

Mountain State Business Index: Technical Report

Brian Lego, Research Assistant Professor
John Deskins, PhD, Director

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bber.wvu.edu

PO Box 6527
Morgantown, WV 26506
(304) 293-7831
bebureau@mail.wvu.edu

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1 Introduction

The questions “How is the economy doing?” and “Where is the economy headed?” are seemingly simple questions that are actually quite complex. The complexity stems from a variety of reasons surrounding the macroeconomic data used to measure the economy. Data complexities arise for various reasons: Perhaps most fundamentally, individual data series can (and often do) provide conflicting signals about where an economy is positioned in the business cycle given the unique nature of particular components of an economic system that certain variables characterize. Second, many macroeconomic data series are lagging indicators, meaning that those series only work to characterize the economy in retrospect by a few months or more. Further, data are often subject to significant revisions over time, and these revision can lead to errors in interpretation. Altogether, it is impossible to cite any single statistic that captures the current state of an economic system or that can be used as a reliable indicator of how that system is likely to evolve in coming months. Further, these data complexities may be more pronounced for US states compared to the US as a whole

In this report we describe the Mountain State Business Index (MSBI) and its supporting index, the West Virginia Business Index – Current Conditions (MSBI - Current). These indexes have been constructed to mitigate the difficulty of characterizing the overall performance of an economic system with any single statistic. The MSBI - Current is designed to characterize the current condition of the state’s economy and supports the MSBI, which is designed to characterize the state’s economy in approximately four to six months. A key purpose of the MSBI is to predict when the state’s economy will reach a turning point – when a period of economic growth turns into a recession, and vice versa. The MSBI will serve to provide important context for business leaders and policymakers operating in West Virginia.

Each index is comprised of several individual indicators that are used to characterize a particular aspect of the state’s economy. Variables are chosen for each index based on the extent to which each indicator best measures the state’s current economic environment versus its likely status several months in the future. The economic indicators that are used are selected because they best satisfy several key criteria that will minimize false signals of shifts in the business cycle. First, indicators must be important drivers of the state’s overall economy. Second, indicators

should move closely with the overall business cycle and they should perform in a consistent manner across different business cycles. Third, indicators should be relevant to the current environment, meaning that they must be released in a timely manner and must not be typically subject to large revisions in the short-term. Last, indicators must not be excessively volatile over the business cycle.

Our approach generally follows that set forth by the US Conference Board, which publishes coincident and leading indexes for the US and several other countries using a standardized methodology, but will be tailored to recognize West Virginia's specific economic structure. The Conference Board considers a contraction signal in the US Leading Economic Indicators reliable if two conditions are met: 1) the index declines by at least two percent on an annualized basis over a six-month period; and 2) a majority of the individual components also decline over that six-month stretch. We use these criteria to identify contraction or expansion signals in the West Virginia economy.

The next section of this report describes in detail the nature and rationale behind the specific variables chosen to comprise the MSBI - Current while the third sections describes the specific components that comprise the MSBI. In the fourth section we describe the statistical methods used to create each index. The report closes with an analysis of how the indexes have performed over the past two decades.

2 Components: Mountain State Business Index – Current Conditions

We begin with the development of an index to capture current economic activity. The broad measures gross state product (GSP) or personal income would be ideal. Unfortunately, neither exists on a monthly basis and therefore come only with significant lags. Further, these data are subject to significant and frequent revisions. As a result, we instead utilize four state-level data series to illustrate current economic conditions: total nonfarm payroll employment, household employment, average weekly wages of private sector production workers, and industrial electricity sales.

The first component of the MSBI – Current is total non-farm payroll employment. It is produced in a timely manner and is generally identified as a key measure of current economic activity by

most researchers. Seasonally adjusted payroll employment data are available monthly from the US Bureau of Labor Statistics. We use the three-month moving average of this variable to smooth occasional volatility created by erratic seasonal adjustments in the state and local government employment component of the overall measure.

