UI Benefits on Employment and Sales in the Private Nonagricultural, Nonmining, Sector of Pima county (in 1975 Dollars)	13
4	Two Year Summary of the Effects of UI Benefits on Employment and Sales in Nonagricultural, Nonmining, Private Wage and Salary Sector of Pima County (in 1975 Dollars)	14
5	Effects of UI Benefit Payments on Selected Variables in Pima County	16
6	Cumulative Effects of 1975 UI Benefits on Selected Variables in Pima County	20
7	UI Induced State and City Sales Tax Revenues in Pima County Construction and Retail Trade	22&23
8	Industry Percentage Shares of UI Tax Contributions and UI Induced Employment and Sales in Pima County	25
9	Average Monthly Insured Unemployed in Nonagricultural Industries in Pima County	27
10	Average Monthly Insured Unemployed and UI Benefits Paid Out by Industry in Arizona	28

APPENDIX

A.1	Estimated Labor Cost per Worker in the Nonagricultural, Nonmining Sector of Pima County (\$1,000)	51
A.2	Estimated Sales and Sales/Employment Ratios for the Nonagricultural, Nonmining Sector of Pima County	53
A.3	UI Data Collected for the Tucson SMSA	62
A.4	Pima UI Denial Rate	64
A.5	UI Payments in Pima/UI Payments in Arizona under State Program	66
A.6	Labor Force Participation in Pima County	71

I. INTRODUCTION

The severity of the last recession generated a great deal of renewed interest in the operations of the unemployment insurance (UI) system in the U.S. In particular the alarming rise in UI benefit disbursements occasioned by the recession led to calls for close scrutiny of the UI system and its justification as a social program. Criticisms of the UI system are that it raises the unemployment rate and the duration of individual spells of unemployment by subsidizing nonmarket activities of individuals, and that it subsidizes seasonal and other unstable employment. Furthermore, it has been argued that the limited taxable wage base and modest upper limits on the payroll tax rates under the experience rating system do not constitute much of a deterrent to employers contemplating layoffs.

Arguments in favor of the UI system refer to its impact on resource allocation and as a countercyclical stabilizer in the economy. It has been argued that UI benefits serve as a financial cushion for temporarily unemployed workers, thus enabling them to make a more careful job search. These workers are able to hold out longer for a job more commensurate with their skills. The foregone output resulting from the refusal of lower paying jobs is eventually recouped through the increased future output which results from better matching of unemployed workers with jobs. Naturally, the provision of UI benefits unambiguously raises the welfare of the individual who is receiving them. However, the argument in favor of UI benefits rests on the social benefits that accrue rather than the private benefits. In other words, the present value of the increased future production made possible by subsidized job search exceeds the present value of the costs represented by

foregone output stemming from the additional period of search in lieu of current employment. This argument rests on the assumption that the level of benefits provided is optimal and that imperfections in the capital market limit the ability of most individuals to finance their job search through borrowing. Finally, UI benefit payments constitute countercyclical transfer payments that serve as automatic stabilizers in the economy. During periods of rising unemployment, purchasing power is pumped back into the economy in the form of UI benefit payments to the insured unemployed. Given that the propensity to spend out of such income is high, UI benefits are a stimulus to the economy as they cushion the downturn in sales and employment.

It is the role of UI benefit payments as a stabilizer in a local economy that forms the basis of this study. To the best of our knowledge, there are no previous studies of the detailed effects of UI benefits on a local economy. In this report we present our estimates of the effects of the UI system in Arizona on the local economy of the Tucson, Arizona SMSA (Pima County). Among the estimated effects of UI benefits are those on local sales, employment, unemployment, labor force, unemployment rate, sales tax revenues, population, and disposable personal income.

These estimated effects of UI benefits on selected measures of local economic activity were obtained from computer simulations of the Pima County quarterly forecasting model. The basic quarterly model of Tucson's economy was developed by the principal investigators under DOL contract 20-04-76-55, OPER/ETA. Under the terms of the OPER contract (which includes the modeling of five other areas in addition to Tucson), construction of the model for Tucson and forecasting local economic activity was an end itself. On the other hand, for purposes of the present UIS contract, construction

of the model was a means to an end. Consequently, additional data pertaining to the operation of the UI system in Arizona and in Tucson were collected, and the Tucson model was modified where appropriate in order to isolate the UI impacts on the local economy.

The period for the simulations was the eight quarters spanning 1975-76. During this period the population of Pima County averaged around 450,000, and disposable personal income was a little over two billion dollars per year. A baseline run was made for the eight quarter period in which UI payments in Pima County under the regular state program were set equal to their historical values. The model's predictions of selected measures of local economic activity under the baseline run were compared with its predictions from a run in which UI payments in Pima County under the regular state program were set equal to zero. The differences in the model's predictions between the baseline run and the run with regular state UI benefit payments set equal to zero constitute our estimates of the effects of the UI system on the local economy.

Our simulations were run on the basis of certain assumptions that need to be made explicit and kept in mind when interpreting the results below. Firstly, we are simulating the local effects of UI payments to Pima County under the regular state UI system only. The effects on Tucson's economy of an absence of payments in Pima County under Federal UI programs are not simulated. Secondly, the UI system is assumed to continue operating in the rest of Arizona and the U.S. Thirdly, it is assumed that regular state UI contributions in Pima County continued to be collected during the absence of UI disbursements. A discussion of each of these assumptions is provided in the summary and conclusion section of this report.

There were three methods used to obtain estimates of the impact of UI benefits on local sales: (1) the sales/employment ratio method, (2) the short run labor cost method, and (3) the geometric mean of the estimated sales obtained from methods (1) and (2). Under method (1), estimated sales changes in each industry are obtained by multiplying the industry sales/employment ratio by the estimated change in the industry's employment. Consequently, the estimated percentage change in sales is equal to the estimated percentage change in employment. The assumed constancy of the sales/employment ratio implies that all inputs are being varied by the same proportion as employment in response to changes in industry sales. In the short run this assumption is difficult to maintain and can lead to relatively large estimates of the effects of UI benefits on sales.

Method (2) assumes that only wage and salary employment is varied in response to changes in sales. That is to say, employment is adjusted so that labor costs rise or fall by the same amount as the change in sales. The result is that the percentage change in sales is some proportion of the percentage change in employment. The factor of proportionality is the ratio of total labor cost to total sales. Consequently, method (2) will yield relatively small estimates of the effect of UI benefits on sales. The actual situation lies somewhere between these two sets of estimates, probably closer to method (2) than to method (1).

Finally, method (3) estimates the change in sales in each industry as the square root of the product of the sales changes estimated under methods (1) and (2). The geometric mean method assigns more weight to the smaller (method (2) estimate and therefore produces estimated sales changes that are somewhat smaller than the simple average of the two estimates. All three estimates are presented in the report but only the method (3) estimates are discussed in the text.

In order to economize in our presentation of the study's findings, the quarterly effects of UI benefits on local economic activity have been expressed in annual terms. Some of the highlights from the study are presented now. Over the two year period, 1975-76, the absence of UI benefit payments in Pima County (in 1975 dollars) would reduce sales by \$48 million, reduce disposable personal income by \$65 million, reduce the population by about 3,200, reduce employment also by about 3,200, reduce the size of the labor force by about 1,200, and raise the number of unemployed by about 2,000. On average over the period, each dollar of UI benefits generated \$1.85 in sales and \$2.50 in disposable personal income.

The findings of our study are reported in more detail below. Part II presents the effects of UI benefits on sales and employment, Part III presents UI impacts of selected economic and demographic variables, Part IV compares each industry in terms of its contributions to and gains from the regular state UI system, and Part V is a summary and conclusion. Following the main body of the report is a technical summary and documentation of the computations underlying the reported results.

II. PRIVATE WAGE AND SALARY EMPLOYMENT AND SALES

Since we are simulating the effects of the absence of UI benefits two years in a row, there are lagged effects that can be estimated from the simulations. Predicted changes in employment and sales in 1975 are treated as marginal effects of the withholding of UI benefits in 1975.¹ In 1976 the predicted changes in employment and sales were the result of both withholding UI benefits in 1976 and the lagged effects of withholding UI benefits in 1975. The marginal employment changes in 1976 are estimated by multiplying the 1975 rate of change in employment with respect

to 1975 UI benefit payments by the simulated change in 1976 UI benefit payments corrected for inflation.² The marginal sales effects in 1976 are estimated as the marginal employment changes multiplied by the sales/employment ratios for 1976. Lagged employment and sales effects in 1976 were simply calculated as the simulated total changes in 1976 minus the estimated marginal changes. In other words, the lagged changes are simply calculated as a residual.

The effects of UI benefits on sales and wage and salary employment in the private, nonagricultural, nonmining (PNN) sector of Tucson are reported in Tables 1-4. Our simulations were constrained to yield no UI impacts on employment and sales in mining. Mining in Pima County is basically copper mining which competes in national and international markets. Hence, sales and employment in Pima County would be virtually unaffected by changes in local purchasing power brought about by the withholding of UI benefit payments locally.

In Table 1 we report the absolute changes in employment and sales due to the presence (or absence) of UI benefit payments in Tucson in 1975-76. The largest effects are in wholesale and retail trade followed by construction and services. In 1975 there would have been 644 fewer employed and approximately \$13 million dollars less in sales in the PNN sector had there been no UI benefits paid out in Pima County that year. By 1976 the combined effects of withholding UI benefits in 1975 and 1976 would have meant 1,724 fewer employed and nearly \$38 million less in sales in the private, nonagricultural sector. The marginal effects of 1976 UI benefit payments were less than the corresponding effects for 1975 because actual 1976 UI payments were smaller than 1975 payments--a little over

Table 1

The Effects of UI Benefits on Nonagricultural, Nonmining, Private
Wage and Salary Employment and Sales in Pima County

Industry	1975			1976				
	ΔE	$\Delta S (\$1000)$			ΔE	$\Delta S (\$1000)$		
		(1)	(2)	(3)		(1)	(2)	(3)
Construction	154	\$ 5,791.6	\$ 2,164.8	\$ 3,540.9	511	\$21,259.6	\$ 7,232.2	\$12,399.7
Manufacturing	17	914.6	224.4	453.0	73	4,160.0	1,040.7	2,080.7
Trans., Comm., & Util.	23	1,324.5	314.9	645.8	141	8,757.1	2,186.6	4,375.9
Trade	255	13,933.2	1,830.1	5,049.7	547	31,938.2	4,330.0	11,759.8
Fin., Ins., & Real Estate	7	301.0	71.0	146.2	38	1,618.2	406.6	811.1
Services	188	3,893.5	1,874.5	2,701.5	414	9,086.1	4,386.3	6,313.0
Total	644	\$26,158.4	\$ 6,479.7	\$12,537.1	1,724	\$76,819.2	\$19,582.4	\$37,740.2

Table 1
(continued)

Industry	1976							
	ΔE^m	ΔS^m (\$1000)			ΔE^l	ΔS^l (\$1000)		
		(1)	(2)	(3)		(1)	(2)	(3)
Construction	106	\$ 4,410.0	\$ 1,500.2	\$ 2,572.1	405	\$16,849.6	\$ 5,732.0	\$ 9,827.6
Manufacturing	12	683.8	171.1	342.0	61	3,476.2	869.6	1,738.7
Trans., Comm., & Util.	16	993.7	248.1	496.5	125	7,763.4	1,938.5	3,879.4
Trade	176	10,276.3	1,393.2	3,783.8	371	21,661.9	2,936.8	7,976.0
Fin., Ins., & Real Estate	5	212.9	53.5	106.7	33	1,405.3	353.1	704.4
Services	130	2,853.1	1,377.4	2,982.4	284	6,233.0	3,008.9	4,330.6
Total	445	\$19,429.8	\$ 4,743.5	\$ 9,283.5	1,279	\$57,389.4	\$14,838.9	\$28,456.7

ΔE is the Employment difference due to UI benefit payments.

ΔS is the Sales difference (\$1000) due to UI benefit payments.

m is the marginal effect of 1976 UI benefit payments.

l is the lagged effect of 1975 UI benefit payments in 1976.

(1), (2), and (3) are the three methods of estimating sales effects corresponding to the sales/employment ratio method, the short run labor cost method, and the geometric mean of the sales/employment and short run labor cost estimates, respectively.

\$11 million in 1976 versus a little over \$15 million in 1975. Thus for the nonagricultural, private sector, 1976 UI benefits accounted for 445 employed and about \$9 million dollars in sales. On the other hand the lagged effects of 1975 UI benefits were sizeable. For example, for the private nonagricultural sector, these lagged effects accounted for 1,279 of the total employment difference of 1,724 and about \$28 million of the \$38 million dollar sales difference.

Table 2 reports the estimated rates of change and proportionate changes in employment and sales with respect to UI benefit payments. We will confine our attention to estimates for the total PNN sector. The estimates for the individual industry groups are interpreted analogously. In 1975 about 42 additional jobs were created for every additional one million dollars disbursed in the form of UI benefits. For every additional dollar of UI benefits paid out, an additional \$0.81 in sales was generated. Sales and employment were quite inelastic with respect to UI benefits. Our estimates show that a 100% reduction in UI benefit payments in 1975 would have generated reductions in employment and sales by about 0.7% and 0.3%, respectively.

