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FORECASTING STATE ECONOMIC GROWTH IN RECESSION AND RECOVERY

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Forecasting state economic growth is a task for which much is asked and in which success is difficult. Yet, with state governments assuming greater fiscal responsibilities, especially when general economic conditions worsen, the need grows for decision-focused state economic forecasts. Federal fiscal and monetary policies, rather than reducing, actually add to, economic uncertainties facing state governments, which also add to difficulties faced in the preparation of state economic forecasts for public decision-making.

The purpose of this paper is to examine current practices in state economic forecasting and to propose needed changes in its structure, content, and strategy. This purpose is pursued in a review and critique of selected short-term, quarter-year and long-term five year forecasts of state economic growth and change. We use Minnesota data for illustrative purposes. We conclude this discussion with a brief examination of state economic forecasts and forecast methods and their implications for state fiscal and economic growth planning and strategy, again with reference to Minnesota.

Economic Linkage and Cyclical Vulnerability

A fundamental characteristic of all U.S. regional economies is economic linkage. This linkage varies with regional self-sufficiency and stage of growth, which, in turn, vary with a region's size, economic base and access to markets and resources.

Economic linkage, while essential to all export-producing industry, enhances a region's economic vulnerability, especially in periods of recession and early recovery when economic activity declines sharply and then reverses direction as general economic prospects improve [3, 5]. Economic vulnerability is heightened when a region has not only forward linkages to rest-of-nation product markets but backward linkages to rest-of-nation resource supplies, like Minnesota's dependence on coal from North Dakota and oil from Kansas and Oklahoma. Economic vulnerability thus extends beyond the short-term fluctuations of the general business cycle to the long-term fluctuations of a product cycle. Minnesota, for example, has already experienced three long cycles of growth and change stemming from the development of its agricultural, forest, and mineral resources. It is now starting still another development cycle based, in part, on its traditional industries but, in part, also, on high technology manufacturing and related business services centered in the Minneapolis-St. Paul metropolitan area.

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State economic vulnerability to the adverse effects of the general business cycle and the regional product cycle is a necessary condition of regional economic linkage and interdependence. Yet, each state is unique in the nature and intensity of its economic linkage and interdependence because of its basic industries and institutions. Each state, for example, can be represented by a unique set of interindustry and interregional transactions which account for state-to-state differences in industry demand and supply multipliers. Over successive years, moreover, the accumulative multiplier effects diverge among states because of natural resource endowments and changing local advantages for, and preferences of, mobile industry and population.

State economic forecasting practice is based generally on the notion of economic linkage. Indeed, most state economic and econometric forecasting models are linked directly to U.S. economic indicators, e.g., Gross National Product and its industry components as represented by the U.S. industry value added series for a region's export-producing industries [4, 9, 10]. Generally, the U.S. demand-driven state economic and econometric models are fitted to annual estimates of industry value added, employment, and earnings. While the long-term five-year forecasts are based on annual data series, they are represented essentially as long-term moving averages of key industry variables, like employment and earnings [15]. Year-to-year fluctuations associated with the general business cycle are sharply reduced in annual forecast series.

Quarterly economic forecast models, while less frequently cited than their annual counterparts, more closely track the general business cycle, especially periods of recession and recovery [1, 12]. The forecast success of these models depends, of course, on their reliability in accurately tracking each cyclical turning point. Such success is limited, however, by the inherent unpredictability of public sector policy changes and private sector responses to these changes. Forecast success is appropriately measured, not simply by the technical precision of the forecast, but by its contribution to the relevant decision-making process which it achieves to the extent that it supports and extends decision-making capacities for coping with the immediate and long-term consequences of policy and market uncertainties. More important than the forecast itself is the process of inferring certain economic consequences from alternative forecast series and devising legislative and administrative approaches for dealing with these consequences insofar as they affect state revenues and expenditures.

