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The Midwest Stock Price Index—Leading Indicator of Regional Economic Activity

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I. Introduction

Accurate forecasting of economic growth, whether nationally or regionally, is an important objective for strategic planners and policy makers. Being able to properly estimate the future direction of the economy leads to better economic decisions. A constant challenge to analysts has been how best to approach the problem of predicting the future course of a sector. Analysts use many techniques to find the best forecast, varying from econometric models incorporating existing data to combining data to form an indicator that can be used for forecasting.[1] The Standard & Poor's 500 Stock Price Index (S & P 500 Stock Price Index) is an example of a series created by combining existing data to form a composite series that can be used for forecasting. Indeed, the S & P 500 Stock Price Index is a widely used leading economic indicator for the U.S. economy. While national indicators are often used to predict regional activity, it is more appropriate to work with indicators that are attuned to regional conditions. These regional indicators should have the ability to detect factors particular to the region that the national indicators would not capture. The purpose of this working paper is to develop a regionally based tool to forecast regional activity and then analyze and compare its performance as a forecasting tool with the S & P 500 Stock Price Index. The results indicate that this new regional stock price index tool can out-perform the S & P 500 Stock Price Index in regional forecasting.

II. Stock price movements as economic indicators

Because of its national scope, however, the S & P 500 Stock Price Index might not be the best indicator of regional economic performance. Regional economies vary dramatically in industrial structure and often move somewhat independently of other regions. For example, the S & P 500 Stock Price Index declined due to the government cutbacks in defense spending, that reduction in spending had a dramatic impact on California, while in the Midwest the effect of those cutbacks was hardly noticeable. If the S & P 500 Stock Price Index was used to explain Midwest activity, that particular downturn in the index would lead to erroneous results. A Midwest based stock price index should provide more region-specific information about the Midwest's economic performance. With this in mind, this paper is organized in three parts: 1) To construct a Midwest Stock Price Index, 2) to compare its regional economic explanatory properties with the S & P 500 Stock Price Index, 3) to examine and compare its forecasting ability of the regional economy with the S & P 500 Stock Price Index.

III. Data sources

Stock price data for companies headquartered in the five states that comprise the Seventh Federal Reserve District (Illinois, Indiana, Iowa, Michigan, and Wisconsin) were acquired from the Compustat database, covering the period January 1988 through June 1992. Of the 632 Midwest companies on the Compustat database, 232 companies were eliminated because they did not have continuous stock price information over the entire period. For the companies that were missing employment information on the Compustat data base, the Standard & Poor's Register for 1991 provided the missing values. Table 1 presents the industry distribution of the 400 companies in the Midwest Stock Price Index as compared with the Midwest distribution of all companies for 1989. The distribution of companies in the Midwest Stock Price Index are quite different than the actual distribution of companies in the Midwest. The Midwest Stock Price Index has a greater percentage of Mining, Manufacturing, Transportation and Public Utilities, and Finance, Insurance, and Real Estate. This is because only companies that have publicly traded stock, which tend to be large companies, comprise the Midwest Stock Price Index. The industries that are over-represented in the Midwest Stock Price Index tend to be industries that have a large number of employees per company. For example, while the number of construction companies made up nine percent of the total number of companies in the Midwest, the average construction company employed only eight people. It is hard to imagine having a publicly traded stock for a company with only eight employees. In order to make the stock price index more representative of the regional economy it will be necessary to adjust the index accordingly. This issue will be dealt with later in the paper.

Table 1
Midwest industry distribution

Industry classification	Midwest companies	Midwest percent	Avg. no. empl	Stock index companies	Stock index percent
Ag., forestry, & fishing	9,124	1.2	6	0	0.0
Mining	2,152	0.3	19	4	1.0
Construction	68,299	9.1	8	3	0.8
Manufacturing	55,447	7.4	62	232	58.0
Trans. & pub. util.	30,781	4.1	22	41	10.3
Wholesale trade	63,190	8.4	14	15	3.8
Retail trade	200,632	26.8	14	29	7.3
Fin., ins., real estate	64,804	8.7	14	49	12.3
Services	254,027	33.9	14	27	6.8
Total	748,456		17	400	