In 1976 about 40 additional jobs were created for each additional one million dollars disbursed in the form of UI benefits. This marginal rate of change is less than in 1975 because each dollar of 1976 UI benefits is worth less than a dollar of UI benefits in 1975. Each dollar of 1976 benefits created \$0.83 worth of sales in 1976. The lagged effects of 1975 UI benefits were large compared with the marginal effects. Thus for example, each additional million dollars of UI benefits in 1975 was responsible for an additional 83 jobs in 1976 in the PNN sector. Also, for each dollar of UI benefits in 1975, \$1.85 in sales was generated in 1976. The combined

Table 2

Absolute and Percentage Changes in Employment and Sales per Unit of
UI Benefits for the Nonagricultural, Nonmining,
Private Wage and Salary Sector of Pima County

Industry	1975							1976						
	$\frac{\Delta E}{\Delta UI}$	$\frac{\Delta S}{\Delta UI}$			$\frac{\Delta S}{S}$			$\frac{\Delta E}{\Delta UI}$	$\frac{\Delta S}{\Delta UI}$			$\frac{\Delta S}{S}$		
		(1)	(2)	(3)	$\frac{\Delta E}{E}$	(2)	(3)		(1)	(2)	(3)	$\frac{\Delta E}{E}$	(2)	(3)
Construction	10.0	0.38	0.14	0.23	1.45	0.54	0.88	19.7	0.82	0.28	0.48	4.63	1.57	2.70
Manufacturing	1.0	0.06	0.01	0.02	0.14	0.03	0.07	2.8	0.16	0.04	0.08	0.61	0.15	0.30
Trans., Comm., and Util.	1.5	0.09	0.02	0.04	0.28	0.07	0.14	5.4	0.34	0.08	0.17	1.69	0.42	0.84
Trade	16.6	0.91	0.12	0.33	0.80	0.11	0.29	21.0	1.23	0.17	0.45	1.69	0.23	0.62
Fin., Ins., and Real Estate	0.5	0.02	0.00	0.01	0.11	0.03	0.05	1.5	0.06	0.02	0.03	0.61	0.15	0.30
Services	12.2	0.25	0.12	0.18	0.69	0.33	0.48	15.9	0.35	0.17	0.24	1.51	0.73	1.05
Total	41.9	1.70	0.42	0.81	0.67	0.16	0.31	66.3	2.96	0.75	1.45	1.77	0.44	0.85

(Continued)

Industry	1976							
	$\frac{\Delta E^m}{\Delta UI_{76}}$	$\frac{\Delta S^m}{\Delta UI_{76}}$			$\frac{\Delta E}{\Delta UI_{75}}$	$\frac{\Delta S^l}{\Delta UI_{75}}$		
	(1)	(2)	(3)	(1)	(2)	(3)		
Construction	9.4	0.39	0.13	0.23	26.3	1.10	0.37	0.64
Manufacturing	1.1	0.06	0.02	0.03	4.0	0.23	0.06	0.11
Trans., Comm., and Util.	1.4	0.09	0.02	0.04	8.1	0.50	0.13	0.25
Trade	15.7	0.91	0.12	0.34	24.1	1.41	0.19	0.52
Fin., Ins., and Real Estate	0.4	0.02	0.01	0.01	2.1	0.09	0.02	0.05
Services	11.6	0.25	0.12	0.18	18.5	0.41	0.20	0.28
Total	39.6	1.73	0.42	0.83	83.1	3.73	0.96	1.85

$\frac{\Delta E}{\Delta UI}$ is the change in employment per million dollar change in UI payments (in 1975 dollars).

$\frac{\Delta S}{\Delta UI}$ is the change in current dollar sales per dollar change in UI payments (in 1975 dollars).

$\frac{\Delta S}{S}$, $\frac{\Delta E}{E}$ are the percentage change in sales and employment, respectively.

$\frac{\Delta E^m}{\Delta UI_{76}}$ is the change in employment per million dollar change in 1976 UI payments.

$\frac{\Delta S^m}{\Delta UI_{76}}$ is the change in sales per dollar change in 1976 UI payments.

$\frac{\Delta E^l}{\Delta UI_{75}}$ is the change in 1976 employment per million dollar change in 1975 UI payments.

$\frac{\Delta S^l}{\Delta UI_{75}}$ is the change in 1976 sales per dollar change in 1975 UI payments.

marginal and lagged effects indicate that over the two year period, each million dollars of UI benefits (in 1975 dollars) generated about 66 jobs in 1976. Each dollar of UI benefits (in 1975 dollars) in 1975-76 generated \$1.45 in sales in 1976. A 100% reduction in UI benefits over the period 1975-76 would have reduced employment and sales in 1976 by about 1.8%, and 0.9%, respectively. The employment and sales elasticities are still quite small, but are much larger than in 1975.

The cumulative effects of 1975 UI benefits on employment and sales in the PNN sector over the period 1975-76 are reported in Table 3. UI benefit payments in 1975 eventually accounted for 1,923 PNN sector jobs and over \$39 million in sales over the two year period. Each additional million dollars in 1975 UI benefits increased or prevented the loss of 125 jobs in 1975 and 1976. Over this period each dollar of 1975 UI benefits eventually stimulated \$2.56 worth of sales. The total effects of 1975 UI benefits may even be larger than the figures in Table 3 indicate to the extent that the lagged effects may extend beyond two years.

Summary UI effects for the PNN sector over the period 1975-76 are presented in Table 4. The summed employment and sales changes over 1975 and 1976 indicate a loss of nearly 2,400 jobs and \$48 million in sales for the two year period. On average over the period, 91 additional people were employed for each million dollars (in constant 1975 dollars) disbursed in UI benefits. On average over the period, each dollar of UI benefits generated \$1.85 in sales (all in constant 1975 dollars). The estimated average elasticity implies that the absence of UI benefit payments for the two year period would have reduced employment and sales by 1.2% and 0.6%, respectively.

Table 3

Cumulative Effects of 1975 UI Benefits on Employment and Sales in
the Private Nonagricultural, Nonmining, Sector of Pima County (in 1975 Dollars)

Industry	ΔE	$\Delta S (\$1000)$			$\frac{\Delta E}{UI_{75}}$	$\Delta S / UI_{75}$		
		(1)	(2)	(3)		(1)	(2)	(3)
Construction	559	\$21,691.1	\$ 7,573.6	\$12,814.3	36.3	1.41	0.49	0.83
Manufacturing	78	4,194.8	1,045.0	2,093.7	5.1	0.27	0.07	0.14
Trans., Comm., and Util.	148	8,650.1	2,144.1	4,306.4	9.6	0.56	0.14	0.28
Trade	626	34,373.6	4,601.3	12,575.9	40.7	2.23	0.30	0.82
Fin., Ins., and Real Estate	40	1,627.1	404.2	810.9	2.6	0.11	0.03	0.05
Services	472	9,775.0	4,713.7	6,787.9	30.7	0.64	0.31	0.44
Total	1,923	\$80,316.7	\$20,481.9	\$39,389.1	125.0	5.22	1.33	2.56

ΔE is the sum of the 1975 employment change and the lagged employment change in 1976.

ΔS is the sum of the 1975 sales change and the lagged sales change in 1976 (in 1975 dollars).

$\frac{\Delta E}{\Delta UI_{75}}$ is the summed employment change per million dollars change in 1975 UI payments.

$\frac{\Delta S}{\Delta UI_{75}}$ is the summed sales change per dollar change in 1975 UI payments.

Table 4

Two Year Summary of the Effects of UI Benefits on Employment and Sales in the
Nonagricultural, Nonmining, Private Wage and Salary Sector of Pima County (in 1975 dollars)

Industry	ΔE	$\Delta S (\$1000)$			$\Delta S/S$			$\frac{\Delta E}{\Delta UI}$	$\Delta S/\Delta UI$		
		(1)	(2)	(3)	$\frac{\Delta E}{E}$	(2)	(3)		(1)	(2)	(3)
Construction	665	\$25,852.4	\$ 8,989.2	\$15,241.4	3.07	1.08	1.83	25.6	0.99	0.35	0.59
Manufacturing	90	4,840.0	1,206.4	2,416.4	0.37	0.09	0.19	3.5	0.19	0.05	0.09
Trans., Comm., and Util.	164	9,587.8	2,378.2	4,774.9	1.00	0.25	0.50	6.3	0.37	0.09	0.18
Trade	802	44,070.4	5,915.9	16,146.4	1.25	0.17	0.46	30.9	1.70	0.23	0.62
Fin., Ins., and Real Estate	45	1,828.0	454.7	911.6	0.36	0.09	0.18	1.7	0.07	0.02	0.04
Services	602	12,467.2	6,013.5	8,658.5	1.10	0.53	0.76	23.2	0.48	0.23	0.33
Total	2,368	\$98,645.8	\$24,957.9	\$48,149.2	1.22	0.30	0.58	91.1	3.80	0.96	1.85

ΔE is the sum of employment changes in 1975 and 1976 due to UI payments.

ΔS is the sum of sales changes (in 1,000's of 1975 dollars) in 1975 and 1976 due to UI payments.

$\frac{\Delta E}{\Delta UI}$ is the employment change per one million (1975) dollars in UI payments over the period 1975-1976.

$\frac{\Delta S}{\Delta UI}$ is the sales change per (1975) dollars in UI payments over the period 1975-1976.

$\frac{\Delta S}{S}$ $\frac{\Delta E}{E}$ are the percentage change in sales and employment, respectively, over the period 1975-1976.

III. UI IMPACTS ON SELECTED ECONOMIC VARIABLES

Tables 5-7 report the estimated effects of UI benefits on selected measures of economic activity for the Tucson SMSA. We can see from Table 5 that the absence of UI benefits would lower government employment as well as private sector employment. There would be increases in the number of unemployed and the unemployment rate, reductions in the size of the labor force, the total population, and disposable personal income.

In 1975 the absence of UI benefit payments would have caused the loss of 191 federal, state, and local government jobs in Pima County. This represents about 0.5% of total government employment in the SMSA. In 1976 the loss in government jobs due to the absence of UI benefits in 1975 and 1976 would have been 605 or about 1.6% of total government employment in 1976. This predicted loss of government jobs is not surprising. First of all, there would be no need for local state employees to administer the state UI system in Pima County. Secondly, public sector employment is also dependent on the size of the population and the personal income of the region. Since both of these factors will be seen to be influenced by UI benefits, changes in these factors will affect the size of the public sector.

Total nonagricultural wage and salary employment would have fallen by 835 or 0.6% in 1975 in the absence of UI benefits. In 1976 the absence of UI payments in 1975 and 1976 would have occasioned the loss of 2,329 jobs or about 1.6% of 1976 nonagricultural, wage and salary employment. In 1975 each one million dollars in UI benefits generated 54 jobs. In 1976 each one million dollars of 1976 UI benefits generated 51 jobs. Each one million dollars of 1975 UI benefits generated about 114 jobs in 1976. Overall, each one million dollars (in 1975 dollars) over the period in 1975-76 generated employment for about 90 workers in 1976. The employment effects over the

Table 5

Effects of UI Benefit Payments on Selected Variables in Pima County^a

Variable (X)	1975			1976							1975 & 1976		
	ΔX	$\frac{\Delta X}{\Delta UI}$	$\frac{\Delta X}{X}$	ΔX^m	ΔX^l	ΔX	$\frac{\Delta X^m}{\Delta UI_{76}}$	$\frac{\Delta X^l}{\Delta UI_{75}}$	$\frac{\Delta X}{\Delta UI}$	$\frac{\Delta X}{X}$	ΔX	$\frac{\Delta X}{\Delta UI}$	$\frac{\Delta X}{X}$
Government Employment	191	12.4	0.5	132	473	605	11.7	30.7	23.3	1.6	796	30.6	1.1
Total Wage & Salary Emp.	835	54.3	0.6	576	1753	2329	51.3	113.9	89.6	1.6	3164	121.7	1.1
Unemployed	-669	-43.5	-5.4	-461	-847	-1308	-41.0	-55.1	-50.3	-9.9	-1977	-76.1	-7.8
Labor Force	166	10.8	0.1	115	906	1021	10.1	59.0	39.3	0.5	1187	45.7	0.3
Unemployment Rate	-0.4%	-0.026%	-5.6	-0.3%	-0.4%	-0.7%	-0.025	-0.028%	-0.027%	-9.9	-1.1%	-0.042%	7.7
Population	448	29.1	0.1	309	2441	2750	27.5	158.7	105.8	0.6	3198	123.1	0.4
Population 16 ⁺	301	19.6	0.1	207	1647	1854	18.4	107.1	71.3	0.5	2155	82.9	0.3
Disposable Personal Income (\$1,000,000)	\$26.9	1.75	1.3	\$19.7	\$20.6	\$40.3	1.75	1.34	1.55	1.9	\$64.9	2.50	1.6

^aThe various measures of UI effects in the table are constructed in a manner similar to those effects described in Tables 1-3.

two year period averaged about 122 jobs per one million dollars (in 1975 dollars).

