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# WHITEPAPER:

# EXAMINING THE PAYNET SMALL BUSINESS DELINQUENCY INDICES (SBDI) AS LEADING INDICATORS OF FINANCIAL STRESS AND MACROECONOMIC TRENDS

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# EXAMINING THE PAYNET SMALL BUSINESS DELINQUENCY INDICES AS LEADING INDICATORS OF FINANCIAL STRESS AND MACROECONOMIC TRENDS

## Introduction

This paper examines the predictive qualities of the PayNet Small Business Delinquency Indices ("SBDI") as leading indicators of financial stress and macroeconomic trends in the United States. PayNet has a rich data set that has been statistically proven to be a reliable indicator of future U.S. economic trends. In particular, Clark and Ware (2010)[1] used a multi-step approach to validate the Thomson Reuters/PayNet Small Business Lending Index ("SBLI") as a leading indicator of the U.S. economy.

The SBDI are designed to gauge small business financial stress and default risk, providing early warning signals of future insolvency across multiple sectors of the economy. The economic rationale for the SBDI being reliable leading indicators of financial stress and macroeconomic trends is that small businesses tend to be more responsive to changes in financial and economic conditions than larger businesses, allowing for the SBDI to more quickly indicate economy-wide financial stress. The purpose of this whitepaper is to discuss the methodology of creating the indices and the results of a sequence of economic tests to quantitatively evaluate whether or not the SBDI are indeed reliable leading indicators of financial stress and macroeconomic trends.

## Index Methodology

The SBDI measure the percentage of loans that are 31-90 days delinquent and are based on the most recent data from the largest commercial and industrial lenders in PayNet's U.S. database, including both loans and leases. The SBDI are defined at the national and state levels, including industry segmentation for Agriculture, Construction, Health Care, Retail, Transportation, and General Industries. In total, PayNet developed 365 indices for the entire U.S., all 50 states, six industries nationally, and six industries for each state. These indices have already been shown to have high correlation with some metrics of financial stress. This paper explores in more detail whether these indices are statistically reliable leading indicators of financial stress and macroeconomic trends.

## Economic Tests

The main objective of this analysis was to determine whether or not the PayNet indices are statistically valid leading indicators of various financial stress and macroeconomic trends in the U.S. In order to determine if such a relationship exists, a four-step methodology was structured after Clark and Ware (2010), in which the researchers determined that the SBLI was a valid leading indicator of U.S. economic growth. In the case of the SBDI, because banks typically

[1] Clark, Andrew and Ware, Thomas. "WhitePaper: Looking into the Future with the Thomson Reuters/PayNet Small Business Lending Index (SBLI)." May 2010.

take up to 90 days to classify a loan as nonperforming, it was expected that the indices would be particularly well-suited for predicting financial stress levels with an approximate lead time of three months. A broader motivation for this whitepaper was to determine whether or not the SBDI were also reliable leading indicators of U.S. macroeconomic trends—e.g., GDP, employment, and various state and industry level target series. Table 1 (see Appendix A) shows the complete list of SBDI and the target series against which they were tested.

For this analysis, four analytical steps were taken. The first two were designed to examine the suitability of the data for statistical analysis. The latter two were designed to test the predictive powers of the SBDI.

1. **Test for Stationarity:** The first step of the methodology was to compute the first difference of all of the data series – both the SBDI and the target series—and test them for stationarity using the Augmented Dickey-Fuller test ("ADF test")[2]. Data series that continuously increase over time are non-stationary, typically exhibiting qualities such as random walks, deterministic trends, or drifts. Conversely, stationary data series are entirely stochastic. Stationary data series, on the other hand, are more commonly used in economic forecasting because they allow for more discernible and predictable patterns in data series to be recognized over time and warrant more accurate predictions. In cases where differenced values of the target series did not pass the ADF test, alternative data transformations were evaluated – e.g., the year-over-year percent change. If a transformation other than the first difference was used, it is indicated in the footnotes to Tables 2 through 5 (see Appendix B). The output of the ADF test is a test statistic, and this test statistic was compared against a critical value at a certain confidence level. For the purposes of this study, the researchers sought a probability value less than 0.1 in order to reject the null hypothesis of non-stationarity.

