The Effectiveness of the State Coincident Indexes[1]

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January 2013

The Federal Reserve Bank of Philadelphia has produced state coincident indexes since 2005. These indexes are monthly indicators of economic activity for each of the 50 U.S. states, based on a composite of four widely available data series on state conditions: total nonfarm payroll employment, the unemployment rate, average hours worked in manufacturing, and real wages and salary disbursements.[2]

Researchers and others have used the indexes[3] as an effective measure of economic activity. This Research Rap Special Report provides some measures of the effectiveness of the indexes as a measure of state gross domestic product (GDP) and an analysis of revisions to the indexes.

Are the Indexes Linked to Economic Output?

GDP has often been considered the best single measure of economic activity. Unfortunately for analysts of state business cycles, state GDP data are published only at a yearly frequency compared with U.S. national GDP, which is published quarterly. One benefit to using the state coincident indexes as an alternative to state GDP is the higher frequency of the data; the indexes are produced monthly. But how

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[1] The views expressed here are those of the author and do not necessarily reflect those of the Federal Reserve Bank of Philadelphia or of the Federal Reserve System. When he wrote this report, Jason Novak was a senior economic analyst in the Research Department of the Philadelphia Fed. Questions about this report should be directed to Elif Sen at Elif.Sen@phil.frb.org.

[2] The methodology applies a standard econometric methodology, the Kalman filter, to a system of equations that produce the state coincident indexes from the four underlying variables. The econometric methodology is intended to estimate the economic trend that underlies the four indicators and the average annual growth rate of state GDP. For further discussion of the methodology, see Theodore M. Crone and Alan Clayton-Matthews, "Consistent Economic Indexes for the 50 States," *Review of Economics and Statistics*, 87 (2005), pp. 593-603.

[3] Bradley T. Ewing and Mark A. Thompson, "A State-Level Analysis of Business Cycle Asymmetry," *Bulletin of Economic Research*, 64:3 (2012), pp. 367-76; Rick Mattoon and Leslie McGranahan, "Revenue Bubbles and Structural Deficits: What's a State to Do?," Federal Reserve Bank of Chicago Working Paper 08-15 (2008); Michael T. Owyang, Jeremy Piger, and Howard J. Wall, "Business Cycle Phases in U.S. States," *Review of Economics and Statistics*, 87:4 (2005), pp. 604-16.

strongly do the December to December changes in the state coincident indexes track annual growth rates of state GDP?[4]

Correlations between the annual growth rates are provided in Table 1. With a correlation coefficient of 0.69, the state coincident indexes do have a strong and positive relationship with state GDP. However, the relationship is not perfect.
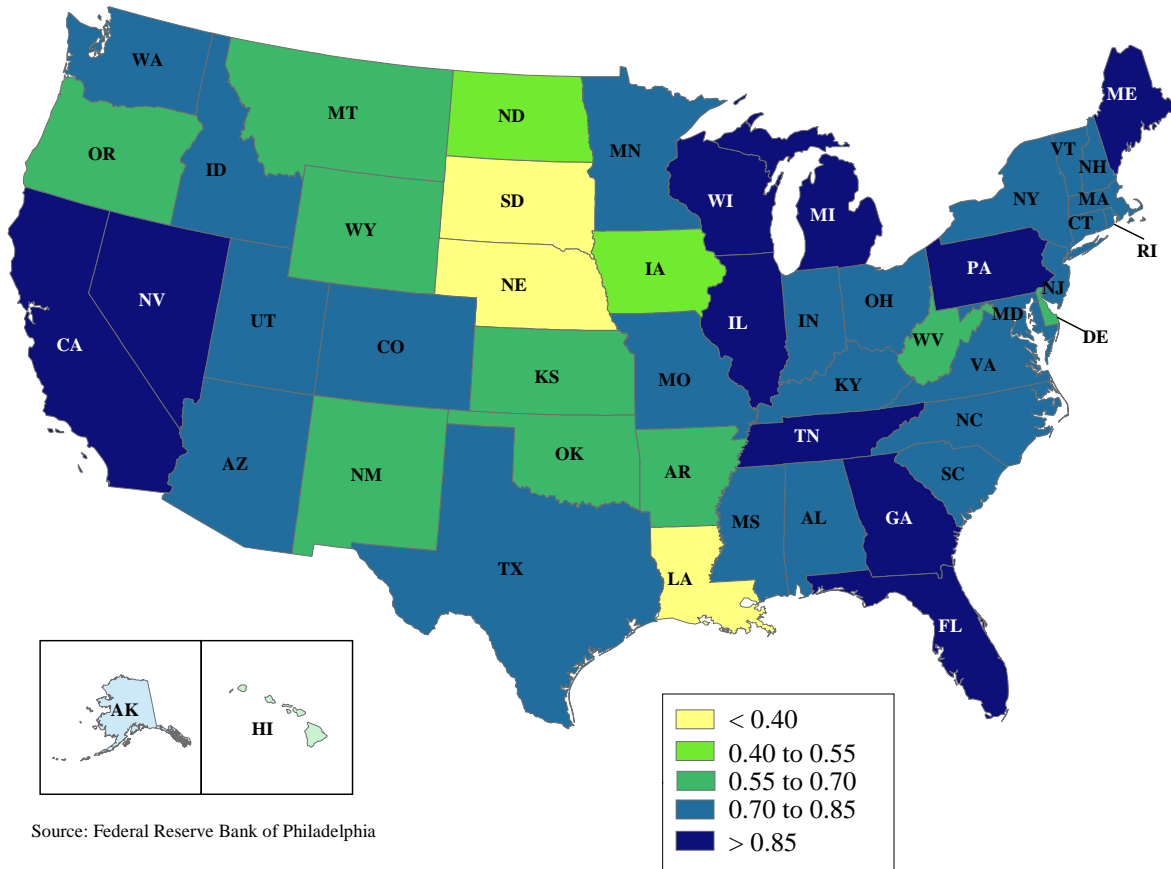
TABLE 1. Correlations Between Annual Growth of State Gross Domestic Product (GDP) and the State Coincident Indexes (CI) (1980-2011)	
	Correlation
All Observations (1,632)	0.69
Only those Observations where…	
GDP and CI are negative (189)	0.50
GDP and CI are positive (1,197)	0.57
GDP and CI diverge (246)	−0.50

