

WHITEPAPER:

EXAMINING THE PAYNET SMALL BUSINESS LENDING INDICES (SBLI)
AS LEADING INDICATORS OF MACROECONOMIC & INDUSTRY
TRENDS

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EXAMINING THE PAYNET SMALL BUSINESS LENDING INDICES AS LEADING INDICATORS OF MACROECONOMIC & INDUSTRY TRENDS

Introduction

This paper will examine the predictive qualities of the PayNet Small Business Lending Indices ("SBLI") as leading indicators of macroeconomic and industry trends in the United States. PayNet's indices, created using its rich data set, have been statistically proven to be reliable indicators of future U.S. economic trends. In particular, Wescott and Karson (2012) determined that the PayNet Small Business Delinquency Indices ("SBDI") were statistically valid leading indicators of financial stress and macroeconomic conditions.¹

The SBLI are designed to gauge small business lending, providing early signals of future economic growth, demand for capital, and business fixed investment across multiple sectors of the economy. The economic rationale for viewing the SBLI as reliable leading indicators of macroeconomic and industry trends is that small businesses tend to be more responsive to changes in financial and economic conditions than larger businesses. Small business investment occurs either to replace worn out capital or to expand the capital base. When small business expands capital by investing in more property, plant equipment, tools, services, or business units, they do so to produce more of their products. The production increases stem from greater customer demand to purchase and consume those goods. Small businesses are able to respond quickly to changes in consumer demand due to the immediate feedback signal generated by an expanded customer base. In this way, the SBLI act as an early signal of changes in GDP.

The purpose of this whitepaper is to discuss the results of a sequence of economic tests which quantitatively evaluate the extent to which the SBLI are indeed reliable leading indicators of macroeconomic and industry trends.

Index Methodology

The SBLI measure the volume of small business loans issued over the past 30 days 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 national SBLI — referred to as the Thomson Reuters/PayNet Small Business Lending Index — has already been shown to be highly correlated with some macroeconomic indicators (e.g., the Conference Board's Leading Economic Index).² This paper will explore in more detail whether the other more granular indices that comprise the SBLI are statistically reliable leading indicators of macroeconomic and industry trends.

The SBLI are defined at the state level, as well as by industry segmentation using 2-digit NAICS codes. For example, nearly every U.S. region includes the following industry breakdown:

¹ Wescott, Robert and Karson, Adam. "Whitepaper: Examining the PayNet Small Business Delinquency Indices (SBDI) as Leading Indicators of Financial Stress and Macroeconomic Trends." December 2012.

² Clarke, Andrew and Ware, Thomas. "Whitepaper: Looking Into the Future with the Thomson Reuters/PayNet Small Business Lending Index (SBLI)." May 2010.

PayNet SBLI Industry Breakdown	
1. Agriculture, Forestry, Fishing and Hunting	2. Real Estate and Rental and Leasing
3. Mining, Quarrying, and Oil and Gas Extraction	4. Professional, Scientific, and Technical Services
5. Construction	6. Administrative and Support and Waste Management and Remediation Services
7. Manufacturing	8. Educational Services
9. Wholesale Trade	10. Health Care and Social Assistance
11. Retail Trade	12. Arts, Entertainment, and Recreation
13. Transportation and Warehousing	14. Accommodation and Food Services
15. Information	16. Other Services (except Public Administration)
17. Finance and Insurance	18. Public Administration

In total, PayNet developed 951 indices — including the national Thomson Reuters/PayNet SBLI, state indices for each state and the District of Columbia, 18 industry-specific indices at the national level, and roughly 18 industries for each state.³

Economic Tests

The main objective of this analysis was to determine if the SBLI are statistically valid leading indicators of various macroeconomic and industry trends in the United States. In order to determine if such a relationship exists, a four-step methodology was structured after Wescott and Karson (2012), in which the researchers determined that the PayNet Small Business Delinquency Indices were statistically valid leading indicators of financial stress and macroeconomic conditions. For the SBLI, because the volume of loans and leases is often a leading indicator for improved economic conditions, it was expected that the indices would be well-suited for predicting economic trends at more granular, industry-specific levels. The broad motivation for this whitepaper was to determine whether or not the SBLI are indeed reliable indicators of U.S. macroeconomic trends (e.g., private fixed investment, employment, and industry-level target series). Table 1 (see Appendix A) shows the complete list of SBLI and the target series against which they were tested.