For the second component we use wages of private sector workers. Although a more inclusive measure might be preferable, private sector wages is available on a monthly basis from the U.S. Bureau of Labor Statistics, compared to the quarterly frequency of income data. In addition, wages account for approximately 60 percent of total personal income in West Virginia, so it should provide a good barometer of income growth. Average weekly wages of private sector production workers is not released as a seasonal series, so we apply a ratio-to-moving average multiplicative seasonal adjustment factor to the data. In addition, we adjust for inflation using the US consumer price index. In a similar fashion to our first measure, we apply a three-month moving average to reduce month-to-month volatility.

Industrial electricity sales serves as our third measure. We use this measure to serve as a proxy of monthly industrial production. The Conference Board uses monthly industrial production (which is from the Federal Reserve Board of Governors) in its US coincident index, but no parallel statistic exists for West Virginia. Electricity is the primary energy source for manufacturers and other industrial customers and therefore tends to closely reflect changes in industrial output. The broader measure of electricity usage - sales by including residential and commercial users – is not usable because it is highly sensitive to changes in heating and cooling degree days and does not move closely with the overall business cycle. Monthly data on total megawatt hours sold to industrial customers are obtained directly from the US Energy Information Administration (EIA). The data are seasonally adjusted and smoothed with a three-month moving average.

3 Components: Mountain State Business Index

Numerous candidate variables were examined statistically to judge their efficacy in predicting turning points in the MSBI. After applying these techniques, and also judging the various series on the basis of volatility, conformity and other standards listed above, we identified seven appropriate variables for the MSBI. Several components are similar to those used by the

Conference Board to construct the US Leading Economic Indicators Index. The variables comprising the MSBI are: building permits authorized for single-family homes; average initial unemployment insurance claims; a stock index of West Virginia's largest publicly-traded employers; the spread between long-term and short-term interest rates (also known as the yield curve); the state real trade-weighted dollar exchange rate; statewide coal production; and statewide natural gas production.

Building permit authorizations for new single-family homes represents the number of permits issued authorizing the construction of a new single-family home by county or municipal governments located within the state. Not all building permits turn into housing starts, but the vast majority do and construction typically commences within the next few months after the permit is issued. Since the construction and eventual sale/purchase of a new home are tied to the financial services and retail trade sectors, building permits are a critical indicator of future economic activity.

Data coverage is somewhat of a concern since not all jurisdictions in West Virginia require a building permit and others do not participate in the report compiled monthly by the US Census Bureau. This is not a grave concern because more than three-fourths of the state's population resides within the jurisdiction of permit-issuing places. Moreover, coverage is nearly universal within the areas that account for most of the home construction activity in West Virginia. These data are provided by the US Census Bureau on a monthly basis. We seasonally adjust the data and convert it to a three-month moving average to reduce its volatility.

Initial claims for unemployment insurance are a leading indicator because a jump in claims suggests cyclical industries or large businesses are cutting payrolls, indicating a broader drop-off is possible in the coming months. In a similar fashion, a drop in claims signals that fewer workers are losing their jobs and labor market conditions would be expected to improve as businesses begin to anticipate better times ahead. To increase the ease of interpretation, we use the inverse of initial unemployment insurance claims, meaning that an increase will likely reduce growth and a decrease in claims will likely yield stronger growth. The data are collected from the Employment and Training Administration at the US Department of Labor, and are adjusted for calendar effects and seasonal variation.

Stock prices are a valuable leading indicator since changes in stock prices tend to reflect investor expectations of a company's earnings potential as well as the overall health of the economy. In order to gauge this effect on West Virginia's economy, we use a weighted index of stock prices for the state's 45 largest publicly-traded employers. The companies represented in the index come from virtually every major sector, but energy-producing companies carry a relatively large weight reflecting the sector's importance to the state's economy. Average daily closing prices for each company during each month are normalized by shares outstanding in order to take stock splits or other price adjustments. Also, each company is weighted by the number of employees it has working within the state, so relatively large employers account for a bigger portion of the overall index. Afterward, the series is indexed to a value of 100 by using the average from calendar year 2005. The index is re-weighted to reflect any instance when a company is delisted from stock exchanges to reflect this compositional change.

