An Index of Leading Economic Indicators for the Fargo-Moorhead Statistical Area

Oscar Flores
Department of Economics
Minnesota State University Moorhead
Moorhead, MN 56563

(218) 236-3499
flores@mnstate.edu

An index of leading economic indicators for a small MSA is developed and tested with "causality" F-tests and cointegration analysis. The tests indicate that the index performs well in forecasting the local economy. The use of cointegration analysis to test the performance of the index is a contribution to the leading indicators literature.

There is considerable demand for a forecasting tool at the local level. Chambers of Commerce and the local media are particularly interested in such a tool. The goal in this paper is to develop and test a Leading Economic Indicators Index (LEI) to forecast the short-term behavior of the economy in the Fargo, ND-Moorhead, MN Metropolitan Statistical Area (FM). We conclude that, used with caution, our index is useful in forecasting the FM economy. A contribution of our paper to the LEI literature is the use of cointegration analysis to test performance.

Below we present a review of the literature on regional and local LEI. In the second section, we discuss the methodology used to develop the index for the FM economy. We evaluate the Index and present some concluding comments.

Four considerations guide the development of an LEI: the selection of a measure of local economic activity, the selection of variables to be included in the index, the weight of the variables, and performance of the index. There are two approaches to derive LEI, the "traditional" and the Stock-Watson (SW) method. The main difference between both approaches is that the SW methodology relies on modern time-series analysis in all aspects of the creation of the index, while the "traditional" indexes use simpler techniques. We review "traditional" indexes first.

Literature Review

While dozens of "traditional" local LEI are available, we believe that the indexes developed by Kozlowski (1977), Lesage and Magura (1987), and Crane (1993) are representative of this approach and as such we will concentrate the discussion on these three indexes. Traditional indexes use employment (payrolls) as the measurement of economic activity at the local or state level because of the lack of a single alternative variable, such as GDP, that would measure local economic activity. For instance, Kozlowski (1977), Lesage and Magura (1987), and Crane (1993) use payrolls in developing the indexes for Kalamazoo, Mich., the state of Ohio, and Milwaukee, Wis., respectively.

There is agreement that the components of the index should be selected on the basis of economic intuition and availability of data. Further, there should be a statistically significant relationship between the candidate variables and local employment. Little consensus exists, however, as to how to interpret this statistical relationship. Each of the papers discussed uses a different approach. Kozlowski (1977) relies on graphical observation of the peaks and troughs of candidate variables in relation to employment. Lesage and Magura (1987) use graphical observation as well and, in addition, run a regression with employment as a dependent variable. They discriminate among candidate variables by entering them sequentially in the regression and using the Final Prediction Error criterion to select the variables to be included in their index. Crane (1993) also uses graphical analysis and discriminates among the final candidate variables by running a regression of seasonally adjusted standardized changes in employment on lagged values of itself and each of the candidate variables. A variable was selected if the lagged values of the candidate variable "added significant explanatory power" (p. 274) to the equation.

There is also no consensus on how to weigh the components of the index. Crane (1993) uses the simple average of the components. Kozlowski (1977) attempts of minimize the impact of the most volatile variables on the index by giving them a lower weight than more stable variables. Lesage and Magura (1987) instead use OLS regressions with employment as the dependent variable and lagged indicators as the independent variables. They run six regressions, with lags one to six, and chose the regression that minimizes the out-of-sample difference between predicted and observed employment.

The three papers reviewed evaluate performance by visually observing whether the indexes signal upcoming cyclical movements, without providing false signals.

Kozlowski (1987) examines the effectiveness of published indexes in four cities (Detroit, Fort Wayne, Memphis, and Toledo) and three states (Nebraska, South Carolina, and Texas). He concludes that the indexes do provide signals of turning points in the local economy and can provide quantitative forecasts of changes in employment. He also tests the performance of the indexes by using an F-causality test. In addition, by reconstructing the seven local indexes, he evaluates the relative effectiveness of equally weighted indexes against indexes with weights inverse to the variability of the components. He concludes that weighted averages perform better than simple average weights.

More recently the Stock-Watson approach has been used by Clayton-Matthews and Stock (1998/99) to estimate the LEI for Massachusetts and Crone and Babyak (1996) estimate LEI for New Jersey and Pennsylvania. In the SW approach, a coincident index (CI) measuring the "state of the economy" is estimated using dynamic factor analysis, instead of relying on a single variable to measure economic activity as "traditional" indexes do.