For this analysis, the following four steps were taken:

- 1. **Test for Stationarity:** The first step of the methodology was to difference all of the data series — both the SBLI and the target series — and test them for stationarity using the Augmented Dickey-Fuller test (“ADF test”).⁴ Data series that continuously increase over time are non-stationary, typically exhibiting qualities such as random walks, deterministic trends, or drifts.

³ In some cases, states do not have an index for every industry.

⁴ Nearly all of the differenced SBLI values were found to be stationary, so their results are not included in Tables 2-5 (see Appendix B). For information on SBLI which did not pass the ADF test, see Table 6 in Appendix B.

Conversely, stationary data series are entirely stochastic. Stationary data series 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 SBLI or the target series did not pass the ADF test, alternative data transformations were evaluated (e.g., 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 differenced SBLI were then matched with their respective transformed target series, on an industry, state, and industry-by-state level. Because some target data were reported quarterly or annually, quarterly and annual averages of the SBLI were created in order to perform the subsequent tests and analyses.⁵ 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 SBLI 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 a critical value at a certain confidence level. For the purposes of this study, the researchers sought a trace statistic larger than 2.57, which indicates 90% confidence in cointegration.

The rationale behind using the ADF and the Johansen tests together was to determine whether the differenced SBLI 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.

- 3. Test for Short-Run Equilibrium:** The differenced SBLI 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 SBLI and transformed target series fit within more stable and predictable patterns over time.

⁵ Some of these quarterly and annual averages of SBLI did not pass the ADF test for stationarity. However, because the monthly SBLI largely did pass the ADF test, the SBLI were considered stationary for this analysis.

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, the researchers sought test statistics with a probability value greater than 0.1, 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, the researchers concluded that there was reason to believe that a short-run relationship existed between the differenced SBLI and the transformed target series.

- 4. Creating the Distributed Lag Models:** The differenced SBLI 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 SBLI and dependent variables of the various transformed target series. The purpose of these econometric models was to directly test whether changes in the SBLI are able to predict future changes in the target series for various state, industry, and industry-by-state level macroeconomic and industry trends. General economic reasoning and the definition of the SBLI 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 researchers sought 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 was integral to fully validate that the SBLI are valid leading indicators of the various macroeconomic and industry target series against which they were tested. However, the primary litmus tests for leading indicators are (1) the cointegration of the SBLI and its respective target series, (2) the statistical significance of the lagged index values' regression coefficients in a time series regression model, and (3) the overall goodness of fit of the regression model (as measured by the R-squared value).

Generally, the analysis showed that the SBLI are well-suited for predicting future trends in economic activity indicators at the industry and state levels with a 2 – 6 month lead time. Specifically, the SBLI are very strong predictors of employment and revenue at a national-industry level, and employment at a state level. These findings are consistent with the researchers' *a priori* expectations and economic rationale behind the SBLI. Additionally, the industry and state level SBLI were statistically valid predictors of national small business loan volume and value and private fixed investment in equipment and software, small business revenue indices for some industries, and state personal income. The regression results are described in more detail below and the results of all economic tests are summarized in Tables 2 through 6 (see Appendix B).