International trade has played a significant role in the state's economy over the past several years as West Virginia companies export significant amounts of coal, chemicals, plastics and other commodities to numerous destination countries in Europe, Asia and other regions. Since changes in the exchange rate of the US dollar will likely lead to changes in export activity, as businesses and their buyers generally need some time to adjust prices and purchasing plans due to exchange rate fluctuations, we use the real trade-weighted dollar into the MSBI. The US Federal Reserve Bank of Dallas publishes a monthly trade-weighted dollar index for each state that calculates the inflation-adjusted value of the US dollar against the currencies of countries with which the state trades. The real exchange rates are aggregated across countries for each state using the average export share to the country from 1997 to 2009. We use the inverse of the trade-weighted dollar to reflect the idea that West Virginia's economy would be expected to grow due to a decline in the exchange rate.

While we mostly focus on state-specific measures in the construction of the MSBI, some national-level series are strong indicators of future economic activity for the state. The yield curve, which measures the term structure of interest rates vis-à-vis the difference between long- and short-term Treasury securities or other investments, is a well-established predictor of US economic recessions, particularly when the curve becomes inverted. The difference between the monthly averages for 10-year and 3-month Constant Maturity Rate Treasury securities is

obtained from the US Federal Reserve Board. No seasonal adjustment is necessary for the yield curve calculation.

Energy remains a sector of particular significance to the state's economy, accounting for 13 percent of total output in 2012. The two variables used to capture this sector's importance are statewide coal and natural gas production. Ideally, average weekly hours of mining employees or spot or front-month futures contract prices for these energy commodities would appear in the MSBI. In practicality, both series suffer from significant limitations. The hours worked figure contains significant volatility even after accounting for seasonal variation and applying reasonable moving average lengths. More importantly, however, neither series is available for a sufficient timespan to accurately test their consistency in predicting turns in the business cycle. The production data do not suffer from these constraints and provide more reliability in predicting short-term changes in the economy.

Total short tons of coal produced by the state's mines each month are provided by the US EIA's Monthly Coal Production Report. Typically, the latest three to six months of data are provisional until final estimates from the US Mine Safety and Health Administration are incorporated. Although this could conceivably affect the currency of the data, the revisions are not large enough to hamper the series' usefulness. As with most of the other series appearing in the indexes, we seasonally adjust the data and apply a three-month moving average to smooth any potentially erratic jumps.

Our last indicator captures the state's natural gas industry, which has grown significantly in terms of its impact on the state's economy over the past several years. Data on natural gas production are obtained from the US EIA. We do not seasonally adjust the data because they lack a discernible seasonal pattern.

4 Methodology

In this section we describe how each index is calculated. The MSBI - Current and MSBI are based upon the Conference Board’s methodology for creating the US Leading Economic Indicators Index, and are enhanced with West Virginia-specific indicators as discussed above.

The first step involves calculating the month-to-month percentage changes for each component that appears in the indexes. However, the calculation must be adjusted so that positive and negative changes are treated in a symmetrical fashion, i.e. a certain percent increase followed by an equally-sized percent decrease returns the variable to its original value. The equation used for this calculation is

$$x_t = 200 * \left(\frac{X_t - X_{t-1}}{X_t + X_{t-1}} \right)$$

Data that are already expressed in percentage changes, such as interest rates or the unemployment rate, only require one to calculate simple month-to-month differences.

Since we are transforming several different variables into indexes, we must account for the differences in volatility between the data series. We weight the symmetric month-to-month changes by the inverse of the standard deviation of that particular variable’s month-to-month change, so that a variable with more variation will contribute proportionately less to the final index (See Table 1 and Table 12).

Table 1: Weighting Scheme for the Mountain State Business Index - Current

	Inverse Standard Deviation	Index Weight
Nonfarm Payroll Employment	4.6230	0.5701
Industrial Electricity Sales	1.2544	0.1547
Real Private Sector Wages	2.2324	0.2752

Table 2: Weighting Scheme for the Mountain State Business Index

	Inverse Standard Deviation	Index Weight
Single-family Building Permits	0.2298	0.0249
Initial Unemployment Insurance Claims	0.3893	0.0423
WV Trade-Weighted Dollar	0.9867	0.1071
WV Stock Index	0.3885	0.0422
Yield Curve	5.9852	0.6497
Coal Production	0.6978	0.0758
Natural Gas Production	0.5342	0.0580

After calculating the weights, we then apply this weight to each symmetrical month-to-month value, x_t . Subsequently, we create a raw index, i_t , which is simply the sum of all the variables' weighted month-to-month changes. Thus far, each step is used for both indexes. However, an additional step is used for the MSBI to ensure future conditions will be anchored appropriately by the present. To do so, we calculate a standardization factor that is simply a ratio of the standard deviations of the indexes. Afterward, we multiply each of the raw index values by this standardization factor.