The number of unemployed workers would have increased by 669 persons in 1975 had there been no UI benefits payments in Pima County. This represents an increase of about 5% in the number of unemployed. Another way of interpreting our findings is to note that each million dollars of UI benefits in 1975 was associated with a reduction in the number of unemployed of about 44 individuals. In 1976 the combined effects of withholding UI benefits in 1975 and 1976 was the addition of 1,308 workers to the ranks of the unemployed. This represents a near 10% increase in the number of unemployed in 1976. Or to put it another way, each million dollar increment in UI benefits over the two year period is associated with a reduction in 1976 unemployment of about 50 individuals.

Unemployment insurance benefits were found to also have an effect on the size of the labor force in Pima County. The absence of UI benefits in 1975 would have meant 166 fewer persons in the labor force that year, or a reduction of about 0.1%. For each one million dollars in 1975 UI benefits, there were about 11 persons attracted to the local labor force. The reduction in the local labor force attendant upon the absence of UI benefit payments comes about in two ways: (1) Some individuals would leave the area, and (2) others would remain in Pima County but would leave the market sector. The absence of UI benefits in 1975 and 1976 would have reduced the labor force in 1976 by 1,021 individuals. This is a 0.5% reduction in the 1976 labor force. Another way to interpret our findings is to note that for every million dollars of UI benefits disbursed over the period 1975-76, 39 individuals were attracted to the local labor force in 1976.

In 1975 the absence of UI benefit payments would have resulted in an increase in the Pima County unemployment rate of four tenths of a percentage

point, which represents a 5.6% rise in the forecasted unemployment rate. The combined effects of the withholding of UI benefits in 1975 and 1976 would have raised the 1976 unemployment rate by seven-tenths of a percentage point, which represents nearly a 10% rise in the forecasted unemployment rate in 1976. Of course the increase in the measured unemployment rate would have been greater had it not been for the exodus from the local labor force of some of the formerly employed persons who would have lost their jobs in the absence of UI payments.

The size of the population in Pima County was also affected by the simulated absence of UI benefit payments. The absence of UI benefits in 1975 would have reduced the population by about 448 persons, 301 of them 16 years of age and over. This represents a reduction of about 0.1%. However in 1976 there would have been a reduction in the population of 2,750 persons, 1,854 of them 16 years of age and older. This is a proportionate reduction of 0.6%.

Pima County disposable personal income would have fallen by nearly \$27 million in 1975 in the absence of UI benefit payments. This represents a reduction of 1.3% in disposable personal income. Another way of looking at these results is to observe each dollar of UI benefit payments raised disposable personal income by \$1.75. The withholding of 1976 UI benefit payments would have reduced disposable personal income by nearly \$20 million. The withholding of 1975 UI benefit payments would have reduced 1976 disposable personal income by nearly \$21 million. The combined withholding of 1975 and 1976 UI benefits is then responsible for a reduction of 1976 disposable personal income of a little over \$40 million, which represents a proportionate reduction of 1.9%. Each dollar of 1976 UI benefits increased 1976 disposable personal income by \$1.75, and each dollar of 1975 UI benefits increased 1976 disposable personal income by \$1.34. On average, for each

dollar (in 1975 terms) of UI benefits in 1975 and 1976 combined, 1976 disposable personal income was raised by \$1.55. In summary, over the two year period disposable personal income would have fallen by about \$65 million (in 1975 dollars) had there been no UI benefit payments. This represents a proportionate reduction of 1.6%. On average over the two year period, each dollar of UI benefits raised disposable personal income by \$2.50.

The cumulative effects of 1975 UI benefits on selected variables are reported in Table 6. UI benefits in 1975 generated or prevented the loss of 2,588 jobs (including 665 in the public sector) over the two year period 1975-76. Each one million dollars in 1975 UI benefits eventually created 168 jobs. The absence of 1975 UI benefits alone would have increased the number of unemployed by 1,516 and reduced the size of the local labor force by 1,072 persons. Furthermore, the absence of UI benefits in 1975 would have led to reduction of the local population by 2,889 persons and a reduction in disposable personal income of \$46 million (in 1975 dollars). Each dollar of 1975 UI benefits increased disposable personal income by \$3.00 over the two year period.

In Table 7 we report the effects of UI benefit payments on state and city sales tax collections in Pima County construction and retail trade. Sales tax collections in these two sectors would have fallen by nearly \$259 thousand in 1975 in the absence of UI benefit payments. This corresponds to a \$197 thousand reduction in the state sales tax revenues and a \$62 thousand reduction in Tucson's city sales tax revenues. The combined effect of withholding UI benefit payments in 1975 and 1976 would have been a reduction in sales tax revenues in Pima County construction and retail trade of \$712 thousand in 1976. This corresponds to a reduction in the state sales tax revenues of about \$549 thousand and a reduction in city sales tax

Table 6

Cumulative Effects of 1975 UI Benefits on Selected Variables
in Pima County^a

Variable (X)	ΔX	$\frac{\Delta X}{\Delta UI_{75}}$
Government Employment	665	43.2
Total Wage and Salary Employment	2,588	168.2
Unemployed	-1,516	- 98.5
Labor Force	1,072	69.7
Unemployment rate	- 0.8%	- 0.052%
Population	2,889	187.8
Population 16+	1,948	126.6
Disposable Personal Income (\$1,000,000)	\$46.3	3.01

^aThe various measures of UI effects in the table are constructed in a manner similar to those effects described in Tables 1-4.

revenues of about \$163 thousand. Over the two year period, the sales tax revenue reduction (in 1975 dollars) would have been nearly \$931 thousand (716 thousand in state sales tax revenues and \$215 thousand in city sales tax revenues). The cumulative effect of 1975 UI benefits on sales tax revenues for these two sectors was \$745 thousand in state and city tax revenues.

Table 7

UI Induced State and City Sales Tax Revenues in Pima County Construction and Retail Trade

Industry	1975								
	(1)			(2)			(3)		
	Arizona	Tucson	Total	Arizona	Tucson	Total	Arizona	Tucson	Total
Construction	\$ 145,162	\$ 29,758	\$ 174,920	\$ 0	\$ 0	\$ 0	\$ 55,133	\$ 11,302	\$ 66,435
Retail Trade	358,308	126,483	484,791	56,525	19,953	76,478	142,313	50,237	192,550
Total	\$ 503,470	\$ 156,241	\$ 659,711	\$ 56,525	\$ 19,953	\$ 76,478	\$ 197,446	\$ 61,539	\$ 258,985

Industry	1976								
	(1)			(2)			(3)		
	Arizona	Tucson	Total	Arizona	Tucson	Total	Arizona	Tucson	Total
Construction	\$ 559,845	\$ 105,811	\$ 665,656	\$ 0	\$ 0	\$ 0	\$ 206,711	\$ 39,068	\$ 245,779
Retail Trade	847,485	306,366	1,153,851	138,381	50,025	188,417	342,456	123,798	466,254
Total	\$1,407,330	\$ 412,177	\$1,819,507	\$ 138,381	\$ 50,025	\$ 188,417	\$ 549,167	\$ 162,866	\$ 712,033

Table 7
(continued)

1975-76 (1975 dollars)

Industry	(1)			(2)			(3)		
	Arizona	Tucson	Total	Arizona	Tucson	Total	Arizona	Tucson	Total
Construction	\$ 673,438	\$ 129,602	\$ 803,040	\$ 0	\$ 0	\$ 0	\$ 250,187	\$ 48,167	\$ 298,354
Retail Trade	1,158,004	415,573	1,573,577	187,102	67,157	254,259	465,458	167,054	632,512
Total	\$1,831,442	\$ 545,175	\$2,376,617	\$ 187,102	\$ 67,157	\$ 254,259	\$ 715,645	\$ 215,221	\$ 930,866

Cumulative Effects of 1975 UI Benefits

Industry	(1)			(2)			(3)		
	Arizona	Tucson	Total	Arizona	Tucson	Total	Arizona	Tucson	Total
Construction	\$ 564,798	\$ 109,069	\$ 673,867	\$ 0	\$ 0	\$ 0	\$ 209,728	\$ 40,520	\$ 250,248
Retail Trade	907,886	325,155	1,233,041	146,262	52,343	198,655	364,389	130,517	494,906
Total	\$1,472,684	\$ 434,224	\$1,906,908	\$ 146,262	\$ 52,393	\$ 198,655	\$ 574,117	\$ 171,037	\$ 745,154

IV. INTERINDUSTRY COMPARISONS OF UI CONTRIBUTIONS AND INDUCED EMPLOYMENT AND SALES

In this section we report how broad industry groups compare in their shares of UI contributions and in the induced effects of UI benefits on their shares of employment and sales. It is evident from Table 8 that the construction, trade, and service industries contribute the bulk of total UI tax collections and receive the bulk of the benefits in UI induced employment and sales. However, construction and trade account for smaller shares of UI tax contributions than their shares of UI induced employment and sales. Over the period 1975-76, the construction industry in the Tucson SMSA contributed 19.2% of the total UI taxes collected, but received 28.1% of the employment induced by UI benefit payments and 31.7% of the induced sales. Employers in wholesale and retail trade contributed 27.1% of the total UI tax collections and received 33.9% of the induced employment and 33.5% of the induced sales.

Although the service industries received a larger share of induced employment than their share of UI tax contributions over the period (25.4% versus 21.2%), their share of induced sales (18.0%) was smaller than their tax share. Manufacturing industries in Pima County accounted for only 13.6% of the total UI tax contributions in 1975-76, but their shares of induced employment and sales were even smaller, 3.8% and 5.0%, respectively. Transportation, communications and utilities, and finance, insurance, and real estate jointly account for a little over 11% of the UI tax contributions and for nearly 9% of the induced employment and 12% of induced sales. Agriculture and mining account for a little under 8% of the UI tax contributions, but do not share in employment and sales induced by local UI benefit payments.

TABLE 9
Industry Percentage Shares of UI Tax Contributions and
UI Induced Employment and Sales in Pima County

Industry	1975					1976					1975 & 1976				
	$\frac{T_i}{T}$	$\frac{\Delta E_i}{\Delta E}$	$\frac{\Delta S_i}{\Delta S}$			$\frac{T_i}{T}$	$\frac{\Delta E_i}{\Delta E}$	$\frac{\Delta S_i}{\Delta S}$			$\frac{T_i}{T}$	$\frac{\Delta E_i}{\Delta E}$	$\frac{\Delta S_i}{\Delta S}$		
			(1)	(2)	(3)			(1)	(2)	(3)			(1)	(2)	(3)
Agriculture	0.9	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0
Mining	6.8	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0
Construction	20.4	23.9	22.1	33.4	28.2	18.5	29.6	27.7	36.9	32.9	19.2	28.1	26.2	36.0	31
Manufacturing	12.9	2.6	3.5	3.5	3.6	14.0	4.2	5.4	5.3	5.5	13.6	3.8	4.9	4.8	5
Transportation, Comm., & Util.	5.1	3.6	5.1	4.9	5.2	5.4	8.2	11.4	11.2	11.6	5.3	6.9	9.7	9.5	9
Trade	26.6	39.6	53.3	28.2	40.3	27.5	31.7	41.6	22.1	31.2	27.1	33.9	44.7	23.7	33
Fin., Ins. & Real Estate	6.0	1.0	1.2	1.1	1.2	6.0	2.2	2.1	2.1	2.1	6.0	1.9	1.9	1.8	1
Services	21.3	29.2	14.9	28.9	21.5	21.1	24.0	11.8	22.4	16.7	21.2	25.4	12.6	24.1	18
Total	100.0	100.0	100.1	100.0	100.0	100.1	99.9	100.0	100.0	100.0	100.0	100.0	100.0	99.9	100

$\frac{T_i}{T}$ = Industry i's percentage share of total UI tax contributions.

$\frac{\Delta E_i}{\Delta E}$ = Industry i's percentage share of total UI induced employment.

$\frac{\Delta S_i}{\Delta S}$ = Industry i's percentage share of total UI induced sales.

In Table 9 we report each covered industry's share of the total number of UI claimants over the period 1975-76 in Pima County. Of course an industry's share of the total UI claimants need not correspond to the industry's claimant share of the total UI benefits paid out. This is because the average weekly benefit amount can vary across industries since the average high quarter earnings of UI claimants are subject to inter-industry variation. Unfortunately, data are not available on the amount of UI benefits paid out to claimants classified by industry by county. However, these data are available on a statewide basis and are reported in Table 10. As is evident from the table, each industry's share of total claimants is virtually identical to its claimant share of total UI benefits paid out. The only notable exceptions are construction and trade. Construction's share of total claimants is slightly smaller than its claimant share of total UI benefit payments. The situation in trade is just the opposite by an almost exactly offsetting amount.