Industry Employment

Industry employment is a commonly cited state economic forecast series because of its availability, both in timeliness and industry disaggregation. Two employment forecast series are presented in this report — a quarterly series starting in 1977 Quarter III, as summarized in Table I, and an annual series with a 1978 base year. The short-term forecast is for the period from 1981 Quarter IV to 1983 Quarter II while the long-term forecast is to 1985, 1990 and later years.

Table 1. Selected Economic Indicators, by Forecast Method, Minnesota, 1977 Qtr. III-1983 Qtr. II.

Year and Qtr.-yr.		Total Civilian Employment		Total Earnings				Income Deflator
				Current Dollars		Constant Dollars		
		Forecast*	Projection+	Forecast†	Projection	Forecast	Projection+	1972=100ξ
		(thou.)	(thou.)	(mil.$)	(mil.$)	(mil.$)	(mil.$)	(%)
1977	III	1,848.7	1,935.0	22,498	23,098	15,922	16,347	141.3
	IV	1,832.4	1,944.8	23,490	23,619	16,427	16,517	143.0
1978	I	1,942.1	1,954.7	24,299	24,333	16,666	16,689	145.8
	II	1,955.9	1,964.6	24,975	25,092	16,784	16,863	148.8
	III	1,998.6	1,974.6	25,501	25,780	16,888	17,039	151.3
	IV	1,992.0	1,984.6	26,871	26,478	17,471	17,216	153.8
1979	I	2,003.2	1,994.7	27,646	27,449	17,520	17,395	157.8
	II	2,004.0	2,004.8	28,759	28,352	17,830	17,577	161.3
	III	2,068.6	2,015.0	29,134	29,322	17,646	17,760	165.1
	IV	2,053.2	2,025.2	30,407	30,309	18,056	17,945	168.9
1980	I	2,093.6	2,035.5	30,223	31,350	17,480	18,132	172.9
	II	2,089.3	2,045.9	29,750	32,438	16,808	17,321	177.0
	III	2,084.3	2,056.3	30,202	33,449	16,714	18,511	180.7
	IV	2,047.7	2,066.7	31,011	34,584	16,772	18,704	184.9
1981	I	2,033.6	2,077.2	31,961	35,625	16,955	18,899	188.5
	II	2,063.7	2,087.8	32,462	36,605	16,934	19,095	191.7
	III	2,074.3	2,098.4	32,735	37,772	16,744	19,295	195.5
	IV	2,032.6	2,109.0	33,494	38,758	16,766	19,496	199.8
1982	I	2,001.2	2,119.8	34,198	40,107	16,796	19,699	203.6
	II	2,045.7	2,130.5	35,257	41,341	16,974	19,904	207.7
	III	2,081.0	2,141.3	36,691	42,575	17,332	20,111	211.7
	IV	2,041.8	2,152.2	37,735	43,914	17,462	20,321	216.1
1983	I	2,055.2	2,163.2	39,101	45,255	17,741	20,533	220.4
	II	2,121.4	2,174.1	40,598	48,672	18,075	20,747	234.6

* Based on quarterly estimates of Minnesota wage and salary positions in nonagricultural industries, which correspond to U.S. employees on payroll in nonagricultural establishments reported monthly in *Survey of Current Business* and Data Resources, Inc., February 1982 quarterly forecast (control) series for U.S.

\+ Interpolated from estimated 1978 and projected 1985 values from Minnesota reported in U.S. Department of Commerce, 1980 OBERS BEA Regional Projections, U.S. Government Printing Office, Washington, D.C., 1981.

† Based on U.S. Department of Commerce quarterly estimates of total Minnesota and U.S. earnings and Minnesota earnings rate function in which quarter-to-quarter changes in earnings per worker are explained by quarter-to-quarter changes in lagged earnings per worker, inflation index, and expected employment.

ξ Based on monthly estimates in *Survey of Current Business* and Data Resources, Inc. February 1982 quarterly forecast (control) series for U.S.