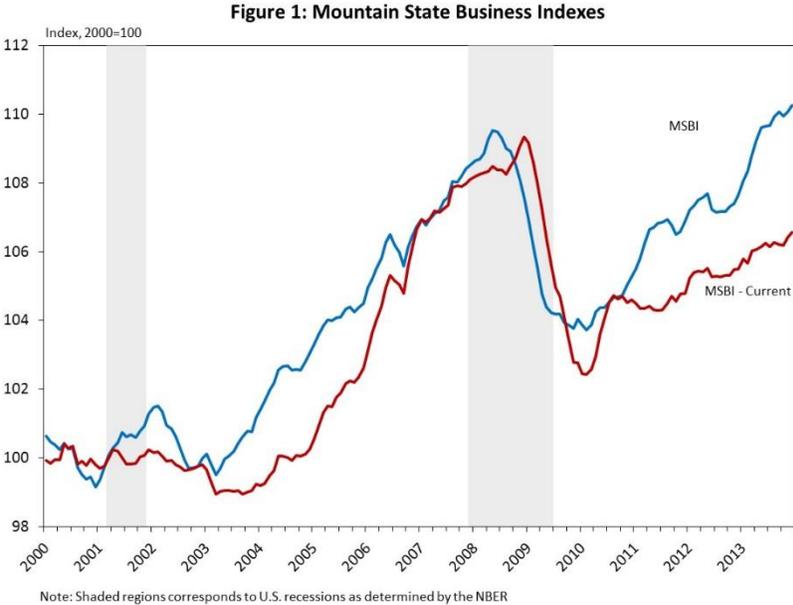
The final step involves creating a new index, I_t , by setting the first possible value (January 1991) equal to 100 and develop values for each subsequent month using the following symmetric change equation

$$I_t = I_{t-1} * \frac{200 + i_t}{200 - i_t}$$

Finally, we rebase these values to equal 100 during calendar year 2000 for both indexes. This is done by taking each monthly value of I_t and dividing it by the average value of I_t over the January to December 2000 time period.