There are a several issues about the construction of the index that need to be discussed. First, each company in the Compustat database is assigned one Standard Industrial Classification (SIC) code based on the company's primary line of business. This SIC code is typically a four-digit code, but several companies are assigned either three or two-digit codes. Only when the company is involved in more than one two digit industry does the problem of having only one SIC assigned exist. Given the number of possible instances of this happening it is not considered to be a major problem. Second, the location of the company was based on the location of the headquarters even though there is a chance that the company may do the bulk of their production outside of the Midwest. The fact that many of the companies operate outside the geographic boundaries of the Midwest, the impact locally of factors that affect these companies is still considered to be quite large. The same type of issue is at play when using the S & P 500 to forecast the national economy. Many things outside the U.S. will have an affect on those companies in the U.S. Third, companies may not have been in the Midwest over the entire time period studied. Only those companies that were located in the Midwest in June 1992 were included. If a company moved to the Midwest in any period prior to June 1992 they are considered to be a Midwest company. If a Midwestern company moved to a non-Midwestern state prior to June 1992 it was not included in the index. This problem is not considered to be widespread enough to cause any major problems. Finally, the technique of weighing the individual stock prices needs to be addressed. The S & P 500 Stock Price Index is constructed by weighing the stock prices of the companies in the index by their respective market value, thus allowing the index to be representative of the market value of the overall stock market. The Midwest Stock Price Index is intended to be representative of the Midwest economy and not of the stock market. Therefore, a different weighing scheme, one that would reflect the regional economy, needs to be used. One good proxy for the distribution of industries in a region, that is readily available with quite a bit of detail, is state employment by SIC code. So by weighing the companies in the Midwest Stock Price Index by their respective share of employment in the region would yield an index that reflects the midwest economy.

IV. Construction of the Midwest Stock Price Index

Equation 1 illustrates how stock price indexes were generated for each four-digit SIC code with January 1988 equalling 100. If a particular four-digit SIC contained only one company, the indexed stock price for this SIC code was created using the stock prices for this one company. If more than one company was in a particular SIC code, an employment weighted stock price index was calculated. The stock price for each company in that SIC code was multiplied by their relative company employment share between the different companies in that SIC code.

$$si_{jt} = \left[\sum_{i=1}^{r} \hat{w}_{ij} \frac{P_{ijt}}{P_{ij\,JAN88}} \right] \times 100 \qquad (1)$$

$$\text{where} \quad \hat{w}_{ij} = \frac{N_{ij}}{\sum_{i=1}^{r} N_{ij}} \quad , \qquad \sum_{i=1}^{r} \hat{w}_{ij} = 1$$

si_{jt} = *Stock price index for four-digit SIC j at time period t.*

$\hat{w}_{ij}$ = *Weight for individual company i in four-digit SIC j.*

N_{ij} = *Employment for company i in four-digit SIC j.*

P_{ijt} = *Stock price for company i in four-digit SIC j at time period t.*

r = *The number of companies in four-digit SIC j.*

$$SI_t = \sum_{j=1}^{p} \{ \tilde{w}_j \, si_{jt} \} \qquad (2)$$

$$\text{where} \quad \sum_{j=1}^{p} \tilde{w}_j = 1$$

SI_t = *Midwest Stock Price Index at time period t.*

$\tilde{w}_j$ = *Weight for four-digit SIC j.*

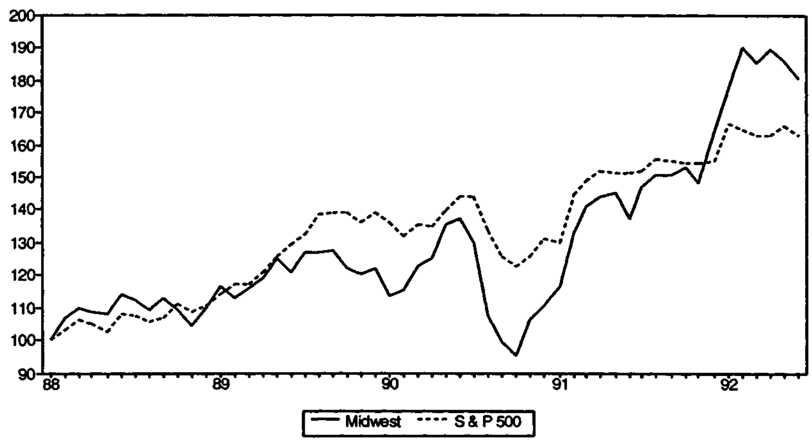
p = *The number of four-digit SIC groups in the index.*

Equation 2 demonstrates the way the four-digit stock price indexes were combined into one overall stock price index. Weights were chosen to reflect Midwest employment at the two-digit level. In the most extreme example, if a two-digit category contained only one four-digit industry, the entire employment for that two-digit industry would be assigned to the four-digit industry. As more four-digit industries comprise a two-digit industry, the respective employment in each four-digit industry in the Midwest would determine its share of the two-digit Midwest employment weight. The weights were then multiplied by the stock price indexes for each four-digit SIC code and the products of those calculations were then summed to create the Midwest Stock Price Index.