During the 1977-79 period total nonagricultural employment increased slightly faster in Minnesota than in the U.S. Starting with the 1981 recession, however, the Minnesota employment level is projected to decline more rapidly and for a longer period than U.S. employment, but, again, the recovery from recession, although delayed, would be accompanied by above-average growth in total employment. Implicit in this measure of Minnesota's economic performance is the expectation that a significant portion of its basic industries would respond strongly in added sales and employment as general economic conditions improve.

The long-term employment forecast prepared by the Bureau of Economic Analysis, U.S. Department of Commerce for the U.S. Water Resources Council is offered as a reference or baseline forecast series [15]. This series shows a gradual increase in total industry employment from 1,989 thousand in 1978 to 2,289 in 1985. Using the shift-share method, all but 15,000 of this increase is attributed to overall national growth [13].

The U.S. industry employment growth rates are partitioned into a quarterly rate and an annual rate in the comparison of short-term and long-term forecasts. For example, U.S. total nonagricultural wage and salary employment increased 1.0 percent from third to fourth quarter, 1978, and 4.3 percent from third quarter, 1977 to third quarter, 1978. The two periods of change are presented for the two-fold purpose of illustrating the degree of variability in both quarterly and annual rates of total and industry-specific employment change and demonstrating the multiplicative nature of the combined five-quarter growth rates. In the same five-quarter period, U.S. mining employment change was 7.7 percent, which compares with a one-quarter aggregate rate of 1.8 percent and a four-quarter aggregate rate of 5.8 percent.

Growth-depressing effects of the general business cycle are demonstrated for the Minnesota economy by the predominance of below-average industry growth rates. During the 1980-81 period, for example, a majority of Minnesota industries experienced below-average growth relative to the corresponding industries in the U.S. The overwhelmingly negative regional differential growth rates manifest the above-average sensitivity of the Minnesota economy to the general business cycle. Conversely, above-average cyclical responsiveness accounts for the overwhelmingly positive regional differential growth rates in the 1983 recovery period.

Relative regional change is represented by the combined differential industry and differential regional effects. [13]. Minnesota's above-average long-term overall growth rate is due to above-average regional industry growth relative to the corresponding U.S. industry. In the recession period of a general business cycle, Minnesota's overall growth usually declines relative to U.S. overall growth, as is demonstrated by the large negative differential regional growth rates. However, most industry employment growth in Minnesota exceeds the corresponding industry growth rates in the U.S. in the OBERS BEA projection series.

An important, but commonly neglected, purpose of long-term forecasts is to provide a baseline for the evaluation of short-term employment estimates and

forecasts in state fiscal and economic growth planning. When the Minnesota quarterly employment series for the 1978-80 period is compared with the interpolated 1979 and 1980 values of the 1978-85 long-term series, a positive employment difference is indicated for practically all industry. Only government employment in 1979 and mining and construction employment in 1980 were below the long-term trend. In the 1981-83 period, however, all but the service industry is forecast with deficit employment. Six above-average growth years, like 1979 and 1980, would be needed to balance the employment losses of the three below-average growth years. Thus forecast differences in the two series provide an initial measure of the impact of inflation and the general business cycle on a state's individual industries and its total employment. Both short-term and long-term state economic forecasts are based on U.S. market requirements, Minnesota market shares of individual industry output, and Minnesota output per worker ratios.