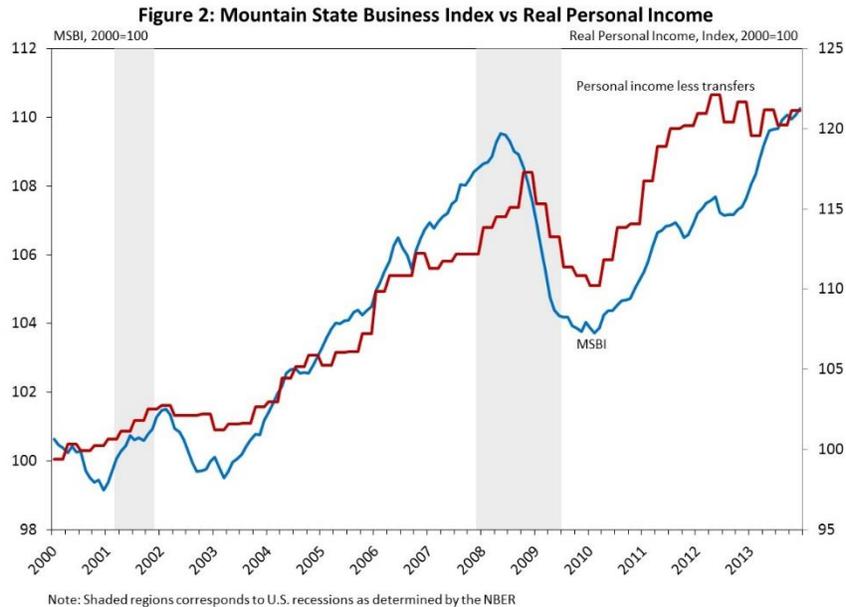
5 Performance of the Indexes

The Mountain State Business Index and the Mountain State Business Index - Current have generally provided a reliable signal about the expected direction and current condition of the state’s economy. Figure 1 illustrates how both indexes have trended since 2000. Before discussing the actual results, we should explain how the MSBI can be used to provide signals about a potential contraction (or expansion) in economic activity. As mentioned in a previous section, the Conference Board considers a contraction signal in the US Leading Economic Indicators reliable if two conditions are met: 1) the index declines by at least two percent on an annualized basis over a six-month period; and 2) a majority of the individual components also decline over that six-month stretch.



In advance of the 2001 national recession, the MSBI began to show warning signs of an impending contraction as early as May 2000 as a majority of indicators were declining. However, the expected index did not experience a sufficiently large six-month annualized change to meet the criteria of a contraction until August 2002. In fact, both criteria were only met for several months in the second half of 2002. While this might suggest some weakness on the index’s part in signaling an economic downturn, it more aptly illustrates the mildness of the 2001 recession in West Virginia that was followed up by a sluggish recovery. Indeed real

personal income less transfer payments, a broad measure of state economic activity, continued to increase throughout the official recession dates of March-November 2001 and fell less than 1.5 percent between 2002 and 2003 (see Figure 2). Other measures such as real GDP showed even smaller declines.



Both indexes track the state’s economic recovery and expansion well throughout the 2003-2008 time period as no false signal for contraction was detected using the two criteria jointly. Growth in the MSBI did begin to slow on a consistent basis by the fourth quarter of 2006, as several indicators such as single-family building permits, initial unemployment insurance claims and the yield curve were all making significant enough negative contributions to the index at the same time. The MSBI - Current index did begin to display an appreciable slowdown in growth by the first half of 2007.

As Figure 1 shows, the MSBI reached its cyclical peak in mid-2008, but did not begin to meet the explicit definition of signaling a contraction within the next six months until November 2008. While the MSBI - Current had been showing signs of modest weakness for several months prior, it did not begin to see sufficiently large enough declines to signal that the state’s economy was in recession until April 2009. Thus, the time elapsed between the points when the MSBI signaled a likely recession until it was ‘confirmed’ by the MSBI - Current was five months.

The six-month rate of change in the MSBI remained sufficiently negative through September 2009, due to ongoing weakness in home construction, coal production and stubbornly-high initial unemployment insurance claims. However, the other four components of the index began to make joint positive contributions to the overall index in July 2009, suggesting a turning point in the business cycle was likely within the next six months. In fact, the MSBI - Current continued its sharp descent until it bottomed out during the first quarter of 2010. Using these months we can designate that West Virginia's economy was experiencing sufficiently large and broad enough weakness to have been in recession from April 2009 through March 2010.

Based on the MSBI, expectations for economic growth were weak during the early phases of the state's economic recovery. Most of this weakness was driven by persistently large negative contributions from single-family building permits, reflecting the continued drop-off in housing construction activity. The WV stock index also had several shaky months over that period, reflecting the significant amount uncertainty that was plaguing broader equity markets at the time. The index has trended upward significantly since this period, but modest dips in the MSBI in late-2011 and late-2012, driven in large part by falling coal production, did suggest some modest weakening in economic activity was possible during the second halves of 2012 and 2013. These expectations were borne out by the MSBI as the index declined slightly over both of these time periods.

Since early 2013, the MSBI has consistently predicted expectations for continued growth in the state's economy. Save for a decline in building permits and an uptick in initial unemployment insurance claims during the second half of the year, the other components of the MSBI have stabilized (as is the case for coal production) or expanded. Two particular components of the MSBI, the WV stock index and statewide natural gas production, increased strongly over the course of 2013—even longer in the case of the stock index—and have accounted for a significant portion of this rapid increase in the MSBI. This could serve to explain some of the divergence seen between the two indexes during the latter half of 2013. Short-term differences are certainly possible and have occurred during past episodes, but we will watch the performance of both indexes closely and assess the need for any possible adjustments should this divergence continue.

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