V. Comparison of the Midwest and S & P 500 Stock Price Indexes

A comparison between the Midwest Stock Price Index and the S & P 500 Stock Price Index yields some interesting differences. Figure 1 graphs both the Midwest Stock Price Index and the S & P 500 Stock Price Index. The correlation between S & P 500 Stock Price Index and the Midwest Stock Price Index indicate that they are somewhat similar in their monthly pattern. The correlation between the levels and the percentage changes of the two indexes is 0.868 and 0.686, respectively.

Figure 1
Midwest and S & P 500 stock price indexes



There are some major differences between the two indexes in terms of their construction and what they attempt to measure. First, the S & P 500 Stock Price Index includes 500 stocks chosen with the aim of achieving a distribution by broad industry groupings that approximates the distribution of these groupings in the New York Stock Exchange common stock population. The S & P 500 Stock Price Index represents 78 percent of the total market capitalization of all domestic stocks. However, the S & P 500 Stock Price Index is heavily dominated by large-capitalized stocks with over 50 percent of its total market value accounted for by the 50 largest stocks. While, the Midwest Stock Price Index uses the stock prices of 400 companies located in the five states that make up the Seventh Federal Reserve District regardless of industry distribution or capitalization. Second, the S & P 500 Stock Price Index includes dividends paid by their companies. The Midwest Stock Price Index uses only stock prices in its construction due to the more timely nature of stock prices compared with dividends that are paid quarterly and tend to lag contemporaneous stock prices. Third, the weighing of the S & P 500 Stock Price Index uses the market value of the company calculated by multiplying the number of shares outstanding times the price of the stock. The Midwest Stock Price Index uses the employment of each company to determine a four-digit SIC stock index and then employment in the Midwest for each SIC to sum to the total stock index value.

The two indexes also differ in their primary objective. While the S & P 500 Stock Price Index exists to represent the pattern of common stock price movement, the purpose of the Midwest Stock Price Index is to be a better indicator of future performance of the regional economy, for example to aid in predicting growth in employment. The difference in the weighing schemes is due to this different focus on what each index hopes to measure.

If the Midwest Stock Price Index is to be used to anticipate future economic activity in the Midwest, it should be representative of the structure of the Midwest economy. Table 2 below shows the distribution of employment in the Midwest and the distribution of employment weights used in the index. The weights are close to the percentage in the population which indicates that the employment represented by the companies included in the index are close to the distribution of actual employment.

Table 2
Midwest industry employment percent and employment weights

Industry classification	SIC codes	Actual Midwest percent	Stock index weight
Ag., forestry, & fishing	00-09	0.4	0.0
Mining	10-14	0.3	0.2
Construction	15-19	4.4	1.6
Manufacturing	20-39	26.8	30.0
Trans. & pub. util.	40-49	5.3	5.9
Wholesale trade	50-51	6.7	7.8
Retail trade	52-59	21.3	22.3
Fin., ins., real estate	60-69	7.0	8.5
Services	70-89	27.7	23.7

VI. Analysis of midwest employment using stock price indexes

Regression models with percent differences from trend employment as the dependent variable and percent differences from trend stock price indexes as the independent variables—estimated through December 1991, reserving the 1992 values for out of sample testing. The models were estimated by eliminating insignificant independent variables one at a time until all the remaining independent variables had t values that were at least below the ten percent probability level. Table 3 presents the initial estimated coefficients for both indexes.