Earnings and Income

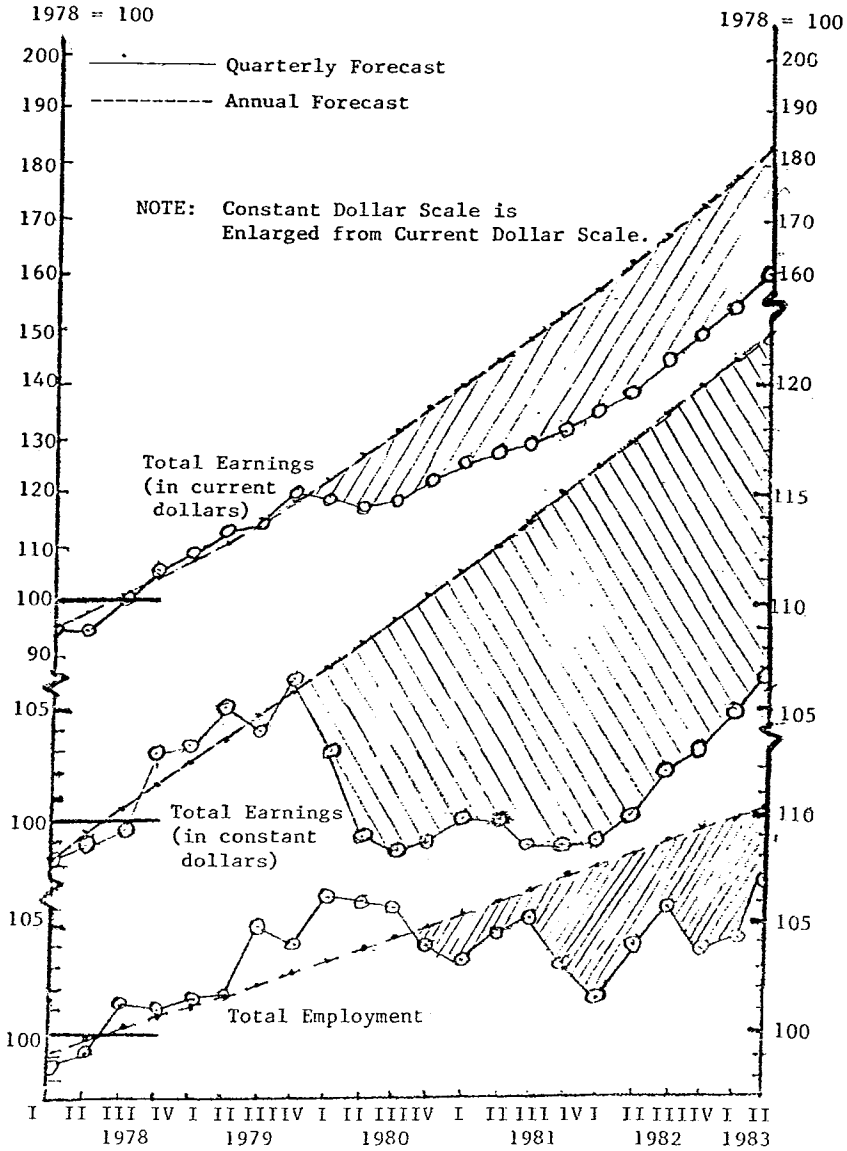
Each of the three principal sources of personal income — total earnings, property income, and transfer payments — are included in the baseline, or reference, statistical series. Of the three, total earnings is the most critical to forecast accuracy because of its importance and volatility. It is a major personal income source and it is, also, a major source of direct taxes for the public sector.

The quarterly forecast of total personal income starts with total wage and salary income, by industry source, or, alternatively, total earnings, by industry source. If wage and salary income is derived, first, then other labor income and proprietorial income must be derived, also, in order to obtain the total earnings component of total personal income. In this report, the alternative approach is used in presenting both the quarterly forecasts and the five-year forecasts of industry earnings.

When total earnings are converted to constant 1972 dollars, the short-term impact of the business cycle and the long-term impact of inflation again are readily demonstrated in the lagging growth of individual industry time series. During the 1977 Qtr. III to 1981 Qtr. II period, a decline in real total earnings in non-durable goods manufacturing signaled the start of the 1980 recession. In the construction, durable goods manufacturing, trade and service industries, the decline in total earnings in 1980 roughly coincided with the 1980 recession. For the construction industry, however, its decline in total earnings in 1981 led the start of the 1981 recession. If monthly data were used, the individual industry series would, of course, more frequently lead the business cycle turning points than the quarterly series. Use of annual forecast series, on the other hand, would result in an almost complete loss of information on industry-specific effects of the general business cycle.