If the CI truly reflects the state of the economy, a good forecast of the CI should be a good leading index. The equation to forecast the CI includes lagged values of itself and additional variables. The model used to forecast is chosen among many specifications using the Bayesian Information Criteria and the Predictive Least Square Sum of Residuals Criterion. Clayton-Matthews and Stock (1998/99) chose among 6132 alternative specifications.

These leading indexes are evaluated by inspecting whether the indexes provided signals for recessions and expansions in these states. During the 1982 to 1998 period, the index for Massachusetts missed two out-of sample turning points and gave the correct signal for four in-sample turning points. The indexes for New Jersey and Pennsylvania for the period 1973-1994 signaled all the recessions, but gave one false signal for Pennsylvania and two for New Jersey.

Phillips (1998/99) provides the only comparison between the "traditional" and SW indexes of which we are aware. He compares the performance of the national LEI published by the Conference Board with the Stock-Watson index. Phillips first estimates the probability of a national recession applying a non-linear regime switching model to the Conference Board Index and then compares these estimates to the probability of national recession published by Stock and Watson. For the 1990-91 recession, the Conference Board index gave the strongest signal of recession while the Stock-Watson Index gave no recession signals for the first half of 1990. Phillips concludes that, "the traditional leading index is still a useful tool for monitoring the ebb and flow of regional and national economies" (p. 141).

A Leading Economic Indicators Index for the Fargo-Moorhead MSA

In this paper we construct a traditional index of LEI for the Fargo, ND-Moorhead, MN MSA. We test performance by observing turning points, running causality tests, and using cointegration analysis. To our knowledge, no other study has used cointegration analysis to test the performance of an LEI.

We select this approach for several reasons. First, in smaller MSAs, there is paucity of data, so availability becomes an important criterion in choosing the components of the index. Second, exiting evidence from Phillips (1998/99) indicates that more statistically sophisticated and computationally expensive indexes do not yield better results than traditional indexes.

Selection and Weighting of Indicators

A large number of variables have been used as components of local and regional LEIs. Among the most frequently used are residential building permits, initial claims of unemployment insurance, and average workweek in manufacturing (see Kozlowski (1987)).

In selecting the indicators, we used the following criteria: First, there had to be some economic intuition for inclusion. Second, the indicators had to be available on a monthly basis. Third, we discarded potential indicators if the correlation between lagged values of the series and values of current employment fell below absolute 0.30. Admittedly, availability of data played a significant role in our selection of indicators.

In developing the Fargo-Moorhead index, monthly data covering January 1989 to February 2002 were used. While a longer data set would have been desirable, the City of Fargo has building permit data available beginning in 1989.

We select payrolls as a proxy for economic activity following other "traditional" indexes, recognizing that the correlation between economic activity and payrolls may breakdown. Two examples will suffice: if economic growth is caused by increases in labor productivity then payrolls may not increase; or, during a recession full-time jobs may be converted into part-time jobs, showing no net loss of jobs. We, however, make no attempt to correct for these biases. We also considered using retail sales as a proxy for economic activity. Unfortunately, the state of Minnesota did not keep the data for 1997.

Our index components then are Help Wanted Ads (HWA), Remodeling Permits (REM), Permits for New Buildings (NBP), Average Weekly Hours in Manufacturing (AWH), National Employment (NE), and National Leading Indicators (NLI). All variables except NE and NLI were seasonally adjusted using the additive method in E-Views. NE and NLI are seasonally adjusted by their source. An index for each variable (1996=100) is calculated.

We also considered including initial unemployment claims as part of the index. Surprisingly, however, the correlation coefficient between payrolls and lagged observations of unemployment claims was too low: -0.03, -0.07, -0.10, for two-, three-, and four-month lags respectively.

We argue that changes in HWA reflect changes in near-future labor demand as it reflects employers' hiring intentions. As HWA increase, near-future increases in employment are expected. Employment ads are measured as the number of inches of want ads, also known as lineage, appearing in the Sunday issue of *The Forum*, the local newspaper. We obtained this series by manually measuring the number of inches for each Sunday issue from January 1989 to date. We then found the average lineage for each month. This approach follows Crane (1993) who uses HWA in developing the index for Milwaukee, Wis., and the Conference Board which also includes lineage in their national index.

NBP and REM measure people's confidence in the local economy and near-future investment in the area. Increases in NBP and REM are expected to signal future increases in employment. We use data for the City of Fargo only because we could not obtain a monthly breakdown dating back to 1989 for the other cities of MSA: Moorhead, Minn., Dilworth, Minn., and West Fargo, N. D. We use the number of permits, not the dollar value of the project for which permits are issued. The data are obtained from the Office of Building Inspection of the City of Fargo.