2. **Test for Cointegration:** The first differenced SBDI were then matched with their respective transformed target series, on a national, industry, state, and industry-by-state level. Because some target data were reported quarterly or annually, quarterly and annual averages of the SBDI were created in order to perform the subsequent tests and analyses. Additionally, where the target series were reported daily, monthly averages were used to match with the SBDI. Matched pairs of data series were then tested for cointegration using the Johansen test. The objective of this step was to examine whether the pairs (i.e. the differenced SBDI and the transformed target series) were cointegrated. In short, two data series are cointegrated if they share a common stochastic drift. Cointegration differs from simple correlation in that if two time series are cointegrated, they cannot drift far apart from each other for long periods of time without reverting to a mean distance between them. The two series can, however, from time to time, have little synchrony (or, low correlation) in their periodic movements.

   The Johansen test inputs values from the two series and produces a trace statistic. The trace statistic was compared against the critical values for certain confidence levels. This study sought a trace statistic larger than 2.57, which indicates 90% confidence in cointegration.

[2] All of the differenced SBDI values were found to be stationary, so their results are not included in Tables 2-5 (see Appendix B).

The rationale behind using the ADF and the Johansen tests together was to determine whether the differenced SBDI and the transformed target series are cointegrated *and* in equilibrium, meaning that although they experience drift between one another at times, there is a stable relationship between the data series over time. The tests were also run using various lead-times to determine the predictive capabilities of the SBDI.

3. **Test for Short-Run Equilibrium:** The first differenced SBDI were then subtracted from their accompanying transformed target series to create a set of "residuals" data series. These series were used as inputs for two tests: the ADF test for stationarity and the Jarque-Bera test for normality. If the "residuals" data series were proven to be stationary, this confirmed the prior results that the two transformed series are in fact cointegrated. The objective of the Jarque-Bera test was to examine whether the "residuals" data series were approximately normally distributed, indicating that the two transformed data series exhibit a short-run equilibrium. In other words, normally-distributed residuals suggest that the differenced SBDI and transformed target series fit within more stable and predictable patterns over time.

   The Jarque-Bera test produces a test statistic with a chi-squared distribution and two degrees of freedom. The null hypothesis was that the data series have skewness and kurtosis of zero (approximately normal). For the purposes of this study, test statistics with a probability value greater than 0.1 were sought, resulting in a failure to reject the null hypothesis of normality. The criteria to pass the Jarque-Bera test were set at a relatively high significance level. If an approximate normal distribution was detected in the "residuals" data series, which can also be detected through a normal residuals plot, it could be concluded that there was reason to believe that a short-run relationship existed between the differenced SBDI and the transformed target series.

4. **Creating the Distributed Lag Models:** The first differenced SBDI were then fitted in regressions with the various transformed target series. The models used were distributed lag models with independent variables of the various lagged differenced SBDI and dependent variables of the various transformed target series. The purpose of these econometric models was to directly test whether changes in the SBDI are able to predict future changes in the target series for various national, state, industry, and industry-by-state level financial stress and macroeconomic trends. General economic reasoning and the definition of the SBDI were used to develop a rationale to test and to fit a certain number of lags into each of the models. Different target series used different lagged models depending on the type of variable and the frequency with which it is reported. For the purposes of this study, the goal was an R-squared (or goodness of fit) for the models of approximately 0.20 and for the independent variables to pass a 90% significance test.

## Results

Each of the four steps in the methodology were integral for being able to fully validate that the SBDI are in fact leading indicators of the various financial stress and macroeconomic target series against which they were tested. However, the primary litmus tests for leading indicators are (a) the cointegration of the SBDI and their respective target series, (b) the statistical

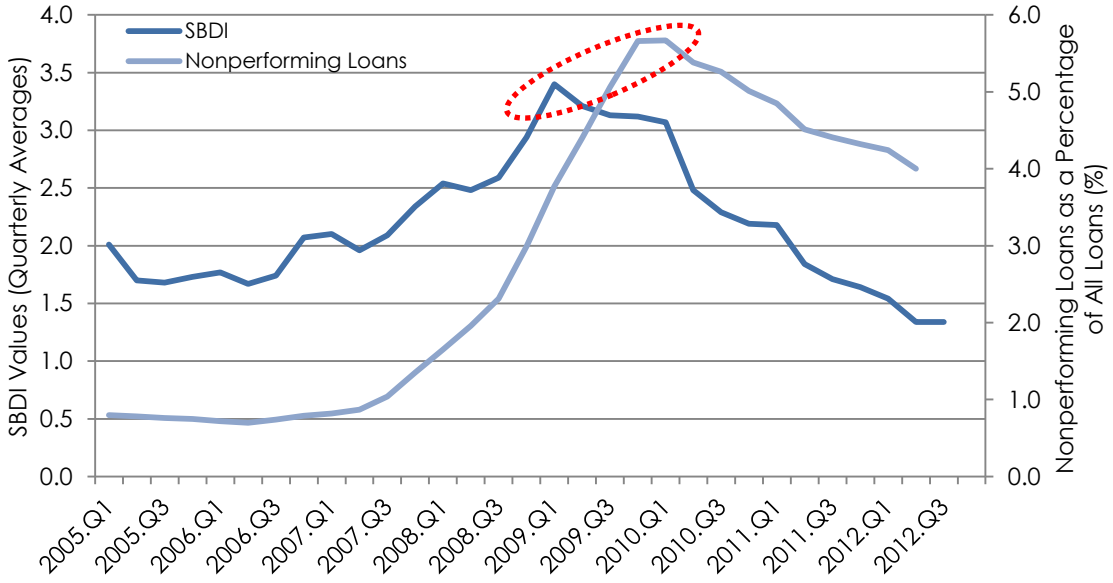
significance of the lagged index values' regression coefficients in a time series regression model, and (c) the overall goodness of fit (as measured by R-squared) of the regression model.