Comparisons of the short-term quarterly total earnings forecasts with the long-term total earnings forecasts show the combined negative income effects (in current dollars) of inflation and recession during the six-year period from 1978 to 1983 (see Table 1). These differences were first derived in 1972

Figure 1. Comparison of Short-term, Quarterly and Long-term Annual Total Earnings and Employment, Minnesota, 1978 Qtr. I-1983 Qtr. II.



dollars and then converted to current dollars using given income deflators. These comparisons are represented in Figure 1 in both current and 1972 dollars.

Actual and forecast quarterly series are compared with the quarterly interpolations of the 1978-85 projection series to show the aggregate effects of inflation and recession in total earnings and of recession on total employment. The 1980 economic decline was indicated first by a sharp drop in total earnings. This decline, which is most clearly evident in constant dollars, preceded the decline in total employment. Both the total employment and the total earnings series thus show the industry specific economic effects of inflation and recession on the Minnesota economy

For example, total employment in 1981 was 2,051,000 rather than the projected 2,093,100 — an employment shortfall of 42,100 for the one year only. Total earnings, in current dollars, were $32,537 million, rather than the projected $36,767 million — a total earnings shortfall of $4,230 million. Projected employment and total earnings shortfalls in 1982 are even larger than the corresponding 1981 short-falls.

The 1980 and 1981-82 recessions, when combined with near double digit inflation, reduced real earnings per worker by ten percent per year over the 1980-83 period. This reduction in the principal source of personal income also reduced the growth of total state and local government revenues. Recent past and projected future state revenue shortfalls are attributed largely to reduced real personal earnings and expenditures and the related decline in business activity.

In brief, the two baseline forecasts show prolonged negative effects of the 1980 and 1981-82 recessions which are equivalent to a net loss of 40,200 in jobs and of $16.3 billion in total earnings over the four-year period from 1980 through 1983 (shown, in part, by the hatchured areas under the long-term trend lines in Figure 1). The earnings loss converts to an over $2 billion state revenue shortfall.

The negative effects of inflation and recession on total earnings occur because of the decline in employment, average hours worked per week, and lagging rates of increase in earnings per worker. While total earning increased each quarter in the 12-quarter period from 1977 Qtr. III to 1979 Qtr. IV, they declined in the first half of 1980 and, again, in 1981, but only in constant dollars, as shown earlier in Figure 1. This decline is explained by an earnings differential, that is, the difference between actual earnings per worker and the interpolated long-term trend value. The earnings differential during the 1979 Quarter IV to the 1981 Quarter II period is attributed to the wage-reducing effect of (1) *expected* employment cutbacks in the 1980 and 1981-82 recessions, and (2) *perceived* price inflation, which is represented by a GNP (personal consumption expenditure) deflator. These two effects, along with the lagged earnings differential, account for the quarter-to-quarter changes in projected total earnings per worker. The three-variable forecast equation used in the preparation of the earnings per worker series for the 1981 Qtr. III to 1983 Qtr. II period is represented by the form,

$$w_{it} - \bar{w}_{it} = a_i + b_i(w_{it-1} - \bar{w}_{it-1}) + c_i\Delta p_t + d_i\Delta\bar{e}_{it},$$

where,

w_{it} = estimated average annual real earnings (in 1972 $) in i-th industry in current quarter-year;

$\bar{w}_{it}$ = projected average annual real earnings (in 1972 $) in i-th industry in current quarter year;

Δp_t = change in income deflator for earnings from preceding quarter year;

$\Delta\bar{e}_{it}$ = expected change in employment in i-th industry from current quarter-year;