From Tables 8, 9, and 10 we may conclude that in Pima County unemployed workers in the construction, trade, and service industries account for the bulk of the UI benefits received. However, the construction industry's claimant share of UI benefit payments exceeds its share of the UI tax contributions. Mining's and manufacturing's claimant shares of UI benefit payments are about the same as their shares of UI tax contributions. On the other hand, trade, transportation, communications, and utilities, finance, insurance, and real estate, and services each contribute a larger share of the UI taxes than their share of UI benefit payments to unemployed workers. Overall, the construction industry in Pima county is clearly a net beneficiary from the functioning of the UI system locally. The construction industry receives larger shares of the UI induced employment and

Table 9

Average Monthly Insured Unemployed
in Nonagricultural Industries in Pima County

Industry	1975		1976		1975 & 1976
	Number	%	Number	%	%
Mining	528	8.6	245	5.5	7.3
Construction	2,022	32.9	1,319	29.4	31.5
Manufacturing	789	12.9	640	14.3	13.5
Trans., Com. & Util.	268	4.4	127	2.8	3.7
Trade	1,102	18.0	975	21.7	19.6
Fin. Ins. & R.E.	258	4.2	147	3.3	3.8
Services	1,040	16.9	914	20.4	18.4
State & Local Government	130	2.1	119	2.7	2.3
Total	6,137	100.0	4,486	100.1	100.1

Source: Arizona Department of Employment Security

TABLE 10

Average Monthly Insured Unemployed and UI Benefits Paid Out by Industry in Arizona

Industry	1975 ^a				1976				1975 & 1976 ^a	
	Number	%	UI Payments	%	Number	%	UI Payments	%	% of Claims	% of UI Payments ^b
Mining	1,546	4.0	\$ 415,794	4.6	946	3.8	\$ 256,579	4.3	4.0	4.5
Construction	11,290	29.5	2,828,137	31.1	7,228	29.2	1,865,044	31.1	29.4	31.1
Manufacturing	9,634	25.2	2,342,021	25.8	4,223	17.1	1,029,514	17.2	22.0	22.5
Trans., Comm. & Util.	1,162	3.0	285,503	3.1	797	3.2	203,264	3.4	3.1	3.2
Trade	7,235	18.9	1,574,576	17.3	5,451	22.1	1,231,218	20.5	20.1	18.6
Fin., Ins., & Rel. Est.	1,510	3.9	353,026	3.9	1,105	4.5	267,832	4.5	4.2	4.1
Services	4,941	12.9	1,071,492	11.8	3,952	16.0	888,689	14.8	14.1	13.0
State & Local Gov't.	423	1.1	89,896	1.0	553	2.2	131,593	2.2	1.5	1.5
Agriculture	296	0.8	64,422	0.7	218	0.9	48,000	0.8	0.8	0.7
Unclassified	215	0.6	64,353	0.7	243	1.0	71,912	1.2	0.7	0.9
Total	38,252	99.9	\$9,089,220	100.0	24,716	100.0	\$5,993,643	100.0	99.9	100.1

Source: Arizona Department of Employment Security

^aExcludes July 1975 data, which were not available.

^bComputations based on conversion of the sum of 1975 and 1976 UI payments into 1975 dollars.

sales, and accounts for a larger claimant share of UI benefit payments than its share of the UI tax contributions. On the other hand, finance, insurance, and real estate contributes a larger share of UI tax contributions in the Tucson SMSA than it receives in UI induced employment and its claimant share of UI benefit payments. The pattern for UI contributions and benefits is mixed in the case of the remaining industries.

V. SUMMARY AND CONCLUSION

This study was conducted over an extreme recessionary period for Arizona's economy. The high unemployment rate caused a severe drain on the state's UI trust fund. In the Tucson SMSA nearly \$26 million (in 1975 dollars) in regular state UI benefits were paid out during the period 1975-76, while only a little over \$11 million was collected in UI tax contributions from local employers during this period. Any effects of the state UI system on the local economy should be most apparent during such a period.

Our simulation revealed a very definite impact of regular state UI benefit payments on Tucson's economy. These effects include UI induced changes in sales, sales tax revenues, disposable personal income, employment, unemployment, labor force, and population size. While in some instances the effects of UI benefits are sizeable in absolute terms, these effects are always small in terms of percentage effects. This result is not surprising in the light of the conditions under which the simulation was conducted.

First of all, in the period 1975-76 regular state UI benefit payments in Pima County averaged only a little over 0.6% of the local economy's disposable personal income. In order to make comparisons between industry

contributions to and benefits from the UI system we restricted our attention to the regular state program. Thus our simulation did not estimate the effects of the absence of payments under Extended Benefits, Federal Supplemental Benefits, Special Unemployment Assistance, Unemployment Insurance for Federal Employees, and Unemployment Insurance for Ex-servicemen. These programs paid out over \$6 million in 1975 in Pima County. Nevertheless, combined payments under these programs plus the regular state UI program still account for no more than 1% of Pima County disposable personal income.

Secondly, our simulations were conducted under the assumption that the regular state UI system continued to function normally in the rest of Arizona and in the rest of the states. This approach was adopted in order to simplify the analysis of what we regard as a pilot or prototype study. On the basis of our findings we can speculate on what the qualitative effects of a complete absence of a UI system anywhere in the country would be on Tucson's economy (or any local economy for that matter). A complete absence of the UI system nationally would clearly have a much larger impact on a local economy than just the absence of local UI benefit payments. For one thing there would be no incentive for newly unemployed workers in the covered sector to migrate to other labor markets where the UI system is still functioning. Consequently, the increase in the local unemployment rate would be larger. Another consequence would be that local industries which sell in national markets would now be affected. For example, copper mining in Pima County would not suffer any noticeable sales reductions by the withholding of UI benefit payments in Tucson. However, the simultaneous withholding of UI benefits everywhere in the country would clearly reduce

employment and sales in Tucson copper mining. Thus, although Pima County copper mining receives no benefits from the local UI system in Tucson, it does derive some benefit from the functioning of the UI system in the aggregate.

Thirdly, we have assumed that UI tax contributions in Pima County continued to be collected from employers during the period in which UI benefit payments were withheld. Naturally, a simulation of the complete absence of the UI system would involve the absence of UI tax contributions as well as UI benefit payments. This aspect of the UI system involves the final incidence of the UI tax and its effects on labor demand and supply. As such, it is beyond the scope of the present study. Although most employers might believe that they absorb the entire UI tax since they are the ones required by law to turn the tax contributions over to the state trust funds, the issue of the final incidence of the tax is far from clear. Workers undoubtedly share in the tax by receiving lower wages than they would receive in the absence of a UI system. UI coverage is a fringe benefit that is partly financed by the employer and the covered worker. The more inelastic the supply of labor to the covered sector, the greater is the portion of the UI tax shifted onto labor. Under 100% coverage the supply of labor would be highly inelastic (dropping out of the labor force being the only alternative to covered employment), and consequently most of the UI tax would be borne by labor.

Our study has demonstrated the feasibility of using econometric forecasting models to simulate the effects of the local UI system on the local economy. The concentration of these effects on local sales and employment in the construction, trade, and service sectors is what one would expect. Hopefully, our modest effort will serve as a useful step in encouraging

studies of the effect of the UI system locally and nationally on local economies and on the U.S. economy. Finally, more research on the incidence of the UI tax is necessary for a more complete assessment of the cost and benefits of a UI system.

FOOTNOTES

1. Strictly speaking, the marginal effects would be the changes in employment and sales in the first quarter of 1975 stemming from the withholding of UI benefits during the quarter. Changes in subsequent quarters would reflect marginal and lagged effects. However, we have annualized our quarterly estimates so that the sums of the first year changes are taken to be marginal changes for 1975.
2. Of course the simulated change in UI benefit payments in a given year is merely the historical value of UI benefit payments made in that year. This is because we are looking at the difference between actual UI benefits disbursed and the complete absence of UI benefits.



APPENDIX

"The Impact of Unemployment Insurance Benefits
on Local Economies-Tucson"

Technical Summary and Documentation

APPENDIX

"The Impact of Unemployment Insurance Benefits
on Local Economies-Tucson"

Technical Summary and Documentation

I. INTRODUCTION

In this appendix we discuss in detail the procedures used to obtain the estimates reported in the main body of the final report. A quarterly econometric forecasting model of the Tucson SMSA (Pima County) was developed under contract with ETA/OPER (DOL 20-04-76-55). The model was modified in order to serve as the basis for obtaining estimates of the impact of the regular state UI (Unemployment Insurance) benefit payments on Tucson's economy. In short, the model was restructured to yield simulations of the impact on Tucson, of a complete absence of UI benefit payments in Pima County in 1975 and 1976. Although the model is a quarterly one, for economy in reporting our findings, the simulations results are expressed in annual terms.

UI benefit payments were treated as an exogenous component of transfer payments for the purposes of the simulation. Pima County transfer payments exclusive of regular state UI benefit payments in Pima County were expressed in per capita terms and regressed against U.S. per capita transfer payments. Total estimated Pima County transfer payments therefore consist of the sum of UI benefits and estimated transfer payments exclusive of UI benefits. In our baseline simulations the Pima County quarterly forecasting model is run using estimated total transfer payments in Pima County. The effects of UI benefit payments in 1975 and 1976 were estimated by running the Pima County model with estimated transfer payments exclusive of UI benefits as opposed to using estimated total transfer payments. The absence of UI benefit payments affects total transfer payments which have both direct and indirect effects on the values of the variables in the model. In some cases, transfer payments enter separately and directly into

the equations of the model. In other cases, transfer payments enter indirectly as a component of personal income or disposable personal income, which in turn enter into some of the model's equations. The differences in the model's predictions between the baseline run and the run without UI benefits constitute the estimates of the regular state UI benefit payments effects.

II. ESTIMATION OF THE EFFECT OF UI PAYMENTS ON ANNUAL SALES BY INDUSTRY

A. The Sales/Employment Ratio Method

Consider the following sales (revenue) relationship for the i th industry in period t :

$$(1) \quad S_{it} = P_{it} Q_{it}$$

$$= P_{it} F_i(E_{it}, K_{it})$$

where S_{it} is total sales (revenue);

P_{it} is the price of output;

Q_{it} is the volume of output;

$F_i(\cdot)$ is the production function;

E_{it} is the wage and salary employment; and

K_{it} is an index of other inputs.

It is assumed that $F_i(\cdot)$ is homogeneous of degree one and firms behave as long run profit maximizers. Now consider a total change in industry sales due to a change in local UI benefit payments: with no change in output prices and omitting the subscripts, we have

$$(2) \quad dS = P(F_E dE + F_K dK)$$

where F_E and F_K are the marginal products of E and K, respectively.

It is easily shown that equation (2) can be expressed in proportionate change form as

$$(3) \quad \frac{dS}{S} = \frac{P}{S} \left(F_E E \frac{dE}{E} + F_K K \frac{dK}{K} \right).$$

Since the industry moves along a linear expansion path, we know that

$$\frac{dE}{E} = \frac{dK}{K}.$$

Also we have

$$\frac{P}{S} = \frac{1}{Q}$$

Therefore equation (3) may be written as

$$(4) \quad \frac{dS}{S} = \frac{dE}{E} \left(\frac{F_E E + F_K K}{Q} \right);$$

however, from Euler's theorem about linearly homogenous functions it is clear that

$$Q = F_E E + F_K K.$$

Consequently, equation (4) simplifies to

$$(5) \quad \frac{dS}{S} = \frac{dE}{E}.$$

Therefore, the proportionate change in sales equals the proportionate change in employment.

It is clear that expression (5) is equivalently stated as

$$(6) \quad d \ln S = d \ln E.$$

Upon integrating both sides of equation (6),

$$\text{i.e., } \int d \ln S = \int d \ln E + \ln \gamma$$

where $\ln \gamma$ is the constant of integration

we have

$$(7) \quad \ln S = \ln E + \ln \gamma.$$

Next, we take the antilog of both sides of equation (7) to obtain

$$(8) \quad S = E\gamma$$

or equivalently

$$(9) \quad \frac{S}{E} = \gamma$$

where γ is the sales employment ratio.

With a constant sales employment/ratio, the change in sales is then proportional to the change in employment, i.e.,

$$(10) \quad dS = \gamma dE.$$

Accordingly, the discrete version of equation (10) and (5) allows us to estimate the change in an industry's sales from the change in its employment:

$$(11) \quad \Delta S_{it}^r = \gamma_{it} \Delta E_{it}$$

or

$$(12) \quad \frac{\Delta S_{it}^r}{S_{it}} = \frac{\Delta E_{it}}{E_{it}},$$

where r denotes the sales/employment ratio estimate, and

S_{it} is the estimated level of sales.

Thus, the assumption that all inputs are variable over the relevant period enables us to estimate sales changes (induced by UI benefits) from the estimated employment changes and the given sales/employment ratios. Accordingly, the method is termed the sales/employment ratio method.

B. The Shortrun Labor Cost Method

As an alternative to assuming that all inputs are variable, we could assume that only wage and salary employment is variable over the period. Since $dK = 0$, the expression for a total change in industry sales due to a change in local UI benefits is given by

$$(13) \quad dS = PF_E dE.$$

The term PF_E is of course the value of the marginal product of labor which we will also interpret as the marginal revenue product of labor on the assumption of constant product prices over the period. Now the first order condition for short run profit maximization is that the marginal revenue product of the variable input equal the input price:

$$(14) \quad PF_E = W$$

where W = the marginal labor cost per worker.