Table 3

Regression models with percent differences from trend employment as the dependent variable and percent differences from trend stock price indexes as the independent variables—estimated through December 1991

Variable	S & P 500 coefficients	t-value	Midwest stock index coefficients	t-value
Intercept	-0.011016	-0.525	0.022105	1.013
Lag 2	0.027301	2.810	--	--
Lag 3	-0.021528	-2.391	0.016029	3.443
Lag 4	--	--	-0.021704	-3.377
Lag 5	0.019747	2.544	0.021427	4.159
Lag 11	0.020325	2.199	0.014335	3.526
Lag 12	0.031379	2.123	--	--
Lag 13	-0.051768	-3.390	-0.012622	-2.504
Lag 14	0.035087	3.536	0.011102	2.261
Lag 17	0.043647	3.662	--	--
Lag 18	-0.048942	-3.735	--	--
r-square	0.6736		0.5040	
Root MSE	0.1102		0.1241	

The regression coefficients represent the percentage changes above trend that would result to employment in the Midwest from a one percent change above trend in stock prices. For example, if the S & P 500 Stock Price Index grew by one percent, the sum of the coefficients indicates that employment in the Midwest would be .044 percent above trend. For the Midwest Stock Price Index, a one percent growth rate above its trend would generate a .051 percent above-trend growth rate for employment. Both models do a very good job of explaining movements in employment. By having an R-square value of .67 it appears that the S & P 500 Stock Price Index does a better job at explaining variations in employment than the Midwest Stock Price Index which has an R-square value of .50. The root mean square errors for both models are very similar with the S & P 500 Stock Price Index having a slightly lower value. Figures 2 and 3 illustrate the fitted values for the regression equations.

Figure 2
Midwest employment—regression using the midwest stock price index

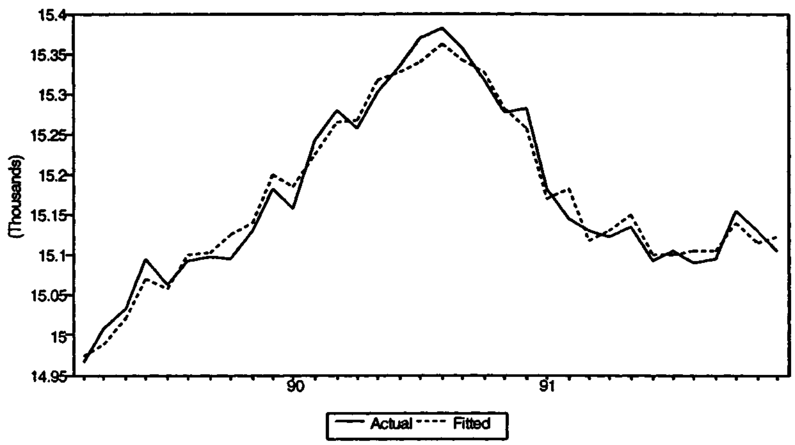
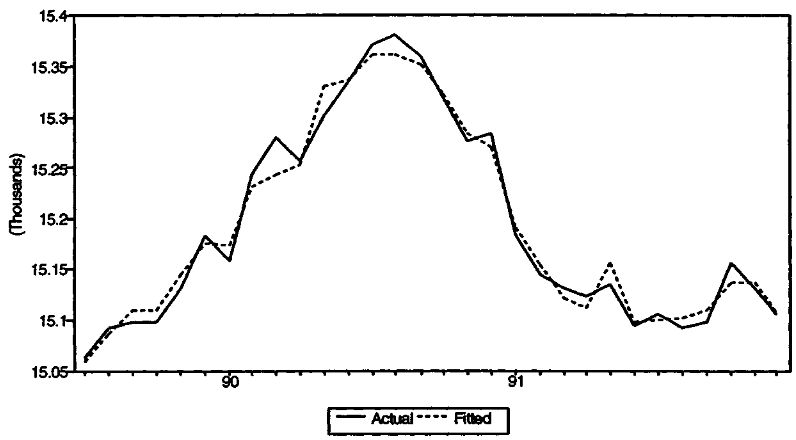


Figure 3
Midwest employment—regression using the S & P 500 stock price index



However, before concluding that the S & P 500 Stock Price Index model is a significantly better model at explaining employment in the Midwest a couple of other factors need to be examined. The S & P 500 Stock Price Index model's first lag is lag 2. This allows the model to forecast ahead by 2 months. For example, if the last actual index value available is December 1992 the S & P Stock Price Index model could forecast January and February 1993 because the most recent actual index value the January forecast would require would be November 1992 and the February forecast would use December 1992 actual. Since its first lag is lag 3, the Midwest Stock Price Index can forecast ahead one extra month compared with the S & P 500 Stock Price Index model. The Midwest Stock Price Index also has the advantage of being a more parsimonious model, using six lagged variables, compared with nine for the S & P 500 Stock Price Index model. One final check on the quality of forecasting models is to check how good the models actually forecast. Figures 4 and 5 contain the out-of-sample forecasts for the two models.