Generally, the analysis showed that the SBDI are particularly well-suited for predicting future trends in financial stress indicators at the national, industry, and state levels with a three- to six-month lead time. Specifically, the SBDI are very strong predictors of nonperforming loans at a national and state level, state municipal bond spreads on a state-by-state basis, and industry level loan delinquency rates. These findings are consistent with the researchers' *a priori* expectations and economic rationale behind the SBDI. Additionally, the national and state level SBDI were statistically valid predictors of national and state level unemployment rates and to a lesser-extent national level GDP, with a lead time of about six months. The regression results are described in more detail below and the results of all economic tests are summarized in Tables 2 through 5 (see Appendix B).

**National Level Thomson Reuters/PayNet SBDI:** At the national level, the SBDI was tested against five target series – nonperforming loans as a percentage of total loans for all U.S. banks, 10- & 30-year government obligation bond spreads, the unemployment rate, and GDP. The SBDI was found to be a very strong predictor of non-performing loans and both maturities of government obligation bond spreads. The SBDI also passed the tests for predicting the national unemployment rate and GDP, but the regression results were on the margins for both target series. Results of the regression models are explained below, and detailed results of all economic tests for the national level SBDI are shown in Table 2 (see Appendix B).

(1) Nonperforming Loans: The differenced SBDI lagged in the 1st, 2nd, 3rd, and 4th preceding quarters were found to be the best predictor of the change in nonperforming loans. This model had an R-squared of 0.78, along with statistically significant independent variables. The relationship is displayed in Figure 1 below.

**Figure 1. The Thomson Reuters/PayNet National Level SBDI as a Leading Indicator of Nonperforming Loans for all U.S. Banks**




Source: PayNet, Federal Reserve Bank of St. Louis

(2) 10- & 30-Year Government Obligation Bond Spreads: The SBDI lagged in the 1st, 4th, and 7th preceding months were found to be good predictors of the level of 10- & 30-Year government obligation bond spreads. The 10-year model had an R-squared of 0.34, while the 30-year model had an R-squared of 0.21, both with statistically significant independent variables.

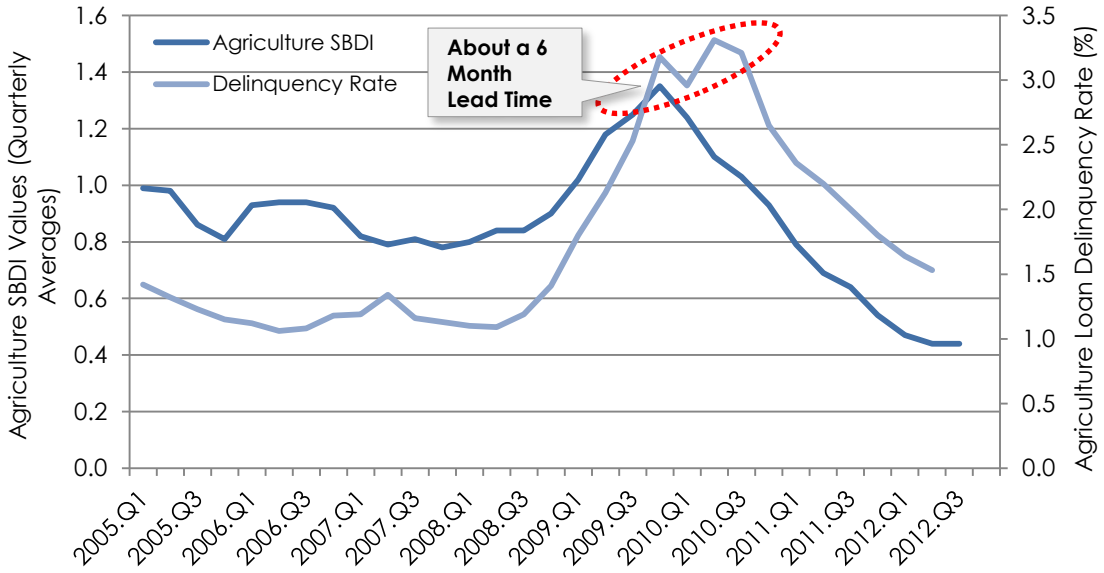
(3) Unemployment Rate: The differenced SBDI lagged in the 3rd, 6th, and 9th preceding months were found to be a good predictor of the change in the unemployment rate. This model had an R-squared of 0.20 along with statistically significant independent variables.