Upon substituting equation (14) into equation (13) we have

$$(15) \quad dS = WdE.$$

The discrete version of (15) allows us to estimate the change in an industry's sales from the change in its employment coupled with an estimate of its marginal labor cost:

$$(16) \quad \Delta S_{it}^c = W_{it} \Delta E_{it},$$

where c denotes the short run labor cost estimate.

In terms of proportionate changes it is easily shown that

$$(17) \quad \frac{\Delta S_{it}^c}{S_{it}} = \frac{W_{it} E_{it}}{S_{it}} \times \frac{\Delta E_{it}}{E_{it}}$$

It is clear that the short run labor cost method will yield smaller estimates of sales changes than the sales/employment ratio method. This is because marginal labor cost is less than the sales/employment ratio, or equivalently, the total labor cost of wage and salary employment is obviously less than total sales.

C. The Geometric Mean Method

In actuality, not all inputs can be varied in a year's time but there are inputs in addition to wage and salary employment that can be varied over the period. Therefore, the actual sales changes induced by local UI payments probably lie somewhere in between the estimates yielded by the sales/employment ratio and short run labor cost methods. The actual changes are likely to be closer to the latter estimates than to the former.

An averaging procedure that gives more weight to the smaller of two positive numbers is the geometric mean. This is simply the square root of the product of two positive numbers. In the present context the geometric mean estimate of the sales effect is given by

$$(18) \quad \Delta S_{it}^g = (\Delta S_{it}^r \cdot \Delta S_{it}^c)^{1/2}$$

where g denotes the geometric mean method estimate.

Equations (11), (16), and (18) imply

$$(19) \quad \Delta S_{it}^g = (\gamma_{it} w_{it})^{1/2} (\Delta E_{it})$$

The estimated proportionate change in sales under the geometric mean method is calculated in a straightforward fashion as $\Delta S_{it}^g / S_{it}$, or equivalently,

$$(20) \quad \frac{\Delta S_{it}^g}{S_{it}} = (\gamma_{it} w_{it})^{1/2} \left(\frac{\Delta E_{it}}{S_{it}} \right) \\ = \left(\frac{w_{it}}{\gamma_{it}} \right)^{1/2} \left(\frac{\Delta E_{it}}{E_{it}} \right)$$

III. ESTIMATION OF THE AVERAGE, MARGINAL, AND LAGGED EFFECTS OF UI PAYMENTS

Let t and $t + 1$ represent the first year and second year, respectively, without UI payments. Let X represent a nonmonetary variable where values are simulated directly by the Pima County econometric model. The difference in the value of X due to the presence of UI payments is denoted by ΔX . Thus, ΔX_t represents the effects of UI payments in year t on X in year t , and ΔX_{t+1} represents the combined effects of UI payments in t and $t + 1$ on X in year $t + 1$.

Now the combined effects ΔX_{t+1} can be decomposed into the marginal effects of UI payments in $t + 1$ on X_{t+1} and the lagged effects of UI payments in t on X_{t+1} . The marginal effects are calculated according to the formula

$$(21) \quad \Delta X_{t+1}^m = \frac{\Delta X_t}{\Delta UI_t} \times \Delta UI_{t+1} \times \frac{CPI_t}{CPI_{t+1}}$$

where ΔUI_t , ΔUI_{t+1} are UI payments in year t and t+1, respectively;

and

CPI_t , CPI_{t+1} are the Consumer Price Indexes for the western region in June of t and t+1, respectively.

The rationale behind equation (21) is that marginal effects of UI payments in year t should be adjusted for any difference in UI payments in year t+1. Thus, we would expect inflation to result in the reduction of the effect of a dollar of current UI payments on real valued variables.

The effects of UI changes in year t on X in t+1 (ΔX_{t+1}^l) is merely calculated as a residual by deducting ΔX_{t+1}^m from ΔX_{t+1} :

$$(22) \quad \Delta X_{t+1}^l = \Delta X_{t+1} - \Delta X_{t+1}^m$$

Now the changes in a variable per unit change in UI payments are given by

$$\frac{\Delta X_t}{\Delta UI_t}, \frac{\Delta X_{t+1}^m}{\Delta UI_{t+1}}, \frac{\Delta X_{t+1}^l}{\Delta UI_t}, \text{ and } \frac{\Delta X_{t+1}}{\Delta UI_t + \Delta UI_{t+1} \times \frac{CPI_t}{CPI_{t+1}}}. \text{ The total rate of}$$

change of X in t+1 with respect to the combined UI payments in t and 't+1' is expressed in constant dollars for year t.

In calculating the above effects for sales and disposable personal income, only minor changes are involved. In the case of sales for a given industry, equation (21) is replaced by

$$(23) \quad \Delta S_{it+1}^m = A_{it+1} \Delta E_{it+1}^m$$

where ΔS_{it+1}^m is the marginal effect of UI payments in t+1 on industry i's sales in t+1;

A_{it+1} is $\gamma_{i,t+1} W_{it+1}$, or $(\gamma_{it+1} W_{it+1})^{1/2}$ corresponding to the sales/employment ratio, short run labor cost, and geometric mean methods, respectively; and

ΔE_{it+1}^m is the marginal effect of UI payments in t+1 on industry i's employment calculated from equation (21).

Similarly, the lagged effects of UI payments in t on t+1 sales are calculated as

$$(24) \quad \begin{aligned} \Delta S_{i \ t+1}^l &= A_{i \ t+1} \Delta E_{i \ t+1}^l \\ &= \Delta S_{i \ t+1} - \Delta S_{i \ t+1}^m \end{aligned}$$

where $\Delta E_{i \ t+1}^l$ = the lagged employment effect computed from equation (22).

These computations allow both inflation and changes in the real sales/employment ratio to be reflected in estimating UI effects on current sales.

Let Y denote disposable personal income. In the case of estimating UI effects on disposable personal income, the only modification made is the dropping of the inflation adjustment (CPI_t/CPI_{t+1}) from equation (21):

$$(25) \quad \Delta Y_{t+1}^m = \frac{\Delta Y_t}{\Delta UI_t} \times \Delta UI_{t+1}.$$

The inflation adjustment is not required since both Y and UI payments are already expressed in comparable nominal values. The lagged effects of UI payments in t on disposable personal income in t+1 are computed as

$$(26) \quad \Delta Y_{t+1}^{\ell} = \Delta Y_{t+1} - \Delta Y_{t+1}^m.$$

The average change in X in year t+1 (ΔX_{t+1}) per unit change in UI payments in years t and t+1 ($\Delta UI_t, \Delta UI_{t+1}$) is computed as a weighted average of the marginal effect of ΔUI_{t+1} and the lagged effect of ΔUI_t in t+1. Since the combined change in UI payments over year t and t+1 is expressed in constant dollars in year t we have

$$(27) \quad \Delta UI = \sum_{v=t}^{t+1} \Delta UI_v \times \frac{CPI_t}{CPI_v}.$$

Accordingly, the average change in X per unit change in UI, $\Delta X_{t+1}/\Delta UI$, can be expressed as

$$(28) \quad \begin{aligned} \frac{\Delta X_{t+1}}{\Delta UI} &= \frac{\Delta X_{t+1}^m}{\Delta UI} + \frac{\Delta X_{t+1}^{\ell}}{\Delta UI} \quad \text{by equation (22)} \\ &= \frac{\Delta X_{t+1}^m}{\Delta UI_{t+1}} \frac{\Delta UI_{t+1}}{\Delta UI} + \frac{\Delta X_{t+1}^{\ell}}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI} \\ \frac{\Delta X_{t+1}}{\Delta UI} &= \frac{\Delta X_t}{\Delta UI_t} \times \left(\frac{CPI_t}{CPI_{t+1}} \times \frac{\Delta UI_{t+1}}{\Delta UI} \right) + \frac{\Delta X_{t+1}^{\ell}}{\Delta UI_t} \times \left(\frac{\Delta UI_t}{\Delta UI} \right) \quad \text{by equation (21)} \\ &= \frac{\Delta X_t}{\Delta UI_t} \times \left(1 - \frac{\Delta UI_t}{\Delta UI} \right) + \frac{\Delta X_{t+1}^{\ell}}{\Delta UI_t} \times \left(\frac{\Delta UI_t}{\Delta UI} \right) \quad \text{by equation (27)}. \end{aligned}$$

Therefore, $\Delta X_{t+1}/\Delta UI$ is a weighted average of marginal effect in year t ($\Delta X_t/\Delta UI_t$) and the lagged effect in year t+1 ($\Delta X_{t+1}^{\ell}/\Delta UI_t$) with the weights in parentheses in equation (28) summing to unity.

It is easily shown that the average change in sales in year t+1 per unit change in accumulated UI payments in constant year t dollars, $\Delta S_{i,t+1}/\Delta UI$, is equal to the appropriate estimated sales effect coefficient in year t+1 ($A_{i,t+1}$) times the weighted average of marginal and lagged employment effects. Thus we have

An average effect of UI payments on real valued variables over the two year period is easily computed. Let $\Delta X = \sum_{v=k}^{t+1} \Delta X_v$, then

$$\begin{aligned} \frac{\Delta X}{\Delta UI} &= \frac{\Delta X_t}{\Delta UI_t} \frac{\Delta UI_t}{\Delta UI} + \frac{\Delta X_{t+1}}{\Delta UI} \\ &= \frac{\Delta X_t}{\Delta UI_t} \frac{\Delta UI_t}{\Delta UI} + \frac{\Delta X_t}{\Delta UI_t} \times \left(\frac{CPI_t}{CPI_{t+1}} \times \frac{\Delta UI_{t+1}}{\Delta UI} \right) + \frac{\Delta X_{t+1}^l}{\Delta UI_t} \times \left(\frac{\Delta UI_t}{\Delta UI} \right) \end{aligned}$$

by equation (28)

$$(32) \quad \frac{\Delta X}{\Delta UI} = \frac{\Delta X_t}{\Delta UI_t} + \frac{\Delta X_{t+1}^l}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI} \quad \text{upon collecting terms.}$$

Therefore the average rate of change is equal to the rate of change in year t plus the weighted lagged rate of change in year $t+1$.

Similarly, the average rate of change in sales over the two year period with respect to UI benefits can be easily expressed. Let $\Delta S_i = \sum_{v=t}^{t+1} \Delta S_{iv} \times \frac{CPI_t}{CPI_v}$ then

$$(33) \quad \frac{\Delta S_i}{\Delta UI} = \frac{\Delta S_{it}}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI} + \frac{\Delta S_{i,t+1}}{\Delta UI} \times \frac{CPI_t}{CPI_{t+1}}$$

Thus, the average rate of change of sales with respect to UI payments over the two year period equals the weighted rate of change in year t plus the rate of change of sales in year $t+1$ in t constant dollars. In the case of sales, any further decomposition of the average rate of change is not particularly illuminating.

Finally, the average rate of change in disposable personal income in constant t dollars with respect to UI payments in constant t dollars over the two year period is easily expressed. Let $\Delta Y = \sum_{v=t}^{t+1} \Delta Y_v \times \frac{CPI_t}{CPI_v}$, then

$$\frac{\Delta Y}{\Delta UI} = \frac{\Delta Y_t}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI} + \frac{\Delta Y_{t+1}}{\Delta UI} \times \frac{CPI_t}{CPI_{t+1}}$$

$$\begin{aligned}
(29) \quad \frac{\Delta S_{i \ t+1}}{\Delta UI} &= A_{i \ t+1} \frac{\Delta E_{i \ t+1}}{\Delta UI} \\
&= A_{i \ t+1} \left[\frac{\Delta E_{i \ t}}{\Delta UI_t} \times \left(\frac{CPI_t}{CPI_{t+1}} \times \frac{\Delta UI_{t+1}}{\Delta UI} \right) + \frac{\Delta E_{i \ t+1}^l}{\Delta UI_t} \times \left(\frac{\Delta UI_t}{\Delta UI} \right) \right] \\
&\hspace{15em} \text{by equation (28)} \\
&= A_{i \ t+1} \left[\frac{\Delta E_{i \ t}}{\Delta UI_t} \times \left(1 - \frac{\Delta UI_t}{\Delta UI} \right) + \frac{\Delta E_{i \ t+1}^l}{\Delta UI_t} \times \left(\frac{\Delta UI_t}{\Delta UI} \right) \right]
\end{aligned}$$

The average change in disposable personal income in year $t+1$ per unit change in UI payments in years t and $t+1$ is expressed as follows:

$$\begin{aligned}
(30) \quad \frac{\Delta Y_{t+1}}{\Delta UI} &= \frac{\Delta Y_{t+1}^m}{\Delta UI} + \frac{\Delta Y_{t+1}^l}{\Delta UI} \quad \text{by equation (22)} \\
&= \frac{\Delta Y_{t+1}^m}{\Delta UI_{t+1}} \times \frac{\Delta UI_{t+1}}{\Delta UI} + \frac{\Delta Y_{t+1}^l}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI} \\
\frac{\Delta Y_{t+1}}{\Delta UI} &= \frac{\Delta Y_t}{\Delta UI_t} \times \frac{\Delta UI_{t+1}}{\Delta UI} + \frac{\Delta Y_{t+1}^l}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI} \quad \text{by equation (25).}
\end{aligned}$$

Thus the average change in Y in $t+1$ constant dollars per unit change in UI payments in t constant dollars is a weighted average of marginal and lagged UI effects; however, the weights do not sum to one. If instead we express the changes in Y in year $t+1$ in terms of t constant dollars, we would have

$$\begin{aligned}
(31) \quad \frac{CPI_t}{CPI_{t+1}} \times \frac{\Delta Y_{t+1}}{\Delta UI} &= \frac{\Delta Y_t}{\Delta UI_t} \times \left(\frac{CPI_t}{CPI_{t+1}} \times \frac{\Delta UI_{t+1}}{\Delta UI} \right) + \frac{CPI_t}{CPI_{t+1}} \times \frac{\Delta Y_{t+1}^l}{\Delta UI} \times \left(\frac{\Delta UI_t}{\Delta UI} \right) \\
&= \frac{\Delta Y_t}{\Delta UI_t} \times \left(1 - \frac{\Delta UI_{t+1}}{\Delta UI} \right) + \frac{CPI_t}{CPI_{t+1}} \times \frac{\Delta Y_{t+1}^l}{\Delta UI} \times \left(\frac{\Delta UI_t}{\Delta UI} \right)
\end{aligned}$$

in which the weights sum to unity.

$$= \frac{\Delta Y_t}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI} + \frac{CPI_t}{CPI_{t+1}} \left[\frac{\Delta Y_t}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI} + \frac{\Delta Y_{t+1}^l}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI} \right]$$

by equation (30)

$$(34) \quad \frac{\Delta Y}{\Delta UI} = \frac{\Delta Y_t}{\Delta UI_t} + \frac{CPI_t}{CPI_{t+1}} \times \frac{\Delta Y_{t+1}^l}{\Delta UI_t} \times \frac{\Delta UI_t}{\Delta UI_t} .$$

The average rate of change of disposable personal income with respect to UI payments over the period thus equals the rate of change in year t plus the weighted lagged rate of change in $t+1$ expressed in constant t dollars.