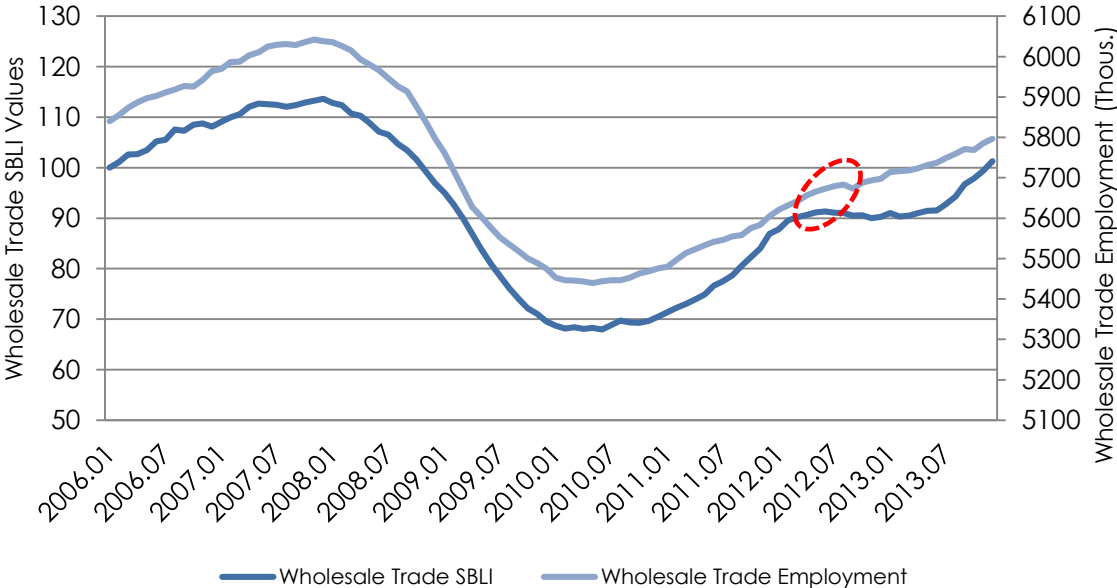
Industry Level SBLI: At the industry level, the SBLI were tested against multiple target series per industry. Almost every industry was tested against payrolls and revenues for that particular industry. Additionally, where data was available, the industry SBLI were tested against Intuit Small Business (“ISB”) Revenue Indices and other gauges of economic activity, including various measures of industrial production. The full list of target series is presented in Table 1 (see Appendix

A). Overall, the industry SBLI were found to be statistically valid predictors of their respective industries' payrolls and revenues and to a lesser extent GDP valued-added and some of the ISB Revenue indices ("ISBRI"). The industry SBLI were not, however, found to be statistically reliable leading indicators of some additional target series. Results of the regression models are explained below, and detailed results of all economic tests for the industry SBLI are shown in Table 3 (see Appendix B).

(1) Intuit Small Business Revenue Indices: The industry SBLI matched with seven Intuit Small Business Revenue Indices at the 2-digit NAICS level, and the differenced SBLI lagged in the 1st preceding month were found to be statistically valid predictors of the changes in small business revenue indices for three industries: Retail Trade, Health Care and Social Assistance, and Other Services. The R-squared values for these models were 0.213 for Retail Trade, 0.233 for Health Care and Social Assistance, and 0.210 for Other Services. Each of the models also had a statistically significant independent variable. The SBLI also passed many of the other tests for predicting the Professional, Scientific, and Technical Services ISBRI, yet the regression results were marginal. Lastly, the SBLI was found to be a strong predictor of the Construction ISBRI, with an R-squared of 0.557, yet the target series failed to pass the ADF test under various transformations.

(2) Nonfarm Payrolls: The industry SBLI matched with seventeen nonfarm payroll series at the 2-digit NAICS level, and the differenced SBLI lagged in the 1st, 2nd, and 3rd preceding months were generally found to be statistically valid predictors of the changes in nonfarm payrolls for a number of industries. Among the results, the industry models with the strongest R-squared values were Wholesale Trade (0.703), Construction (0.619), Professional, Scientific, & Technical Services (0.573), and Administrative & Waste Management Services (0.527) – all with at least one statistically significant independent variable. The relationship for the Wholesale Trade Industry is shown below.