(4) GDP: The differenced SBDI lagged in the 2nd, 3rd, and 4th preceding quarters were found to be a somewhat reliable predictor of the change in GDP. The model had a moderately acceptable R-squared of 0.18 and statistically significant independent variables.

**National Industry Level SBDI**: At the industry level, the SBDI were tested against multiple target series per industry. Four industries were tested against loan delinquency rates, while two industries were tested against other industry level gauges. Additionally, where data was available, the industry level SBDI were tested against the Intuit Small Business ("ISB") Revenue Indices, corporate bond yields, and unemployment rates. Overall, the industry level SBDI were very strong predictors of their respective industries' loan delinquency rates and ISB Revenue Indices. The industry level SBDI were not found to be statistically reliable leading indicators of either corporate bond yields or unemployment rates. Results of the regression models are explained below, and detailed results of all economic tests for the industry level SBDI are shown in Table 3 (see Appendix B).

(1) Loan Delinquency Rates: The Agriculture, Construction, Retail, and General Industries SBDI were found to be strong predictors of delinquency rates for Agriculture, Real Estate, Consumer, and total Commercial & Industrial loans, respectively. The differenced SBDI lagged in the 1st, 2nd, and 3rd preceding quarters were found to be strong predictors of the changes in delinquency rates in these loan categories. The R-squared values for the models were 0.61 for Agriculture, 0.80 for Construction, 0.38 for Retail, and 0.70 for General Industries. All of these models contained statistically significant independent variables. The relationship for Agriculture is displayed in Figure 2 below.

**Figure 2. The PayNet Agriculture SBDI as a Leading Indicator of the Agriculture Loan Delinquency Rate**




Source: PayNet, FDIC

(2) Other Target Series for the Health Care and Transportation Industries: The FDIC does not provide delinquency rates for either Health Care or Transportation loans, nor was a comparable financial stress indicator discovered for these industries. The next best alternatives were the ISB Revenue Index for Professional, Scientific and Technical Services, and total payrolls for Trucking & Transportation. These target series were paired with the Health Care SBDI and the Transportation SBDI, respectively. The Health Care SBDI lagged in the 6th preceding month was found to be a good predictor of the year-over-year change in the ISB Revenue Index for Professional, Scientific and Technical Services, with an R-squared of 0.21 and a statistically significant independent variable. The Transportation SBDI lagged in the 1st preceding month was found to be a good predictor of the year-over-year change in Transportation payrolls, with an R-squared of 0.82 and a statistically significant independent variable. For both of these models, the coefficients on the regressions indicated negative relationships between the independent and dependent variables.

Additionally, the industry level SBDI were tested against ISB Revenue Indices for Construction, Retail Trade (matched with the Retail SBDI), and Other Industries (matched with the General Industries SBDI), and unemployment rates for all six industries. The results were consistent across the board for the industry level unemployment rates: the SBDI were not found to be valid leading indicators of industry level unemployment rates. However, the results showed that the industry level SBDI were found to be valid leading indicators of the ISB Revenue Indices in these industries. For Construction, Retail, and General Industries, the industry level SBDI predicted the year-over-year change in the ISB Revenue Indices for Construction, Retail Trade, and Other Industries, respectively. The Construction model used lagged values from the 1st, 2nd, 3rd, and 4th preceding months, while the Retail and General Industries Models used lagged values from the 1st preceding month. The R-squared values for the

Construction, Retail, and General Industries models were 0.68, 0.39, and 0.43 – all with at least one statistically significant independent variable.