IV. ESTIMATION OF UI ELASTICITIES

For any variable X we wish to compute the following arc elasticity:

$$(35) \quad \eta_{X \cdot UI, t} = \frac{\Delta X_t}{\Delta UI_t} \times \frac{UI_t}{X_t} \quad \text{for } t = 1975, \text{ and } t+1 = 1976.$$

$$= \frac{\Delta X_t}{X_t} \quad \text{since } \Delta UI_t = UI_t .$$

In the case of sales elasticities we have

$$\eta_{S_i \cdot UI, t} = \frac{\Delta S_{it}}{S_{it}}$$

$$= \frac{A_{it} E_{it}}{S_{it}} \frac{\Delta E_{it}}{E_{it}}$$

$$(36) \quad \eta_{S_t \cdot UI, t} = \frac{A_{it} E_{it}}{S_{it}} \eta_{E_i} \quad UI_t .$$

When considering the case in which A_{it} equals γ_{it} (the sales/employment ratio) expression (36) simplifies to

$$(37) \quad \eta_{S_i \cdot UI, t} = \eta_{E_i} \cdot UI_t .$$

A weighted average elasticity can be calculated over the two year period as

$$\begin{aligned}
 \eta_{x \cdot UI} &= \frac{\Delta X}{X} = \frac{\Delta X_t}{X_t} \times \frac{X_t}{X} + \frac{\Delta X_{t+1}}{X_{t+1}} \times \frac{X_{t+1}}{X} \\
 (38) \quad &= \eta_{x \cdot UI, t} \times \frac{X_t}{X} + \eta_{x \cdot UI, t+1} \left(1 - \frac{X_t}{X} \right) \\
 &\text{since } X = \sum_{v=t}^{t+1} X_v
 \end{aligned}$$

In the case of disposable personal income, we have

$$\begin{aligned}
 \eta_{y \cdot UI} &= \frac{\Delta y}{y} = \frac{\Delta y_t}{y_t} \times \frac{y_t}{y} + \frac{\Delta y_{t+1}}{y_{t+1}} \times \frac{y_{t+1}}{y} \times \frac{CPI_t}{CPI_{t+1}} \\
 (39) \quad &= \eta_{y \cdot UI, t} \times \frac{y_t}{y} + \eta_{y \cdot UI, t+1} \times \left(1 - \frac{y_t}{y} \right) \times \frac{CPI_t}{CPI_{t+1}}
 \end{aligned}$$

The two year, weighted, sales elasticity is given by

$$\begin{aligned}
 \eta_{S_i \cdot UI} &= \frac{\Delta S_i}{S_i} \\
 &= \frac{\Delta S_{it}}{S_i} + \frac{\Delta S_{i t+1}}{S_i} \frac{CPI_t}{CPI_{t+1}} \\
 &= \frac{A_{it} E_{it}}{S_i} \frac{\Delta E_{it}}{E_{it}} + \frac{A_{i t+1} E_{i t+1}}{S_i} \frac{CPI_t}{CPI_{t+1}} \frac{\Delta E_{i t+1}}{E_{i t+1}} \\
 &= \frac{A_{it} E_{it}}{S_i} \eta_{E_i \cdot UI, t} + \frac{A_{i t+1} E_{i t+1}}{S_i} \frac{CPI_t}{CPI_{t+1}} \eta_{E_i \cdot UI, t+1} \\
 &= \frac{E_i A_{it} E_{it}}{S_i} \eta_{E_i \cdot UI, t} + \frac{E_i A_{i t+1} E_{i t+1}}{S_i} \frac{CPI_t}{CPI_{t+1}} \left(1 - \frac{E_{it}}{E_{i t+1}} \right) \eta_{E_i \cdot UI, t+1} \\
 (40) \quad \eta_{S_i \cdot UI} &= \left[\frac{E_i A_{it} E_{it}}{S_i} \right] \left[\eta_{E_i \cdot UI, t} + \frac{A_{i t+1} E_{i t+1}}{A_{it} E_{i t+1}} \frac{CPI_t}{CPI_{t+1}} \left(1 - \frac{E_{it}}{E_{i t+1}} \right) \eta_{E_i \cdot UI, t+1} \right]
 \end{aligned}$$

In the special case where

$$(41) \quad \frac{A_{i,t+1}}{A_{i,t}} = \frac{CPI_{t+1}}{CPI_t}$$

expression (40) simplified to

$$(42) \quad \eta_{S_i} \cdot UI = \frac{E_i A_{i,t}}{S_i} \eta_{E_i} \cdot UI$$

When considering the sales/employment ratio method ($A_i = \gamma_i$) in the case in which expression (41) holds, the sales elasticity condenses to

$$(43) \quad \eta_{S_i} \cdot UI = \eta_{E_i} \cdot UI$$

Of course if (41) does not hold exactly, expression (42) (expression (43) in the case of the sales/employment ratio method) is only an approximation to the sales elasticity.

V. ESTIMATION OF LABOR COST PER WORKER

As was shown in section II of the appendix, the marginal labor cost of employment is central to estimation of sales changes via the short run labor cost method. For the i th industry at time t , the formula used to calculate marginal labor cost is

$$(44) \quad W_{it} = \left[(0.0585) (Y_{it}^{WS}) + Y_{it}^L + C_{it} \right] / E_{it}$$

where W_{it} is total labor cost per worker;

Y_{it}^{WS} is total wages and salaries

Y_{it}^L is total labor compensation (Y_{it}^{WS} + value of fringe benefits);

C_{it} is the industry's UI contributions; and

E_{it} is actual employment.

The first term in the numerator of equation (44) is an upper bound estimate of the employers' social security contributions.

The data on wages and salaries paid by industry for Pima County were obtained from Bureau of Economic Analysis (B.E.A.) estimates. While data on total labor compensation by industry are not available on an SMSA basis from the BEA, it is possible to obtain estimates based on comparable state-wide BEA data. The ratio of proprietor income of each industry to total proprietor's income is available for Arizona as a whole. These ratios were applied to total proprietors' income for Tucson to obtain estimates of proprietor income for each industry in Pima County. These estimates were then subtracted from BEA estimates of total personal income by industry in Pima County to obtain estimates of total labor compensation by industry in the SMSA. The resulting estimates of labor cost per worker are presented in Table A.1.

VI. ESTIMATION OF SALES AND SALES/EMPLOYMENT RATIOS

Total sales in an industry are estimated as the product of the industry's sales/employment ratio times its estimated employment obtained from the Tucson econometric forecasting model:

$$(45) \quad S_{it} = \gamma_{it} E_{it}$$

Naturally, the estimated sales from (45) will differ from actual sales whenever estimated employment differs from actual employment. Because of data limitations sales/employment ratios could be directly estimated for

Table A.1

Estimated Labor Cost per Worker in the Nonagricultural, Nonmining
Sector of Pima County (\$1,000)

Industry	1975	1976
Construction	\$14.057	\$14.153
Manufacturing	13.200	14.256
Trans., Comm., & Util.	13.692	15.508
Trade	7.177	7.916
Fin., Ins., & Real Estate	10.143	10.699
Services	9.971	10.595

only four broad industry groupings: construction (SIC 15-17), manufacturing (SIC 20-39), wholesale and retail trade (SIC 50-59), and services (SIC 70-89). Collectively, these industries account for nearly 80% of private wage and salary employment in Pima County. In the cases of transportation, communications, and utilities (SIC 40-49) and finance, insurance, and real estate (SIC 60-69), the sales/employment ratios were estimated from the information available on the four broad industry groupings. This procedure is discussed below. The estimated sales and sales/employment ratios are presented in Table A.2.

Construction

The sales/employment ratio in construction for 1975 and 1976 was calculated by first estimating sales each year from annual state sales tax revenues from Pima County construction. These sales tax revenues were obtained from reports by the Arizona Department of Revenue. Since the state sales tax is 4%, the state tax revenues for Pima County construction in each year were divided by 0.04 to obtain the total taxable sales for the year. Since in Arizona the sales tax base in construction is total sales net of labor costs, total labor costs in Pima County construction were added to the sales tax base to yield total sales in Pima County construction (total wage and salary payments data were generated from the Arizona DES 202 data on covered employment). Accordingly, total construction sales in Pima County were calculated to be \$353.894 million in 1975 and \$381.089 million in 1976. With Pima County construction employment of 9,410 persons in 1975 and 9,160 persons in 1976, the sales/employment ratios for the two years are \$37,608 per worker and \$41,604 per worker, respectively.

Table A.2

Estimated Sales and Sales/Employment Ratios for
the Nonagricultural, Nonmining Sector of Pima County
(in thousands)

Industry	1975	1976	1975	1976
Construction	\$400,562	\$459,516	\$37.608	\$41.604
Manufacturing	650,988	685,154	53.774	56.987
Trans., Comm. & Util.	464,216	516,913	57.050	62.032
Trade	1,736,349	1,886,224	54.640	58.388
Fin., Ins., & Real Es.	264,355	267,946	42.263	42.796
Services	566,998	600,096	20.710	21.947

Manufacturing

Since manufacturing is not taxed per se in Arizona, data were obtained from the Annual Survey of Manufacturers 1975: Statistics for State, Standard Metropolitan Statistical Areas, Large Industrial Counties, and Selected Cities, M75(AS)-6, Bureau of the Census, Department of Commerce. The sales/employment ratio for 1975 was calculated as the rates of the value of shipments in 1975 (\$666.8 million) in Pima County to the Pima County manufacturing employment in 1975 (12,400 persons). This yields a 1975 sales/employment ratio of \$53,774 per worker. The 1976 census estimates for the value shipments and persons employed were \$743.5 million and 13,900 persons respectively. Unfortunately, the 1976 employment figure implies an implausible growth rate of 12% from 1975 to 1976. On the other hand, Arizona DES estimates imply a growth rate of little over 3% for Pima County manufacturing employment (12,100 in 1975 and 12,500 in 1976). The growth rate in manufacturing employment for the state was a little under 4%. Furthermore, the percentage standard error of estimate of the census estimate of Pima County manufacturing employment in 1976 was 10%. This implies a standard error range of 12,510 to 15,290 around the employment estimate of 13,900. Since the available evidence suggests that the census employment estimate for 1976 is too high, the resulting sales/employment ratio is likely to be too low.

It was decided that the 1976 sales/employment ratio be estimated as the product of the 1975 ratio times the ratio of the 1976 to the 1975 CPI for the West. This means that the sales/employment ratio remains the same in real terms. This yields an estimated ratio of \$56,987 per worker. Given the 1976 value of shipments this ratio implies 1976 employment of a little

over 13,000. This would correspond to a more plausible employment growth rate of close to 5%. In all likelihood the estimated value of shipments in 1976 is also too high but not necessarily by the same proportion.

Trade

This sector combines wholesale and retail trade. Retail trade sales in 1975 and 1976 were calculated by summing Pima County state tax revenues for retail trade (bars and restaurants + non bar and restaurant) and dividing by 0.04. Since wholesale trade is not subject to sales tax in Arizona, the dollar volume of wholesale trade had to be estimated. First, the wholesale trade sales/employment ratio was calculated from Pima County data given in the 1972 Census of Wholesale Trade. In 1972 the sales volume in Pima County wholesale trade was \$566.857 million and March employment was 4,575 persons. Thus the 1972 sales/employment ratio is about \$123,903 per worker. The 1975 (1976) sales/employment ratio in Pima County wholesale trade was estimated by multiplying the 1972 sales/employment ratio by the ratio of the 1975 (1976) CPI for the west to the 1972 CPI for the west. This of course is an attempt to express the sales/employment ratio in 1975 (1976) dollars. The estimated 1975 (1976) sales/employment ratio was then multiplied by 1975 (1976) wage and salary employment in wholesale trade to yield an estimate of 1975 (1976) sales volume.