Figure 2. The PayNet Wholesale Trade SBLI as a Leading Indicator of Wholesale Trade Employment



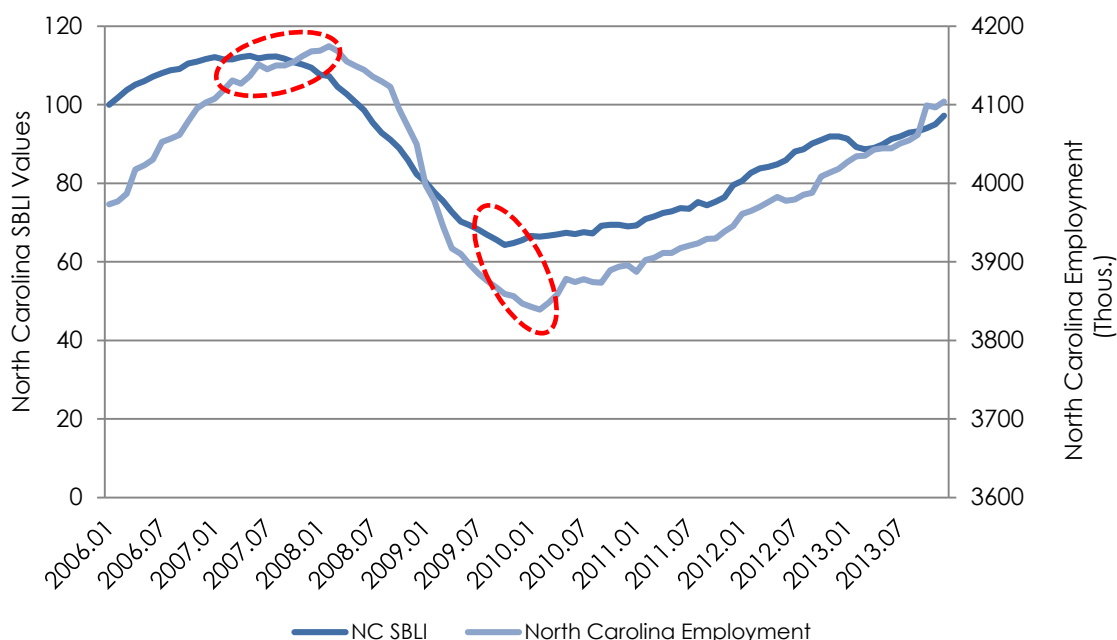
Source: PayNet, Macrobond Financial

- (3) GDP Value-Added: The industry SBLI matched with all eighteen industry GDP series at the 2-digit NAICS level, and the difference SBLI lagged in the 1st, 2nd, 3rd, and 4th preceding quarters were not found to be reliable predictors of the change in industry GDP. While the average R-squared was 0.233, only half of the models had R-squares above 0.20 and even fewer had statistically significant independent variables.
- (4) Revenues: The industry SBLI matched with thirteen industry revenues at the 2-digit NAICS level, and the differenced SBLI lagged in the 5th and 6th preceding quarters were found to be generally strong predictors of the change in industry revenue. Among the results, the industry models with the strongest R-squared values were Health Care & Social Assistance (0.865), Transportation & Warehousing (0.810), and Administration & Waste Management (0.804). All models had R-squares above 0.20 and nearly all had at least one statistically significant independent variable.
- (5) Miscellaneous Target Series: The industry SBLI matched with Industrial Production for Manufacturing, Transportation Equipment, and Construction Supplies; the Transportation Services Index, and Retail Sales. The differenced SBLI lagged in multiple combinations of preceding months were not found to be statistically significant predictors of the target series.

State SBLI: At the state level, the SBLI were tested against three different target series: Employment, Personal Income, and the Philadelphia Federal Reserve Bank Coincident Economic Activity Index ("CEAI"). The state SBLI were generally good predictors of employment and personal income for many states. The results were less consistent for state level CEAI, as the state SBLI were good predictors for 25 out of 50 states. Results of the regression models are explained below, and detailed results of all economic tests for the state SBLI are shown in Table 4 (see Appendix B).

