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WHITEPAPER:

EXAMINING THE THOMSON REUTERS/PAYNET SMALL BUSINESS DELINQUENCY INDEX (SBDI) AS A LEADING INDICATOR OF FINANCIAL STRESS AND MACROECONOMIC TRENDS

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Introduction

This paper examines the predictive qualities of the Thomson Reuters/PayNet Small Business Delinquency Index ("SBDI") as a leading indicator 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 is 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 a reliable leading indicator 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 index and the results of a sequence of economic tests to quantitatively evaluate whether or not the SBDI is indeed a reliable leading indicator of financial stress and macroeconomic trends.

Index Methodology

The SBDI measures the percentage of loans that are 31-90 days delinquent and is 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 has already been shown to have high correlation with some metrics of financial stress. This paper explores in more detail whether this index is a statistically reliable leading indicator of financial stress and macroeconomic trends.

Economic Tests

The main objective of this analysis was to determine whether or not the Thomson Reuters/PayNet SBDI is a statistically valid leading indicator 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 take up to 90 days to classify a loan as nonperforming, it was expected that the index would be particularly well-suited for predicting financial stress with an approximate lead time of three months. A broader motivation for this whitepaper was to determine whether or not the SBDI is also a reliable leading indicator of U.S. macroeconomic trends—e.g., GDP and

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

employment. Table 1 (see Appendix A) shows the complete list of target series against which the SBDI was 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 its 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 Table 2 (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 was then matched with a transformed target series. Because some target data were reported quarterly, quarterly 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. 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.

   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.

[2] The differenced SBDI was found to be stationary, so its results are not included in Table 2 (see Appendix B).

3. **Test for Short-Run Equilibrium:** The first differenced SBDI was then subtracted from its 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 was then fitted in regressions with the various transformed target series. The models used were distributed lag models with independent variables of the 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. 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 is in fact a leading indicator of the various financial stress and macroeconomic target series against which it was tested. However, the primary litmus tests for leading indicators are (a) the cointegration of the SBDI and its 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.

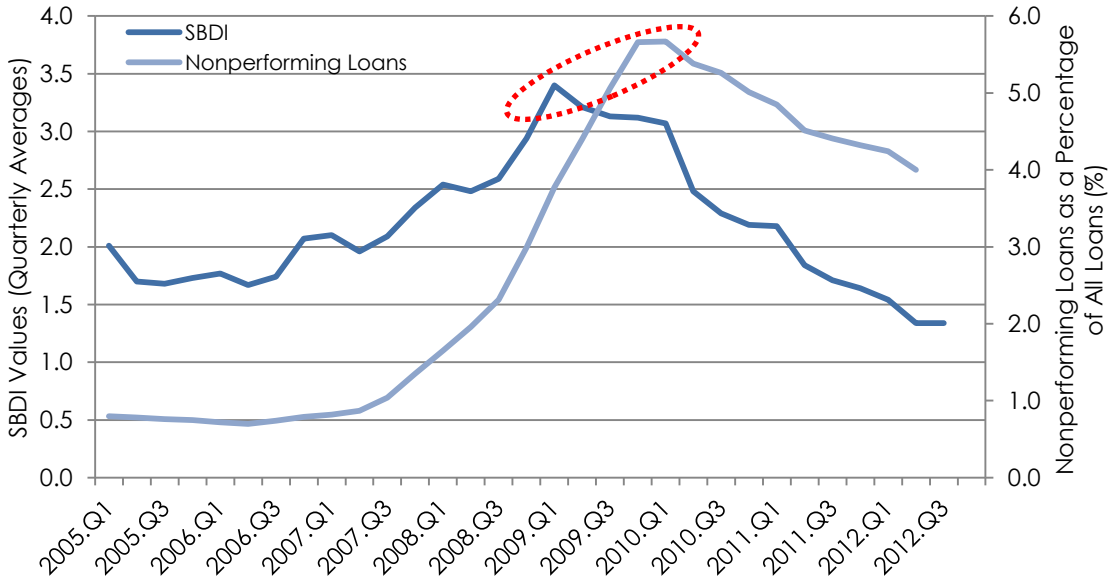
Generally, the analysis showed that the SBDI is particularly well-suited for predicting future trends in financial stress with a three- to six- month lead time. Specifically, the SBDI is a very strong predictor of nonperforming loans and both maturities of government obligation bond spreads. These findings are consistent with the researchers' *a priori* expectations and economic rationale behind the SBDI. Additionally, the SBDI was shown to be a statistically valid predictor of the unemployment rate and to a lesser-extent 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 Table 2 (see Appendix B).

National Level Thomson Reuters/PayNet SBDI: 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 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 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 was 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 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 was found to be a good predictor 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 was 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 was 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.

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 Thomson Reuters/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 this index itself but also for demonstrating how beneficial this index can be for explaining the future health of the U.S. economy with various lead times.

The results indicate that the SBDI is most suitable at predicting financial stress by nonperforming loans. By virtue of the economic tests, the statistically significant independent variables, and strong goodness of fit measures, the SBDI does reliably predict future changes in financial stress. The results also show that the SBDI is a good leading indicator of government obligation bond spreads, changes in the unemployment rate, and GDP.

[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: The Thomson Reuters/PayNet SBDI and its Target Series

	Target Data Series	Source	Frequency
Thomson Reuters/PayNet SBDI	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

Appendix B

Table 2: Detailed Analytical Results

	(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	-

[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

For More Information

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