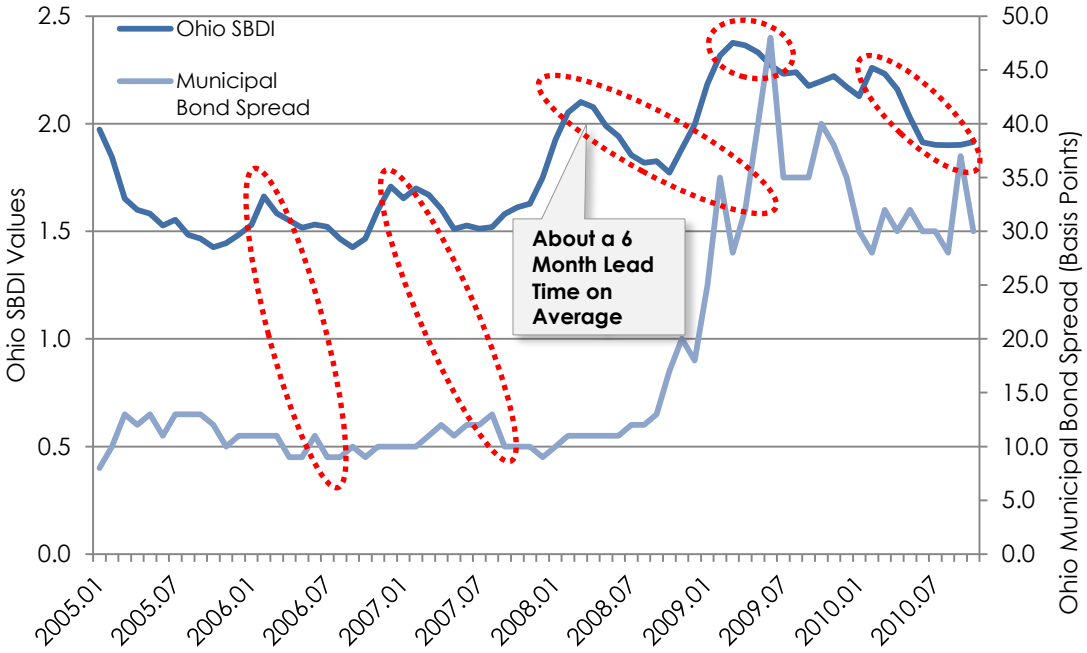
(3) Corporate Bond Yields: The industry level SBDI were also tested as leading indicators of corporate bond yields. The only direct industry match was in the Transportation industry. For all other industry categories, the headline U.S. SBDI was tested to see if it was a statistically significant leading indicator of the bond yields for other sectors not specifically covered by the SBDI. The results indicated that the SBDI were not statistically valid leading indicators of corporate bond yields.

**State Level SBDI**: At the state level, the SBDI were tested against six different target series – Nonperforming Loans as a Percentage of Total Loans, the Unemployment Rate, State Municipal Bond Spreads, Employment, Personal Income, and the Philadelphia Federal Reserve Bank Coincident Economic Activity Index ("CEAI"). The state level SBDI were found to be strong predictors of nonperforming loans for many states. The state level SBDI were also generally good predictors of state municipal bond spreads—meeting the necessary criteria for 32 out of 50 states. The results were less consistent for state level unemployment rates—the state level SBDI were good predictors for 19 out of 50 states. Results of the regression models are explained below, and detailed results of all economic tests for the state level SBDI are shown in Table 4 (see Appendix B).

(1) Nonperforming Loans: The differenced SBDI lagged in the 1st, 2nd, 3rd, and 4th preceding quarters were generally found to be strong predictors of the change in nonperforming loans in many states. The R-squared values for these models ranged from 0.04 to 0.76 (with 37 states being above the 0.20 threshold) in addition to having statistically significant independent variables. Additionally, the state-GDP-weighted average R-squared for all states was 0.42. Some notable results include California with an R-squared of 0.50, Florida with 0.68, and Texas with 0.76. The states that did not meet the 0.20 R-squared threshold were generally smaller states with smaller loan volumes and less variance in nonperforming loans over time.

(2) State Municipal Bond Spreads: The SBDI lagged in the 3rd and 6th preceding months were found to be strong predictors of the level of state municipal bond spreads in many states. The R-squared values for these models ranged from 0.01 to 0.90 (with 32 states being above the 0.20 threshold), and many of the models contained statistically significant independent variables. Additionally, the state-GDP-weighted average R-squared for all states was 0.42. The results for Ohio are displayed in Figure 3 below.