- (1) Employment: The differenced SBLI lagged in the 1st, 2nd, and 6th preceding months were generally found to be reliable predictors of the change in nonfarm employment in many states. The R-squared values for these models ranged from 0.011 to 0.660 (with 33 states being above the 0.20 threshold) in addition to having at least one statistically significant independent variable. Additionally, the state-GDP-weighted average R-squared for all states was 0.385. The states that did not meet the 0.20 R-squared threshold were generally smaller states with lower employment levels and less variance in small-business lending over time. The results for North Carolina are displayed in Figure 3 below.

Figure 3. The PayNet North Carolina SBLI as a Leading Indicator of North Carolina Employment



Source: PayNet, Macrobond Financial

- (2) Personal Income: The SBLI lagged in the 1st, 2nd, 3rd, and 4th preceding quarters were found to be good predictors of the change in personal income in many states, although very few of the models had independent variables that were all statistically significant. The R-squared values for these models ranged from 0.063 to 0.607 (with 40 states being above the 0.20 threshold), and the majority of the models contained some statistically significant independent variables. Additionally, the state-GDP-weighted average R-squared for all states was 0.335.
- (3) Coincident Economic Activity Index: The differenced SBLI lagged in the 1st, 2nd, and 3rd preceding months were generally found to be good predictors of the change in the CEAI's in many states. The R-squared values for these models ranged from 0.009 to 0.641 (with 25 states being above the 0.20 threshold), along with having at least one statistically significant independent variable. 13 states had very strong results; however, the state-GDP-weighted average R-squared for all states, at 0.195, was on the margin.

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

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

Conclusion

Given that about 48% of U.S. workers are employed by a small business⁶ and that small businesses are also greatly affected by macroeconomic trends, the data used to construct the SBLI are informative and useful for forecasting broader 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 SBLI are best at predicting macroeconomic activity on the industry and state level, represented by national GDP, industry payrolls, industry revenues, and state personal income in particular. By virtue of the economic tests, the statistically significant independent variables, and strong goodness of fit measures, various transformations of SBLI do reliably predict future changes in economic activity on the industry and state levels. At the highest level of granularity, there is not strong evidence to demonstrate that the SBLI are good predictors of industry-by-state 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 SBLI are statistically significant predictors of future macroeconomic trends at various different levels in the U.S. economy.

⁶ U.S. Census Bureau Statistics about Business Size, 2011 Census Data, www.census.gov; N.B. Small businesses are defined as businesses with fewer than 500 employees.

Appendix A

Table 1: SBLI and Their Target Series

Category	Target Data Series	Source	Frequency
Industry-by-National	<i>Small Business Revenue Indices:</i> Construction; Retail Trade; Accommodation & Food Services; Professional, Scientific & Tech Services; Real Estate & Rental & Leasing; Health Care & Social Assistance; Other Services	Intuit	Monthly
	<i>Employment:</i> All 18 Industries less Agriculture	BLS	Monthly
	<i>GDP (Value-Added):</i> All 18 Industries	BEA	Quarterly
	<i>Revenues:</i> All 18 Industries less Agriculture, Construction, Real Estate & Rental & Leasing ⁷ , Accommodation & Food Services, and Public Administration	Census Bureau	Quarterly
	<i>Miscellaneous:</i> IP: Manufacturing; IP: Transportation Equipment; Transportation Services Index; IP: Construction Supplies; Retail Sales: Retail Trade	Federal Reserve, Bureau of Transportation Statistics, Census Bureau, BEA	Monthly
State	Coincident Economic Activity Index (CEAI)	Federal Reserve Bank of Philadelphia	Monthly
	Personal Income	BEA	Quarterly
	Employment	BLS	Monthly
Industry-by-State ⁸	Nominal GDP	BEA	Annually
	Employment	BLS	Monthly

⁷ Real Estate & Rental & Leasing was taken out of the analysis due to limited data.