The overall 1975 (1976) employment/sales ratios for trade were calculated as the sum of wholesale and retail trade sales in 1975 (1976) all divided by the sum of total employment in trade in 1975 (1976). These calculations gave estimated sales/employment ratios in Pima County of \$54,640 per worker and \$58,388 per worker in 1975 and 1976 respectively.

Services

A 1972 sales/employment ratio for the service sector was calculated from data given on Pima County in the 1972 Census of Selected Service Industries. It is assumed that the sales/employment ratio for the combined selected industries is representative of the entire service sector in Pima County. The sales/employment ratio was converted in 1975 (1976) dollars by multiplying the 1972 ratio by the 1975 (1976) CPI for the West divided by the 1972 CPI for the West. These calculations yielded estimates of \$20,710 per worker in 1975 and \$21,947 per worker in 1976.

Transportation, Communication and Utilities and Finance, Insurance, and Real Estate

For these two sectors it was assumed that under the short run labor cost method the elasticity of sales with respect to employment was equal to the aggregate elasticity of sales with respect to employment for the above four broad industry groupings combined. This aggregate elasticity is calculated according to the formula

$$(46) \quad \bar{\eta}_S \cdot E = \frac{\sum_i \Delta S_i}{\sum_i S_i} \cdot \frac{\sum_i E_i}{\sum_i \Delta E_i}$$
$$= \frac{\sum_i (\Delta S_i / S_i) \theta_i}{\sum_i (\Delta E_i / E_i) \lambda_i} \quad , i = 1, \dots, 4$$

where θ_i is the i th industry's share of total sales ($S_i / \sum S_i$), and λ_i is the i th industry's share of total employment ($E_i / \sum E_i$).

This aggregate elasticity is calculated to be approximately 0.24 and 0.25 for 1975 and 1976, respectively.

Assuming that the elasticity of sales with respect to employment for both transportation, communications and utilities and finance, insurance, and real estate equals the aggregate elasticity, we can solve for the sales/employment ratio:

$$(47) \quad \gamma_{jt} = \frac{\Delta S_{jt}}{\Delta E_{jt}} \cdot \frac{1}{\bar{\eta}_S \cdot E_{,t}}$$

$$= \frac{W_{jt}}{\bar{\eta}_S \cdot E_{,t}}$$

where j represents either of the above two industries.

Estimated total sales in each year are then obtained as the product of γ_{jt} times the estimated total employment in the industry.

VII. ESTIMATION OF UI EFFECTS ON SALES TAX REVENUES

Construction

The tax revenue formula for state sales tax revenues from construction involves a 4% tax rate and is given by

$$(48) \quad T_s = (0.04)(S - W \cdot E)$$

where T_s is total state sales tax revenues, and the remaining terms are defined as before.

The UI induced change in state sales tax revenues from Pima County construction is calculated by

$$(49) \quad \Delta T_s = (0.04)(\Delta S - W \cdot \Delta E).$$

The tax revenue formula for the City of Tucson involves a 2% tax rate and is given by

$$(50) \quad T_c = (0.02) \left(\frac{S_c}{S} \right) (T_s)$$

where T_c is the total city sales tax revenue and
 S_c is the industry's sales in the city of Tucson.

Accordingly, the UI induced change in city sales tax revenues is calculated by

$$(51) \quad \Delta T_c = (0.02) \left(\frac{S_c}{S} \right) (\Delta T_s).$$

It is assumed that UI induced effects do not alter the composition of sales between the city of Tucson and the Tucson SMSA (Pima County).

Retail Sales

In the case of retail sales, the formula for state sales tax revenues is simply

$$(52) \quad T_s = 0.04 S.$$

Accordingly, the UI induced effects on state sales tax revenues is simply:

$$(53) \quad \Delta T_s = 0.04 \Delta S.$$

The formulas for city sales tax revenues and UI induced changes in these revenues are given by equations (50) and (51), respectively.

VIII. UI PAYMENTS AND LABOR FORCE PARTICIPATION

It is difficult to say a priori what the net effect of UI benefits would be on the aggregate labor force participation rate in a local labor

market. To the extent to which UI benefits keep unemployed workers in the labor force, the discouraged worker effect is weakened. Benefits allow unemployed workers to search longer for suitable employment as an alternative to accepting undesirable market employment or to allocating their time exclusively to nonmarket activities, or to moving out of the state. The first alternative doesn't affect labor force participation because one merely changes his status within the labor force by moving from unemployment to employment. The second and third alternatives do affect local labor force participation by postponing or preventing dropping out of the local labor force. If for no other reason, a UI recipient would remain in the labor force because it is a necessary condition for receiving benefits. Increases in UI benefits may actually attract new labor market entrants because UI benefits contribute to the attractiveness of market work in the covered sector by cushioning expected future spells of unemployment. It is not clear how long this effect lasts each time UI benefits rise since wage rates in the covered sector should eventually reflect this "fringe" benefit by falling relative to wages in the noncovered sector. Finally, UI benefits could lower labor force participation by weakening the added worker effect. To the extent that UI benefits cushion the earnings loss of the unemployed there is less pressure for other household members to enter the labor force. On balance, therefore, we cannot predict the net effect of UI benefits on labor force participation.

The UI variable we use in the labor force participation equation is the expected real weekly UI benefit amount, lagged one quarter. The expected weekly benefit amount (WBA) is the product of the probability of

receiving UI benefits times the WBA. The probability of receiving UI benefits depends on the probability of being in the covered sector and the probability of having a UI claim accepted. Of course the probability of having a claim accepted is not independent of whether or not one is in the covered sector. Therefore, the probability of receiving UI benefits should be calculated as the product of the probability of a claim acceptance given that one is employed in the covered sector times the probability of being employed in the covered sector. Let $P(A,C)$ = the probability that one is covered under the UI law and that one's claim is accepted. It is easily shown that $P(A,C) = P(A|C) \cdot P(C)$ where $P(A|C)$ = the conditional probability of claim acceptance (i.e., given that one is covered) and $P(C)$ = the probability of coverage.

Our empirical estimate of the probability of an employed individual being employed in the covered sector, $P(C)$, is simply the ratio of covered local employment to total local employment. Our estimate of the conditional probability of claims acceptance is given by one minus the UI denial rate among initial claimants. This estimate is interpreted as a conditional probability because all reported initial claimants have been screened for covered employment prior to the start of the formal UI claims process. The denial rate is defined as the ratio of denials resulting from nonmonetary determinations to the number of initial claimants. The causes for denials we selected are misconduct, voluntary quits, and refusal of suitable work.

These were selected because they apply mainly to initial claimants, and because they involve some degree of discretion on the part of local claims offices. Strictly speaking, denials for refusal of suitable work can include those already drawing benefits; however, the numbers involved are miniscule (typically less than three-tenths of one percent of the number of initial claimants). Denials stemming from monetary determinations are not included because they involve no discretion on the part of local UI claims offices. The requisite number of quarters employed and minimum earnings in the covered sector are specified by law.

We chose as our measure of real WBA the maximum WBA allowed by law divided by the CPI for the west. This measure most accurately captures changes in the UI benefit schedule. The average WBA would confound the effects of legislated changes in benefit awards with changes in the composition of UI recipients. The characteristics of UI recipients determine their WBA insofar as the WBA is determined by high quarter earnings in the base period. Similarly, the total benefit award is determined by earnings during the base period. The ratio of total benefit award to WBA determines the maximum duration of benefits. The maximum benefit duration allowed by Arizona state law is 26 weeks. Since the maximum duration has not changed over the study period, it was not necessary to take this factor into account. Of course the extended benefits program was triggered on occasion by a high unemployment rate, but this is only a temporary measure.

As can be seen from Table A.3 some of the UI data for Tucson were missing for certain quarters in the study period. In response to this missing data

Table A.3

UI Data Collected for the Tucson SMSA

Data	Frequency	Period
Initial UI Claims	monthly	7/62-present ^a
New Claims Denials (nonmonetary determinations)	monthly	1/73-present ^b
Total Benefit Payments	quarterly	196701-present ^c
Covered Employment	quarterly	196201-present

^a1/72-11/72 not available

^b6/73 not available

^c197201 and 197202 not available

problem, we have developed procedures for estimating the missing data. UI denials for Pima County were available starting from January of 1973. Unfortunately, UI denials in Pima County were not available for June of 1973. Thus the second quarter UI denials in 1973 could not be computed. However, we noted that UI denials in Pima County constituted 17% of state-wide denials in the first and third quarters of 1973. Consequently, we multiplied the number of Arizona UI denials in the second quarter of 1973 by 0.17 to obtain an estimate of Pima County denials in the second quarter. Since we are interested in the denial rate rather than the number of denials per se, the Pima County denial rate was estimated as a linear function of the Arizona denial rate, the Pima County unemployment rate, and seasonal dummy variables. The equation was estimated over the 16 quarter period spanning 197301 to 197604. Our estimated equation was then used to estimate the Pima County denial rate from 196501 to 197204. Thus, our Pima County denial rate variable consisted of predicted values from 196501 to 197204 and actual values from 197301 to 197604. The regression results are reported in Table A.4. It is interesting to note that the Pima County UI denial rate is negatively associated with the unemployment rate. There are at least three reasons for this finding: (1) In periods of high unemployment, workers are less likely to engage in misconduct on the job or quit voluntarily, (2) local claims offices may become more lenient in order to cushion the effects of unemployment, and (3) the heavy deluge of UI claims may make it impossible to screen UI claimants very carefully.

Data on total UI benefit payments in Pima County under the state program were not available for the first two quarters of 1972. Consequently, we estimated the ratio of Pima County to Arizona UI payments as a linear function

Table A.4

Pima UI Denial Rate

Dependent Variable: PDENY/UICLAIMP (mean 0.107)

Independent Variables	Coefficient	T Value	Mean	η
Constant	0.070	3.007	1.000	
AZDENY/UICLAIMAZ	0.527	3.508	0.126	0.623
PIMAUN	-0.006	-4.026	5.613	-0.317
Season 02	0.008	1.140	0.250	
Season 03	0.007	0.882	0.250	
Season 04	0.002	0.350	0.250	
\bar{R}^2	0.859			
DW	1.808			
S.E.E.	0.009			
Period	197301-197604			

PDENY/UICLAIMP and AZDENY/UICLAIMAZ = the UI denial rates for Pima County and Arizona, respectively. They are defined as denials for misconduct, voluntary quits, and refusal of suitable work all divided by the number of initial UI claims.

PIMAUN = Pima County unemployment rate

SEASON 02, SEASON 03, and SEASON 04 = dummy variables for the second, third, and fourth quarters, respectively.

η = elasticity.

of the ratio of the Pima County unemployment rate to the Arizona unemployment rate over the period 196701 to 197104. The estimated relationship was then used to predict the Pima County/Arizona UI payments ratio for the first and second quarters of 1972. These estimated ratios were then multiplied by the actual Arizona UI payments in 197201 and 197202 to obtain estimates of the Pima County UI payments in these two quarters. Thus, our Pima County UI payments variable is equal to the actual UI payments for 196701 to 197104 and 197203 to the present, and is equal to estimated values for 197201 and 197202. The regression results are reported in Table A.5. Preliminary results suggested that serial correlation among the residuals may be a problem. Therefore, we corrected for serial correlation through the Cochrane-Orcutt procedure.

Of course the serial correlation correction procedure necessitates slight amendments to the usual way of predicting from an estimated equation. For example, consider the following linear model:

$$(54) \quad Y_t = a + bX_t + U_t, \quad U_t = p U_{t-1} + e_t, \quad t = 1, \dots, T$$

where e_t satisfies all of the standard assumptions.

Estimates of 'p' are obtained through an iterative process, and equation (54) is transformed for the purpose of estimating 'a' and 'b':

$$(55) \quad (Y_t - \hat{p} Y_{t-1}) = \hat{a}(1 - \hat{p}) + b(X_t - \hat{p} X_{t-1}) + \hat{e}_t.$$

Our situation is one in which we have data on 'Y' for the period 1 through T and T+2 to the present. The data on 'X' is available from period 1 to the present. Our estimate of Y_{T+1} is obtained from equation (55) as

$$(56) \quad \hat{Y}_{T+1} = \hat{a}(1 - \hat{p}) + \hat{b}(X_{T+1} - \hat{p} X_T) + \hat{p} Y_T$$

Table A.5

UI Payments in Pima/UI Payments in Arizona under State Program

Dependent Variable: UIPIMA/UIPAYAZ (mean 0.155) $\hat{p}=0.649$

Independent Variables	Coefficient	T Value	Mean	η
Constant	-0.091	-1.599	1.000	
PIMAUN/AZUN	0.270	4.372	0.913	1.589
\bar{R}^2	0.90			
DW	1.789			
S.E.E.	0.020			
Period	196701-197104			

UIPIMA/UIPAYAZ = the ratio of total Pima County UI benefit payments under the state program to total UI benefit payments in Arizona under the state program.