**Figure 3. The PayNet Ohio SBDI as a Leading Indicator of Ohio's Municipal Bond Spread**




Source: PayNet

(3) Unemployment Rate: The differenced SBDI lagged in the 3rd, 6th, and 9th preceding months were generally found to be good predictors of the change in the unemployment rate in many states. The R-squared values for these models ranged from 0.01 to 0.50 (with 18 states being above the 0.20 threshold), along with statistically significant independent variables. Additionally, the state-GDP-weighted average R-squared for all states was 0.24.

(4) Employment, Personal Income, and the Philadelphia Federal Reserve Bank CEAI: The results were not strong enough to conclude that the SBDI were good leading indicators of any of these state level macroeconomic trends.

**Industry-by-State Level:** At the industry-by-state level, the SBDI were tested against two different target series – industry-by-state level GDP and industry-by-state level employment. Results of the regression models are explained below, and detailed results of all economic tests for the industry-by-state level SBDI are shown in Table 5 (see Appendix B).

(1) GDP and Employment: The results were not strong enough to conclude that the SBDI were good predictors of either of these industry-by-state level macroeconomic trends.

Overall, the results are consistent with *a priori* expectations. Together, the results from the economic tests and the regression models show that the SBDI are statistically significant predictors of future financial stress and some macroeconomic trends at various different levels in the U.S. economy.

## Conclusion

Given that about 49% of U.S. workers are employed by a small business[3] and that small businesses are also greatly affected by macroeconomic trends, the data used to construct the PayNet SBDI are informative and useful for forecasting broader financial stress and macroeconomic trends. The results produced from this whitepaper's analysis are practical not only for examining the predictive power and relevancy of these indices themselves but also for demonstrating how beneficial these indices can be for explaining the future health of the U.S. economy on different segmented levels and with various lead times.

The results indicate that the SBDI are most suitable at predicting financial stress on the national, industry, and state level, represented by nonperforming loans, industry loan delinquency rates, and state level nonperforming loans and municipal bond spreads. By virtue of the economic tests, the statistically significant independent variables, and strong goodness of fit measures, various transformations of SBDI do reliably predict future changes in financial stress on the national, industry, and state levels. The results also show that the SBDI are good leading indicators of changes in unemployment rates on both the national level and for some states. At the highest level of granularity, there is not strong evidence to demonstrate that the SBDI are good predictors of industry-by-state level macroeconomic trends. However, given the strong results from the various other segments, there is reason to believe that the industry-by-state level SBDI would be suitable indicators of financial stress at a commensurate level in the U.S. economy if such data were available to test.

[3] U.S. Census Bureau Statistics about Business Size, 2008 Census Data, www.census.gov; N.B. Small businesses are defined as businesses with fewer than 500 employees.

## Appendix A

### Table 1: SBDI and Their Target Series

| Category | Target Data Series | Source | Frequency |
|---|---|---|---|
| National Level | Nonperforming Loans (past due 90+ days plus nonaccrual)/Total Loans for all U.S. Banks | Federal Reserve Bank of St. Louis | Quarterly |
| | GDP | Bureau of Economic Analysis ("BEA") | Quarterly |
| | Unemployment | Bureau of Labor Statistics ("BLS") | Monthly |
| | 10- & 30-Year Government Obligation Bond Spreads | PayNet | Daily |
| Industry Level | *Agriculture*: Loan Delinquency Rate: Agriculture Loans and Agriculture Unemployment Rate | Federal Deposit Insurance Corporation ("FDIC"), BLS | Quarterly, Monthly |
| | *Construction*: Loan Delinquency Rate: Real Estate Loans, ISB Revenue Index: Construction, and Construction Unemployment Rate | FDIC, Intuit, BLS | Quarterly, Monthly, Monthly |
| | *Health Care*: ISB Revenue Index: Professional, Scientific & Technical Services, and Medical Unemployment Rate | Intuit, BLS | Monthly, Monthly |
| | *Retail*: Loan Delinquency Rate: Consumer Loans, ISB Revenue Index: Retail Trade, and Retail Trade Unemployment | FDIC, Intuit, BLS | Quarterly, Monthly, Monthly |
| | *Transportation*: Trucking & Transportation Employees and Transportation Unemployment Rate | BLS, BLS | Monthly, Monthly |
| | *General Industries*: Loan Delinquency Rate: C&I Loans, ISB Revenue Index: Other Industries, and Other Industries Unemployment Rate | FDIC, Intuit, BLS | Quarterly, Monthly, Monthly |
| | Corporate Bond Yields (industry coverage: Finance, Utilities, Industrial including Consumer, Energy, Manufacturing, Services, and Transportation) | Citigroup/Salomon Smith Barney | Monthly |
| State Level | Nonperforming Loans (past due 90+ days plus nonaccrual)/Total Loans for all banks in each state | FDIC | Quarterly |
| | State municipal bond spreads | PayNet | Monthly |
| | Coincident Economic Activity Index | Federal Reserve Bank of Philadelphia | Monthly |
| | Personal Income | BEA | Quarterly |
| | Employment | BLS | Monthly |
| | Unemployment rate | BLS | Monthly |
| Industry-by-state Level | Employment | BLS | Monthly |
| | GDP | BEA | Annually |