In short, the forecast equation shows the earnings per worker differential, $w_{it} - \bar{w}_{it}$, as a function of (1) the earnings per worker differential, lagged one quarter, (2) actual change in inflation index (used in converting earnings per worker from current to constant dollars) and (3) expected change in industry employment. A one-unit change in each of the three explanatory variables accounts for a change in the earnings per worker differential (in 1972 dollars), as follows:

Industry Group	Lagged Earnings (thou. $)	Actual Change in Inflation (1972=100) ($)	Expected Change in Employment (thou.)
1. Agricultural Production	815	–826	25
2. Agr. serv., for., fish	430	–33	0
3. Mining	48	–197	198
4. Construction	85	–371	18
5. Mfg., nondurable goods	348	–214	43
6. Mfg., durable goods	580	–55	20
7. Tran., comm., util.	80	0	37
8. Trade	593	–36	3
9. Fin., ins., real est.	128	–20	184
10. Services	165	–79	18
11. Government	780	–90	15

Thus, in nondurable goods manufacturing, a $1,000 increase in the earnings rate differential this quarter would be associated with a $348 increase in the earnings rate differential in the next quarter, but a one-unit increase in the inflation index this quarter would be associated with a $214 decrease in the earnings rate differential in the next quarter. An expected reduction of 1,000 jobs in this industry would be associated with a decrease of $43 earnings per worker. The individual industry earnings per worker rate is reduced because of fewer hours worked per week and lower earnings per hour, but the reductions vary widely among the 11 industry groups because of differences in labor contracts and interindustry and industry-to-final market linkages.

The earnings per worker differential is a key variable in tracking state economic growth in recession and recovery. When multiplied by industry employment, it becomes a major component of total personal income and, hence, of a state's income-related tax collections. It is, in turn, a key variable in accounting for both short-term and long-term supply-side changes in a state's work force [8, 14]. It is an essential part of any econometric model which purports to accurately track state economic growth in recession and recovery.

Typically, Minnesota's recovery from a recession is delayed relative to U.S. recovery. During each recovery period, earnings per worker increase in the months immediately preceding the recession trough, with large increases continuing well into the recovery stage. These increases in earnings are attributed initially to increases in average weekly hours worked and later to increases in total employment. Thus, the wage rate function is central to any quarterly forecasts for state planning. Important, also, is the forecast of industry employment, which is derived directly from quarter-to-quarter changes in industry output and output per worker.

Forecast Methods

Use of both short-term quarterly forecasts, which closely track the general business cycle, and long-term, five-year forecasts is essential in monitoring state economic growth. Without the two forecast series, an accurate assessment of a state's economic well being, relative to other states, is easily distorted by excessive emphasis on either the short-term or the long-term forecast. Moreover, each state is unique in its cyclical sensititivy and its overall responsiveness to the various stages of either the general business cycle or the regional product cycle. To ignore the uniqueness of a state's cyclical behavior is no less an omission than to ignore a state's close economic linkage to the U.S. economy. Uniqueness and linkage are essential attributes of all regional economic systems.

Recent experience in tracking Minnesota's economic growth has confirmed the need for a three-phase approach in state economic forecasting [12]. The first phase calls for the implementation of a dynamic input-output-based state economic model for long-term regional economic impact simulation and forecasting. The 1980 OBERS BEA projection series serve as a baseline for calibrating the input-output-based model. The simulation runs would track either the State's year-to-year response to the general business cycle or a long-term moving average of the yearly observations. This phase has been completed in several states and is now nearing completion in Minnesota

The second phase of state economic forecast modeling starts with quarterly industry employment, earnings, and related economic indicators. In Minnesota, the quarterly forecast model is essentially an econometric model in which an 11-industry two-region (Minnesota and rest-of-nation) input-output table is embedded. The input-output table provides the industry market (i.e. output) forecasts and related demand and/or supply multipliers for deriving the statewide ripple effects of changes in Minnesota's export-producing industries in different stages of the general business cycle.