Figure 4
Midwest employment-regression using the midwest stock price index

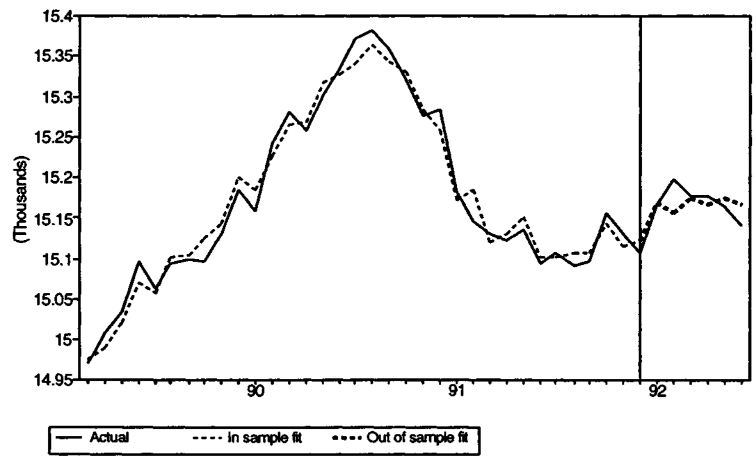
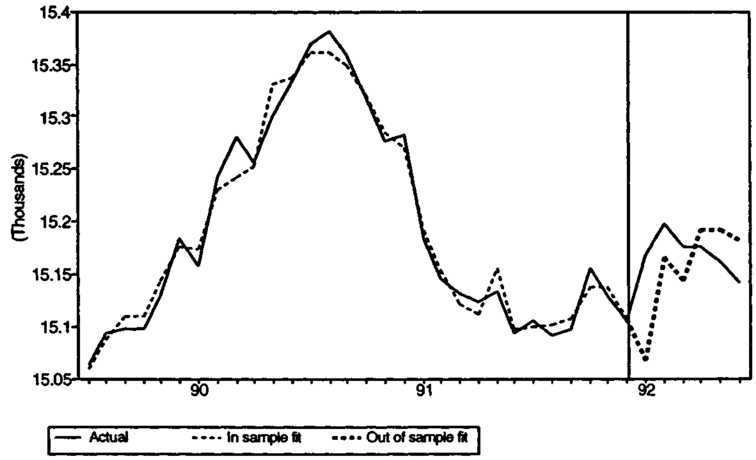


Figure 5
Midwest employment—regression using the S & P 500 stock price index



Clearly, the S & P 500 Stock Price Index does a much poorer job in forecasting the data than the Midwest Stock Price Index. In fact, the root mean square error for the S & P 500 Stock Price Index model was over twice as large as the Midwest Stock Price Index 0.3304 versus 0.1414. For the Midwest Stock Price Index, the root mean square error for the out-of-sample forecasts was much closer to the root mean square error for the in-sample fits. So the Midwest Stock Price Index model is a more stable model than the S & P 500 Stock Price Index model.

The models were reestimated using the same lag specification that had been established in the 1988-1991 specification but adding the additional five months of data for 1992. Table 4 presents the results for the reestimated models.

Table 4
Regression models with percent differences from trend employment as the dependent variable and percent differences from trend stock price indexes as the independent variables—estimated through June 1992

Variable	S & P 500 coefficients	t-value	Midwest stock index coefficients	t-value
Intercept	0.000480	0.021	0.024527	1.212
Lag 2	0.020034	1.941	--	--
Lag 3	-0.015966	-1.606	0.014189	3.180
Lag 4	--	--	-0.020887	-3.423
Lag 5	0.023831	2.971	0.021449	4.346
Lag 11	0.031095	3.113	0.015591	3.998
Lag 12	0.005641	0.472	--	--
Lag 13	-0.025970	-2.146	-0.012236	-2.483
Lag 14	0.013548	1.504	0.009718	2.021
Lag 17	0.021545	2.045	--	--
Lag 18	-0.022260	-2.117	--	--
r-square	0.4493		0.4466	
Root MSE	0.1344		0.1257	