## Appendix B

### Table 2: National Level Analytical Results

| National Level Table | (I) ADF Test | (II) Johansen Test | (III) ADF Test on "Residuals" | (III) Jarque-Bera Test on "Residuals" | (IV) Lags in the Distributed Lags Models | Goodness of Fit Results ($R^2$) | Best Predictive Leading Indicator |
|---|---|---|---|---|---|---|---|
| Nonperforming Loans | Yes | Yes | Yes | No | 1st, 2nd, 3rd, & 4th Quarters | 0.78 | Yes |
| 10-Yr G.O. Bond Spread[4] | Yes | Yes | Yes | No | 1st, 4th, & 7th Months | 0.34 | - |
| 30-Yr G.O. Bond Spread[5] | Yes | Yes | Yes | No | 1st, 4th, & 7th Months | 0.21 | - |
| Unemployment Rate | Yes | Yes | Yes | No | 3rd, 6th, & 9th Months | 0.20 | - |
| GDP | Yes | Yes | Yes | Yes | 2nd, 3rd, & 4th Quarters | 0.18 | - |

### Table 3: Industry Level Analytical Results

| Industry Level Table | (I) ADF Test | (II) Johansen Test | (III) ADF Test on "Residuals" | (III) Jarque-Bera Test on "Residuals" | (IV) Lags in the Distributed Lags Models | Goodness of Fit Results ($R^2$) | Best Predictive Leading Indicator |
|---|---|---|---|---|---|---|---|
| ***Loan Delinquency Rates*** | | | | | | | |
| Agriculture | Yes | Yes | Yes | No | 1st, 2nd, & 3rd Quarters | 0.61 | Yes |
| Construction | Yes | Yes | No | No | 1st, 2nd, & 3rd Quarters | 0.80 | Yes |
| Retail | Yes | No | Yes | No | 1st, 2nd, & 3rd Quarters | 0.38 | Yes |
| General | Yes | Yes | Yes | No | 1st, 2nd, & 3rd Quarters | 0.70 | Yes |
| ***ISB Revenue Indices***[6] | | | | | | | |
| Construction | Yes | Yes | Yes | No | 1st, 2nd, 3rd, & 4th Months | 0.68 | - |
| Professional, Scientific & Technical Services | No | Yes | Yes | No | 6th Month | 0.21 | - |
| Retail | No | Yes | No | No | 1st Month | 0.39 | - |
| General | No | Yes | Yes | No | 1st Month | 0.43 | - |
| ***Employment***[7] | | | | | | | |
| Transportation | Yes | Yes | Yes | No | 1st Month | 0.82 | - |
| ***Unemployment Rates*** | | | | | | | |
| Agriculture | Yes | Yes | Yes | No | 3rd, 4th, 5th, & 6th Months | 0.01 | - |
| Construction | Yes | Yes | Yes | No | 3rd, 4th, 5th, & 6th Months | 0.07 | - |

[4] This model used a left hand side variable of the level of the 10-year government obligation bond spread and a right hand side variable of the level of the SBDI

[5] This model used a left hand side variable of the level of the 30-year government obligation bond spread and a right hand side variable of the level of the SBDI

[6] These models used a left hand side variable of the year-over-year change in the ISB Index and a right hand side variable of the level of the SBDI

[7] This model used a left hand side variable of the year-over-year change in Trucking and Transportation Employment and a right hand side variable of the level of the Transportation SBDI