The indexes reviewed include permits for residential construction only. However, since most new businesses build or remodel an existing location before opening and existing businesses require a permit before expanding, building permits to businesses partially reflect increases in investment by the business sector and therefore are included in NBP and REM.

Current increases in Average Weekly Working Hours may indicate future increases in employment. At the beginning of an economic expansion, employers may not be confident enough to start adding workers, instead they may rely on overtime and, only as the expansion continues, will they hire more workers. We obtain the data from North Dakota Job Services. This, as mentioned above, is one of the most frequently used components of LEIs.

Both NLI and NE are included in the index to reflect the linkage between the FM economy and the national economy. The NLI is obtained from the Conference Board and National Employment from the Bureau of Labor Statistics. Of the indexes reviewed, only Crane includes the NLI and while some have included national components, none have included NE. Yet, we include them because we believe our economy is linked to the national economy, the series are easily available, and the correlation between lagged NE and NLI and payrolls is above .90.

Following Kozlowski (1977), the weight of each component in our index is the inverse of its variability over time: that is, the greater the absolute month-to-month average variation exhibited by a series, the lower its weight, preventing an unstable series to dominate the movement of the composite index. This type of weighting outperforms simple average weights (Kozlowski's (1987)). The steps to calculate the weights are as follows. First, estimate $\Delta_j\%$ = average absolute percentage change of indicator j, and $\sum\Delta_j\%$. Second, obtain $(1/\Delta_j\%)$ and $\sum(1/\Delta_j\%)$. The weight of indicator j is $[(1/\Delta_j\%)/\sum(1/\Delta_j\%)]*100$. This procedure yields FM LEI =NE* (50.6%)+ NLI* (32.9%)+ HWA* (6.6%)+ AWH* (3.9%)+ REM* (3.1%)+ NBP* (2.8%).

Performance of the LEI

Performance is evaluated by visually assessing the FM index, using the F-test, and testing whether the FM index is cointegrated with local employment.

Performance of LEIs is often evaluated by observing whether the indexes provide signals of cyclical movements without providing false signals. The test period is January 1989 to January 2002. Also, let us define a signal of an expansion (recession) as increases (decreases) for at least three consecutive months in the FM index.

As Figure 1 shows, the FM area seems to have two periods of slow growth–one in 1990 and the second beginning mid-2000–but no recessions. Hence, we can not evaluate whether our index correctly signals recessions. The index however did provide a faint false signal of a recession in 1992 (five consecutive slight declines in the index).

Because of the lack of turning points in the test period, we will evaluate the index by examining it at all points in our period of study. Auerbach, in evaluating the National Leading Index, suggests it is important to examine the relationship between leading indexes and the series being forecast at all points, not just at turning points. To do so, Auerbach tests whether the index "causes" a series that measures the general state of the economy. Later, Kozlowski (1987) uses this approach to test the performance of several local indicators.

We use Auerbach approach as well. That is, we test whether the FM index, LEI, "causes" employment, E. This is done by estimating the unrestricted regression (1) $\Delta E = \alpha_0 + \alpha_1 \Delta E_{t-1} + \ldots + \alpha_k \Delta E_{t-k} + \beta_1 \Delta LEI_{t-1} + \ldots + \beta_k \Delta LEI_{t-k} + e_t$ and the restricted regression $\beta_1 = \beta_2 = \ldots = \beta k = 0$. If the sum of squared errors of the unrestricted equation is statistically smaller than the sum of squared errors of the restricted equation, then the LEI "causes" E. This hypothesis is tested by using an F-test which assumes that both ΔE and ΔLEI are stationary. To test for nonstationarity, we ran Augmented

TABLE 1
Causality Test of the Leading Indicator Sample Period 1989: 1-2002:1; n=156

Lags	F-Statistic
7	2.69
8	2.32
9	1.92
10	1.98

All significant at the 0.05 level

Dickey-Fuller Tests for E, LEI, ΔE, and ΔLEI (see tables with test results in Appendix). For both LEI and E the null hypothesis of nonstationarity could not be rejected. For ΔE and ΔLEI nonstationarity was rejected. In addition, we found no autocorrelation among the residuals.

We ran four F-tests, with the first lag set to one and the last lag set to seven, eight, nine, and ten. The coefficients for lags eleven and beyond were not significant. The F-test suggests that changes in the index are helpful in predicting changes in employment.

Lastly, we test whether LEI and payrolls are cointegrated. If they are, they exhibit a long-term equilibrium relationship and they do not diverge too far from each other. Two nonstationary I(1) variables, such as LEI and E, are cointegrated if a linear function of the two is stationary. We test whether the residuals of regressing E on LEI are stationary. Both t-tests and F-tests show that the appropriate number of lags to be included in the ADF test is three.