Both the quarterly and the annual forecast models include the earnings rate and the labor demand and supply functions cited earlier and, also, state tax and budget functions. The tax function links the private sector to the public sector. It makes possible the forecasting of state and local tax revenues. The budget function links state and local expenditures to state and local revenues and the beneficiaries of the expenditures. It includes decision rules for budget allocations among government functions and between current and capital expenditures.

The third phase of state economic forecast modeling is a critical examination of the annual and the quarterly forecasts, as demonstrated in this review and critique. The shift-share method provides the summary statistics, both quarterly and annual, for comparison and evaluation. The third phase is essentially interpretative and illustrative in its intent. It is not productive. It depends on region-to-nation comparisons and it serves the model user as well as the model builder in its formation feedback role. It thus supports an essential learning process in state economic forecasting.

Central to this three-phase approach to state economic forecasting is its focus on a state's current economic status relative to its long term prospects. It draws attention to the critical importance of cyclical economic behavior in the accurate forecasting of industry employment and earnings and, also, investment and output. Its decision focus draws attention, also, to the importance of state economic linkages and sensitivity to the general economy.

LITERATURE CITED

1. Barnard, Jerald R. and Warren T. Dent. "State Tax Revenues — New Methods of Forecasting," *Annals of Regional Science* 12 (3) November 1979, 1-14.

2. Bennett, R. F. "Regional Monitoring in the U.K.: Imperatives and Implications for Research," *Regional Studies,* 12 (1978), 311-321.

3. Bretzfelder, Robert B. "Contrasting Developments in the States During Recession and Early Recovery," *Survey of Current Business,* 56 (4), April 1976, 30-32.

4. Chang, Hui S. "Regional Econometric Model and the Fiscal Policy of a State: The Case of Tennessee," *Annals of Regional Science,* 11 (2), 1977.

5. Friedenburg, Howard and Robert Bretzfelder. "Sensitivity of Regional and State Nonfarm Wages and Salaries to National Business Cycles, 1948-79," *Survey of Current Business,* 60 (5), May 1980, 15-27.

6. Goldsmith, Oliver Scott. "A State Personal Income Tax Simulation Model," *The Annals of Regional Science,* 13 (1).

7. Gramlich, Edward M. "State and Local Governments and Their Budget Constraint," *International Economic Review,* 10 (2), June 1969, 163-182.

8. Hanson, James A. "The Short-Run Relation Between Growth and Inflation in Latin America: A Quasi-Rational or Consistent Expectations Approach," *The American Economic Review,* 70 (5), December 1980, 972-989.

9. Klein, Lawrence R. and N. J. Glickman, "Econometric Model-Building at Regional Level," *Regional Science and Urban Economics,* 7 (1977), 3-23.

10. L'Esperance, W. L., G. Nestel and D. Fromm. "Gross State Product and an Econometric Model of a State," *American Statistical Association Journal,* 64 (1969), 787-807.

11. L'Esperance, W. L., A. R. King, and R. Sines. "Conjoining an Ohio Input-Output Model with an Econometric Model of Ohio," *Regional Science Perspectives,* 6 (1977), 54-77.

12. Maki, Wilbur R. Minnesota State Revenue Trends and Forecasts. Staff Paper Series P81-19. Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, August, 1981.

13. Maki, Wilbur R., Carlo del Ninno, and Peter Stenberg. *Minnesota's Economic Growth in Recession and Recovery: Part I,* Staff Paper Series P82-2, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, Minnesota, February 1982.

14. Treyz, George I., Ann F. Friedlander and Benjamin H. Stevens. "The Employment Sector of a Regional Policy Simulation Model," *Review of Economics and Statistics,* 62 (1), February 1980, 63-73.

15. U.S. Department of Commerce, Regional Economic Analysis Division. "Regional and State Projections of Income, Employment and Population to the Year 2000," *Survey of Current Business,* 60 (11), 1980, 44-70.