## Appendix B

### Table 3 (continued): Industry Level Analytical Results

| Industry Level Table (Continued) | (I) ADF Test | (II) Johansen Test | (III) ADF Test on "Residuals" | (III) Jarque-Bera Test on "Residuals" | (IV) Lags in the Distributed Lags Models | Goodness of Fit Results ($R^2$) | Best Predictive Leading Indicator |
|---|---|---|---|---|---|---|---|
| Medical | Yes | Yes | Yes | No | 3rd, 4th, 5th, & 6th Months | 0.05 | - |
| Retail | Yes | Yes | Yes | No | 3rd, 4th, 5th, & 6th Months | 0.04 | - |
| Transportation | Yes | Yes | Yes | No | 3rd, 4th, 5th, & 6th Months | 0.03 | - |
| General | Yes | Yes | Yes | No | 3rd, 4th, 5th, & 6th Months | 0.01 | - |
| ***Corporate Bond Yields***[8] | | | | | | | |
| Consumer | Yes | Yes | Yes | No | 9th, 10th, 11th, & 12th Months | 0.13 | - |
| Energy | Yes | Yes | Yes | No | 9th, 10th, 11th, & 12th Months | 0.12 | - |
| Finance | Yes | Yes | Yes | No | 9th, 10th, 11th, & 12th Months | 0.08 | - |
| Industrial | Yes | Yes | Yes | No | 9th, 10th, 11th, & 12th Months | 0.12 | - |
| Manufacturing | Yes | Yes | Yes | No | 9th, 10th, 11th, & 12th Months | 0.10 | - |
| Services | Yes | Yes | Yes | No | 9th, 10th, 11th, & 12th Months | 0.12 | - |
| Transportation | Yes | Yes | Yes | No | 9th, 10th, 11th, & 12th Months | 0.10 | - |
| Utilities | Yes | Yes | Yes | No | 9th, 10th, 11th, & 12th Months | 0.12 | - |

### Table 4: State Level Analytical Results

| State Level Table | (I) ADF Test | (II) Johansen Test | (III) ADF Test on "Residuals" | (III) Jarque-Bera Test on "Residuals" | (IV) Lags in the Distributed Lags Models | Goodness of Fit Results (State-GDP-Weighted Average $R^2$) | Best Predictive Leading Indicator |
|---|---|---|---|---|---|---|---|
| Nonperforming Loans | 41/50 Yes | 41/50 Yes | 48/50 Yes | 12/50 Yes | 1st, 2nd, 3rd, & 4th Quarters | 0.42 | Yes |
| Unemployment Rate | 50/50 Yes | 47/50 Yes | 49/50 Yes | 0/50 Yes | 3rd, 6th, & 9th Months | 0.24 | - |
| Employment | 47/50 Yes | 47/50 Yes | 31/50 Yes | 4/50 Yes | 3rd, 6th, & 9th Months | 0.21 | - |
| Personal Income | 50/50 Yes | 50/50 Yes | 50/50 Yes | 26/50 Yes | 2nd, 3rd, & 4th Quarters | 0.17 | - |
| Philadelphia Fed CEAI | 27/50 Yes | 40/50 Yes | 32/50 Yes | 1/50 Yes | 5th, 6th, 7th, & 8th Months | 0.18 | - |
| Municipal Bond Spreads[9] | 46/46 Yes | 31/46 Yes | 46/46 Yes | 0/46 Yes | 3rd & 6th Months | 0.42 | Yes |

[8] The only exact match for the Corporate Bond Yields and the SBDI was in Transportation. For all other corporate bond yields, the headline US SBDI was tested to see if it was a statistically valid leading indicator.

[9] This model used a left hand side variable of the state municipal bond spread and a right hand side variable of the level of the SBDI for each individual state. Additionally, there were only municipal bond spreads provided for 46 states.

## Appendix B

### Table 5: Industry by State Level Analytical Results

| Industry-by-State Level Table[10] | (I) ADF Test | (II) Johansen Test | (III) ADF Test on "Residuals" | (III) Jarque-Bera Test on "Residuals" | (IV) Lags in the Distributed Lags Models | Goodness of Fit Results ($R^2$ Range) | Best Predictive Leading Indicator |
|---|---|---|---|---|---|---|---|
| GDP[11] | 150/306 Yes | N/A | 115/306 Yes | N/A | 1st & 2nd Years | 0.00 to 0.99; Avg. 0.62 | - |
| Employment | 305/306 Yes | 306/306 Yes | 306/306 Yes | 4/306 Yes | 3rd, 6th, & 9th Months | 0.00 to 0.26; Avg. 0.05 | - |

[10] These data series included the District of Columbia

[11] Because this data series was annual, there were too few observations to conduct both the Johansen test and the Jarque-Bera test

## For More Information

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