To determine the appropriate specification for the ADF model to test for nonstationarity of the residuals of the regression of E on LEI, we follow the guidelines suggested by Enders (pp. 256-257). Since nonstationarity cannot be rejected at any level in the intercept and trend model and can be rejected at the 5% level with the intercept model, we test whether the coefficients for the time trend and intercept are statistically equal to zero, see Table 2 below. The t-statistic for the trend and intercept components were lower than the appropriate (-statistic, these results were confirmed with the modified F-test (using the (-statistic). Hence, we select the ADF model with neither intercept nor trend and three lags to test for nonstationarity; in this case the null hypothesis of nonstationarity is rejected at all levels. We conclude that index for the FM MSA and payrolls are cointegrated and hence that there is a long-term equilibrium relationship between our leading indicator index and payrolls.

Final Comments

We have tested the performance of the LEI with graphical observation, the F-test, and cointegration analysis. Graphical observation shows that the index has given a faint false signal of a recession. The F-test suggests that lagged changes in LEI help predict current changes in employment. In addition, employment and LEI are cointegrated implying that they do not diverge from each other. All together these tests indicate that the index of local economic indicators for the FM MSA performs a respectable job at predicting changes in local employment conditions.

The LEI developed here helps predict the near-future behavior of the FM economy confirming Kozlowski's (1987) findings that traditional local LEI's are useful in predicting the future direction of local economies.

TABLE 2
ADF Test for Residuals of E on LEI Sample Period 1989:1-2002:1

ADF(k) Test Statistic (critical values at the 5% level of significance)

Variable	General Model equation 2	Model with No Trend $a_2=0$	Neither Intercept nor Trend $a_2=a_0=0$
y	-2.61 (-3.44)	-2.64 (-2.88)	-2.63 (-1.95)
a_2	0.22 (2.79)		
a_0	0.16 (3.09)	0.76 (2.54)	
RSS	345.44	345.56	346.90

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TABLE 3
Nonstationarity Test for E

	ADF (k) Test Statistic for LEI		
	General Model equation 2	Model with No Trend a_2=0	Neither Intercept nor Trend a_2=a_0=0
ADF (k) Test Statistics	-1.85	-0.47	2.79
Critical Value at the 5% Level	-3.44	-2.88	-1.95

TABLE 4
Nonstationarity Test for E

	General Model equation 2	Model with No Trend a_2=0	Neither Intercept nor Trend a_2=a_0=0
ADF (k) Test Statistics	-2.55	-0.67	4.35
Critical Value at the 5% Level	-3.44	-2.88	-1.95

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Appendix

In this appendix, we include the results of the Augmented Dickey-Fuller tests on the Leading Economic Indicators (LEI), payroll (E), differenced LEI and E, and on the residuals of regressing E on LEI.

Following Enders (1995, p. 227), we selected the lags to be used in the test by first choosing a long lag length and paring down the model using the t- and F-test. For example, if the t-statistic at twelve months lag is insignificant, we reduced the lags to eleven and successively until the lag is statistically different from zero. This was confirmed with the F-test.

The ADF model to test for nonstationarity was selected following Enders (pp. 256-257) as well. We begin with the more general model and if the null hypothesis of nonstationarity cannot be rejected, we use the (-statistic to test if the trend is different from zero. If it is not, we use the model with a drift. If we cannot reject nonstationarity, we test whether the drift is different from zero. If not, we use the ADF model with neither drift nor trend.

For Payroll (E) on Table 4, the null hypothesis of nonstationarity cannot be rejected with any model or lag. To save space, we have only included lags 1, 3, and 12. For the LEI on Table 3, the null hypothesis of nonstationarity cannot be rejected for lags above 3 with any model. The null hypothesis can be rejected at the 10% level for the model with both drift and intercept with one lag. However, using the t and F-test described above, we conclude that the appropriate lag is three for which nonstationarity cannot be rejected.

In the case of differenced E and LEI the null hypothesis of nonstationarity can be rejected with the more general model and long lags. For differenced LEI, the null hypothesis can be rejected at the 10% level with twelve lags. Since this confidence level is high, we tested whether fewer lags would be appropriate. The appropriate lags are 2 and the null hypothesis is clearly rejected. See Table 5.

For differenced E, it is clear that even at long lags the null hypothesis of nonstationarity can be rejected with the model with both drift and trend (Table 6). Consequently we did not attempt to find if the appropriate lags are ten or less as the ADF is bound to increase with fewer lags.