PIMAUN/AZUN = the ratio of the Pima County unemployment rate to the Arizona unemployment rate.

\hat{p} = the estimated first order serial correlation coefficient.

Since Y_{T+1} is not observed and must be estimated, we cannot simply lead equation (56) by one quarter to estimate Y_{T+2} . This would involve compounding the error in the estimate of Y_{T+2} with the error in the estimate of Y_{T+1} . Normally, this is inevitable in forecasting. Fortunately, we have data on Y_{T+3} , X_{T+3} , and X_{T+2} which allow us to obtain an estimate of Y_{T+2} :

$$(57) \quad Y_{T+3} = \hat{a}(1 - \hat{p}) + \hat{b}(X_{T+3} - \hat{p} X_{T+2}) + \hat{p} \hat{Y}_{T+2}$$

which implies

$$(58) \quad \hat{Y}_{T+2} = [Y_{T+3} - \hat{a}(1 - \hat{p}) - \hat{b}(X_{T+3} - \hat{p} X_{T+2})] / \hat{p}.$$

In other words, we are seeking the value of Y_{T+2} which would yield the actual value of Y_{T+3} from the estimated relationship given by equation (55).

Our measure of labor supply is the aggregate labor force participation rate in Pima County. The stochastic specification of the labor force participation relationship used in the study is given by the logit form

$$(59) \quad l_t = 1 / [1 + e^{-(X_t' b + \mu_t)}]$$

where l_t = the labor force participation rate in time t ;

X_t' = a $1 \times k$ vector of independent variables;

b = a $k \times 1$ vector of coefficients; and

μ_t = the disturbance term.

Equation (54) is estimated in its equivalent form,

$$(60) \quad \ln[l_t / (1 - l_t)] = X_t' b + \mu_t,$$

by ordinary least squares.

An advantage of the logit specification is that the predicted and simulated values of l_t are constrained to lie between zero and one.

In addition to expected real weekly UI benefits, labor force participation was specified to be a function of the Pima County unemployment rate, estimated real transitory and permanent real wages in natural logarithms, the reciprocal of the U.S. population (in millions), and seasonal dummy variables for the second and third quarters. The reciprocal of the U.S. population serves as a time trend variable. The permanent real wage variable ($\ln W_{pt}$) is formed as follows:

$$(61) \quad \ln W_{pt} = \ln W_{t-1} + \sum_{j=1}^4 a_j \Delta \ln W_{t-j}$$

$$\sum_{j=1}^4 a_j = 1, \quad 0 < a_j < 1, \quad \text{and} \quad a_j = a_1 \lambda^{j-1}, \quad 0 < \lambda$$

where W_t = the average hourly manufacturing wage in Pima County divided by the CPI for the west;

$$\Delta \ln W_{t-j} = \ln W_{t-j} - \ln W_{t-j-1}; \text{ and}$$

a_j = the weight attached to the j th proportionate wage change.

The transitory wage variable ($\ln W_t^T$) is simply

$$(62) \quad \ln W_t^T = \ln W_t - \ln W_{pt}$$

Equation (60) is estimated for different (a_1, λ) pairs, where for a given trial value of a_1 , a value of λ is obtained from the numerical solution of the following equation implied by the above restrictions on a_j :

$$(63) \quad \frac{1 - a_1}{a_1} = \sum_{j=1}^3 \lambda^j.$$

Our best estimate of the labor force participation relationship is the one corresponding to the value of a_1 which minimized the sum of squared residuals in equation (60).

Elasticity estimates are easily obtained from the logit model. In the case of a variable which is linear in the logit specification, such as the unemployment rate and expected real weekly UI benefit payments, we proceed by denoting the variable and its coefficient by x_1 and b_1 , respectively. Ignoring the disturbance term, we have

$$(64) \quad \frac{\partial \ell}{\partial x_1} = \frac{b_1 e^{-x_1 b_1}}{(1 + e^{-x_1 b_1})^2} .$$

Accordingly the elasticity of ℓ with respect to x_1 is

$$(65) \quad \eta_{\ell \cdot x_1} = \left(\frac{\partial \ell}{\partial x_1} \right) \left(\frac{x_1}{\ell} \right) \\ = \frac{b_1 x_1}{(1 + e^{-x_1 b_1})} .$$

In the case of variables entered in log form (transitory and permanent wages), we proceed by denoting the variable and its coefficient by $\ln x_2$ and b_2 , respectively. The rate of change of ℓ with respect to x_2 is

$$(66) \quad \frac{\partial \ell}{\partial x_2} = \frac{b_2 e^{-x_2 b_2}}{(x_2) (1 + e^{-x_2 b_2})^2}$$

Accordingly the elasticity of ℓ with respect to x_2 is

$$(67) \quad \eta_{\ell \cdot x_2} = \left(\frac{\partial \ell}{\partial x_2} \right) \left(\frac{x_2}{\ell} \right) \\ = \frac{b_2}{(1 + e^{-x_2 b_2})} .$$

Finally, we denote the reciprocal of the U.S. population and its corresponding coefficient by $1/X_3$ and b_3 , respectively. The rate of change of ℓ with respect to X_3 is given by

$$(68) \quad \frac{\partial \ell}{\partial X_3} = \frac{-b_3 e^{-X_3 b_3}}{(X_3)^2 (1 + e^{-X_3 b_3})^2},$$

therefore the elasticity is calculated as

$$(69) \quad \eta_{\ell \cdot X_3} = \left(\frac{\partial \ell}{\partial X_3} \right) \left(\frac{X_3}{\ell} \right) \\ = \frac{-b_3}{(X_3) (1 + e^{-X_3 b_3})}.$$

The above elasticities are evaluated at the mean and reported in Table A.6.

The results in Table A.6 indicate that expected real weekly UI benefits have little or no effect on the labor force participation rate in Pima County. The elasticity implies that, evaluated at the mean, a 100% change in the UI variable would change the labor force participation rate by 3.9% in the same direction. This corresponds to nearly a two percentage point change in the labor force participation rate. While this estimated effect is not inconsequential, the t value associated with the coefficient on the UI variable indicates that at the 10% level of significance we could not reject the null hypothesis that the UI variable has no effect. Also, since the coverage rate, maximum real weekly benefit and one minus the denial rate all enter multiplicatively in forming the UI variable, the estimated elasticity of the labor force participation rate with respect to each of these components is identical to the estimated elasticity for the UI variable.

The absence of UI effect on labor force participation does not necessarily imply that there is no UI effect on the size of the local labor

Table A.6

Labor Force Participation in Pima County

Dependent Variable: $\ln [l/(1-l)]$ (mean 0.0048)

Independent Variable	Coefficient	T Value	Mean	$\eta l \cdot x$
Constant	2.954	8.360	1.000	
PIMAUN (-1)	-0.022	-3.600	4.129	-0.040
RUIVAR (-1)	0.003	1.620	25.996	0.039
LTW	0.691	3.652	-0.002	0.345
LPW	0.919	8.737	1.120	0.458
RPOP	-818.133	-11.886	0.005	2.040
Season 02	0.042	4.111	0.263	
Season 03	0.047	4.879	0.237	

\bar{R}^2 0.961
 DW 1.290
 S.E.E. 0.023
 Period 196601-197502

l = labor force participation rate in Pima County

PIMAUN = Pima County unemployment rate lagged one quarter

RUIVAR(-1) = expected real weekly UI benefit allowance in Arizona, lagged one quarter

LTW = log of transitory real wage variable in Pima County

LPW = log of permanent real wage in Pima County

RPOP = 1/U.S. population (in millions)

Seasons 02, 03 = dummy variables for the second and third quarters, respectively

force. It may be that UI has nearly the same proportionate effect on the size of the adult population in the local labor market as it does on the size of the labor force. If true this would mean virtually no change in the labor force participation rate. Our simulations do indicate a definite effect of UI payments on the size of the adult population in the Tucson SMSA. We have, therefore, estimated the effects of UI on the size of the labor force by applying the same proportionate effect observed on the size of the adult population.

IX. CALCULATION OF THE EFFECTS OF UI PAYMENTS ON THE SIZE OF THE LABOR FORCE AND UNEMPLOYMENT

The effects of UI payments on the labor force and unemployment were calculated by imposing the following restrictions: (1) UI impacts on employment are confined only to wage and salary employment; and (2) the impact of UI effects on the labor force participation rate is set equal to zero. If we denote the presence of UI payments by a 1 and their absence by a 0, then the corresponding sizes of the labor force are calculated according to

$$(70a) \quad L_{1t} = l_{1t} P_{1t}^{16+}$$

$$(70b) \quad L_{0t} = l_{0t} P_{0t}^{16+}$$

where L_{1t} and L_{0t} = the size of the labor force in the presence and absence, respectively, of UI payments in year t.

l_{1t} = the labor force participation rate in year t in the presence of UI benefits; and

P_{1t}^{16+} , P_{0t}^{16+} = the size of the population 16 and over in the presence and absence, respectively, of UI payments in year t.

Thus, our estimate of L_{0t} is obtained from the value of P_{0t}^{16+} generated by the computer simulation.

From the labor force identity

$$(71) \quad L_t = E_t + U_t$$

where E_t = total employment, and U_t = the number unemployed.

We can express the change in the size of the labor force attributable to the presence of UI payments by

$$(72) \quad \Delta L_t = \Delta E_t + \Delta U_t$$

where $\Delta L_t = L_{1t} - L_{0t}$;

ΔE_t = the change in wage and salary employment; and

ΔU_t = the change in the number of unemployed.

Now, ΔL_t is calculated from equations (70a) and (70b), and ΔE_t is calculated directly from the computer simulated values of wage and salary employment in the presence and absence of UI payments. The change in the number of unemployed, ΔU_t , is calculated as a residual according to

$$(73) \quad \Delta U_t = \Delta L_t - \Delta E_t.$$

Given that U_t may also be expressed as

$$(74) \quad \Delta U_t = U_{1t} - U_{0t},$$

the number of unemployed workers in the absence of UI benefit payments, U_{0t} , can be calculated from the relationship

$$(75) \quad U_{0t} = U_{1t} - \Delta U_t$$

where $U_{1t} = u_{1t} \times L_{1t}$, and

u_{1t} = the simulated unemployment rate in the presence of UI payments.

Finally, the unemployment rate in the absence of UI payments is calculated according to

$$(76) \quad u_{0t} = U_{0t}/L_{0t}.$$

Selected References

- Entes, Ruth. Family Support and Expenditures Survey of Unemployment Insurance Claimants in New York State, September 1972 - February 1974, Report under DOL contract with the Unemployment Insurance Service, 1977.
- Ehrenberg, Ronald G. and Ronald L. Oaxaca. "Impacts of Unemployment Insurance on the Duration of Unemployment and the Post-Unemployment Wage," Proceedings of the 28th Annual Winter Meetings of the Industrial Relations Research Association, Industrial Relations Research Association Series, 1976.
- _____. "Unemployment Insurance, Duration of Unemployment and Subsequent Wage Gain," American Economic Review, Vol. 66, No. 5 (December 1976).
- Fair, R.C. "Labor Force Participation, Wage Rates, and Money Illusion," Review of Economics and Statistics, Vol. 53 (May 1971).
- Feldstein, Martin. "The Unemployment Caused by Unemployment Insurance," Proceedings of the Twenty-Eighth Annual Winter Meetings, Industrial Relations Research Association Series, 1976.
- Katz, Arnold, ed. "The Economics of Unemployment Insurance: A Symposium," Industrial and Labor Relations Review, Vol. 30, No. 4 (July 1977).
- Kauffman, et. al. An Analysis of Some of the Effects of Increasing the Duration of Regular Unemployment Insurance Benefits, Report under DOL Contract No. 99-6-806-04-22 with the Unemployment Insurance Service, 1978.
- Lolon, Gary. "Labor Supply Effects of Extended Unemployment Benefits," Technical Staff Paper No. 3, Unemployment Insurance Service, U.S. Department of Labor, 1978.
- Strand, Kenneth and Dernbury, Thomas. "Cyclical Variation in Civilian Labor Force Participation," Review of Economics and Statistics, Vol. 46, No. 4 (November 1964).
- Wachter, M.L. "A Labor Supply Model for Secondary Workers," Review of Economics and Statistics, Vol. 54 (May 1972).

THE UNIVERSITY OF CHICAGO
DEPARTMENT OF CHEMISTRY

REPORT OF THE COMMITTEE ON THE
PROGRESS OF THE DEPARTMENT OF CHEMISTRY
DURING THE YEAR 1950

BY THE DEPARTMENT OF CHEMISTRY
CHICAGO, ILLINOIS

1951

CHICAGO, ILLINOIS

CHICAGO, ILLINOIS

CHICAGO, ILLINOIS

CHICAGO, ILLINOIS

CHICAGO, ILLINOIS

CHICAGO, ILLINOIS

CHICAGO, ILLINOIS

CHICAGO, ILLINOIS

CHICAGO, ILLINOIS