For the Midwest Stock Price Index model the model changed very little from the previously estimated model. The coefficients and their significance levels were approximately the same, demonstrating the stability of the model. Previously, a one percent above trend value for the Midwest Stock Price Index correlated with a 0.050 percent above trend employment level in the Midwest, in the revised model the value is 0.052. The R-square value fell by about six percentage points, while the root mean square error rose by 0.0016. The S & P 500 Stock Price Index model changed dramatically by adding the six additional observations. The coefficient values changed quite a bit with lags 3, 12, and 14 becoming insignificant. In the earlier model a one percent above trend value for the S & P Stock Price Index would have translated into a 0.045 percent above trend level employment in the Midwest, the new model's value is 0.052. The R-square value fell by 22 percentage points and the root mean square error increased by 0.0242. In fact, while in the earlier model the S & P 500 Stock Price Index model had a lower root mean square error than the Midwest Stock Price Index model, in the new model the root mean square error advantage is reversed. Figures 6 and 7 present the actual and fitted values for the reestimated models.

Figure 6
Midwest employment—regression using the midwest stock price index

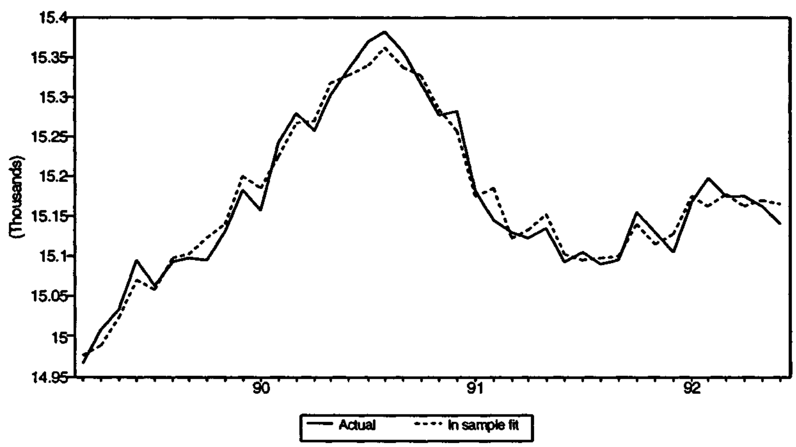
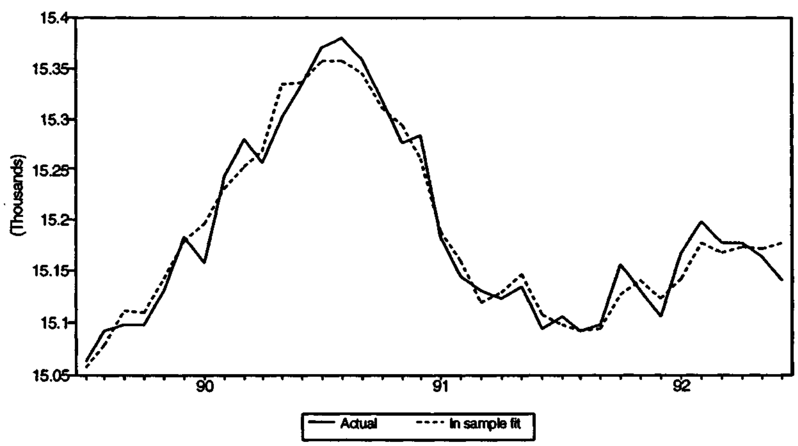


Figure 7
Midwest employment—regression using the S & P 500 stock price index



VII. Conclusions

This research set out to accomplish three things: 1) to construct a Midwest Stock Price Index, 2) compare its regional explanatory power with the S & P 500 Stock Price Index, and 3) to examine and compare the forecasting abilities of the Midwest Stock Price Index with the S & P 500 Stock Price Index. The Midwest Stock Price Index was constructed using both regionally headquartered company stock prices and a weighing scheme utilizing regional employment that would generate an indicator that would be more reflective of Midwest economy. The Midwest Stock Price Index appears to be able to add substantially to our ability to anticipate movements in employment in the Midwest. While at first glance it appeared that the S & P 500 Stock Price Index would do a better job of explaining variations in Midwest employment, judging by the out-of-sample forecasts the Midwest Stock Price Index captured more of the regional influences that affect employment than the S & P 500 Stock Price Index.

Footnotes

[1]The models used by Wharton Econometric Forecasting Associates and Data Resources Inc. are examples of large econometric forecasting models using existing data to generate forecasts. The Index of Leading Economic Indicators is an example of a technique tool using existing data to generate a series to be used for forecasting.

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