⁸ Not all states had indices for all 18 industries.

Appendix B

Table 3: National-Industry 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	Best Predictive Leading Indicator
Small Business Revenue Indices (7)	6/7	6/7	7/7	0/7	1st Month	0.231 (average)	Yes
<i>Construction</i>	No	No	Yes	No	1 st Month	0.557	-
<i>Retail Trade</i>	Yes	Yes	Yes	No	1 st Month	0.213	Yes
<i>Accommodation & Food Services</i>	Yes	Yes	Yes	No	1 st Month	0.156	-
<i>Professional, Scientific, & Technical Services</i>	Yes	Yes	Yes	No	1 st Month	0.193	-
<i>Real Estate & Rental & Leasing</i>	Yes	Yes	Yes	No	1 st Month	0.052	-
<i>Health Care and Social Assistance</i>	Yes	Yes	Yes	No	1 st Month	0.233	Yes
<i>Other Services</i>	Yes	Yes	Yes	No	1 st Month	0.210	Yes

Table 3 (continued): National-Industry 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 (Average)	Best Predictive Leading Indicator
Employment (17)	16/17	13/17	17/17	1/17	1st – 3rd Months	0.010-0.703; Avg. 0.313	Yes
GDP (18)	18/18	13/18	16/18	8/18	1st – 4th Quarters	0.049-0.610; Avg. 0.233	-
Revenue (13)	13/13	9/13	11/13	5/13	5th & 6th Quarters	0.290 -0.865; Avg. 0.623	Yes
Miscellaneous	5/5	2/5	0/5	0/5	1st – 3rd Months	0.163	-
IP Manufacturing	Yes	Yes	No	No	1 st – 3 rd Months	0.106	-
IP Transportation Equipment	Yes	No	No	No	1 st – 3 rd Months	0.168	-
Transportation Service Index	Yes	No	No	No	1 st – 3 rd Months	0.111	-
IP Construction Supplies	Yes	No	No	No	1 st – 3 rd Months	0.344	-
Retail Sales	Yes	Yes	No	No	1 st – 3 rd Months	0.087	-

Appendix B

Table 4: State 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)	Best Predictive Leading Indicator
Personal Income	51/51	38/51	51/51	16/51	1 st - 4 th Quarters	0.335	-
Employment	51/51	48/51	51/51	0/51	1 st , 2 nd , & 6 th Months	0.385	Yes
Coincident Economic Activity Index (CEAI) ⁹	48/50	49/50	50/50	0/50	1 st – 3 rd Months	0.195	-

Table 5: Industry-by-State Analytical Results

Industry-by-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 (Range)	Best Predictive Leading Indicator
GDP ¹⁰ (836)	317/836	N/A	332/836	N/A	1 st Year	0.00 - 0.984; Avg. 0.192	-
Employment ¹¹ (880)	880/880	N/A	880/880	11/880	1 st – 4 th Months	0.00 – 0.357; Avg. 0.036	-

Table 6: Non-Stationary PayNet SBLI

Monthly SBLI Which Failed ADF Test ¹²	Alternate Transformation	ADF Test
National Construction SBLI (Differenced)	Percent Change Y/Y	No
National Transportation & Warehousing SBLI (Differenced)	Percent Change Y/Y	No
Florida Overall SBLI (Differenced)	Percent Change Y/Y	No
Texas Overall SBLI (Differenced)	Percent Change Y/Y	No
Rhode Island Wholesale Trade SBLI (Differenced)	Percent Change Y/Y	No

⁹ Excludes the District of Columbia.

¹⁰ Because this data series was annual, there were too few observations to conduct both the Johansen test and the Jarque-Bera test.

¹¹ Because of an issue of perfect collinearity, we were not able to conduct the Johansen test.

¹² Additionally, many of the industry-level, state-level, and state industry-level SBLI, when averaged into quarterly or annual series, did not pass the ADF test for stationarity. However, if the monthly SBLI passed the ADF test, the series was considered stationary for this analysis.

For More Information

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