If we break down the observations by state-specific periods of expansion and contraction, we see that the two variables are more strongly correlated during expansions (1,197 observations), and there are some periods of divergence (246 observations).

These correlations are for the total set of states over the period. Now let us look at the correlations between state GDP and the coincident indicators on a state-by-state basis. While the number of observations is much smaller (32 per state), there are insights to be gained. Figure 1 displays a map of the state-specific correlations.

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[4] The coincident indexes are treated as flow variables in this analysis. The flow accumulates from January to December. Therefore, annual growth rates can be calculated from December to December. The timing is equivalent to state GDP.

Figure 1. Correlations Between State GDP and the Philadelphia Fed Coincident Indexes

Source: Federal Reserve Bank of Philadelphia

Legend:
- < 0.40
- 0.40 to 0.55
- 0.55 to 0.70
- 0.70 to 0.85
- > 0.85

As can be seen from the map, the degree of correlation between GDP and the Philadelphia Fed state coincident indexes varies across states. For example, Florida, Nevada, and Michigan are highly correlated, while Louisiana, South Dakota, and Nebraska are weakly correlated.

Most of the states with weaker correlations are in the central plains. Interestingly, this area of the country has large proportions of agriculture and natural resources. If we test the relationship between the ratio of agriculture and mining output to total GDP with the correlations on the map, we find a highly negative relationship (−0.62). This negative correlation suggests that a state with a high proportion in these two sectors tends to have a weak correlation between state GDP and the coincident index.

Based on their construction, it makes sense that the state coincident indexes do not effectively measure states with a lot of economic activity in these two sectors. For one, agricultural employment is not accounted for in the index; it is difficult to measure, and the index uses only nonfarm payroll

employment. Output from mining activities is affected more by changes in commodity prices than changes in employment.

Besides this limitation, the state coincident indexes track state GDP quite well, and in that sense, they are a useful proxy for state GDP.

Reliable Output Measures in the Face of Revisions

The strong correlations we have just reviewed are for final revised data. The underlying data used for constructing the state coincident indexes are subject to revision as more information is collected by the statistical agencies that produce the data. This means that the state coincident indexes are subject to revisions as well.

The state coincident indexes have been released on a monthly basis since 2005. Staff in the Philadelphia Fed's Research Department have been collecting real-time data on the indexes — that is, observations at the time of release — effectively since the beginning of 2005. We have 86 monthly vintages of coincident indexes for the 50 states along with the national coincident index and 90 dates of observation.[5] A vintage is defined here as the month and year in which new data are released to the public.[6] When the new data are released, revisions to the previous observations on the index are also released.

I focus this analysis on three measures for tracking economic activity: the one-month, the three-month, and the 12-month percentage change in the state coincident indexes. I modify the three-month and 12-month change into averages by dividing by 3 and 12, respectively, so I can compare the magnitude directly with the one-month change.

Tracking revisions to these measures in real time requires settling on terminology:

- A one-month revision compares the initial release with the release one month in the future.
- A benchmark revision compares the initial release with the following January release, when benchmark revisions are made to employment, the unemployment rate, and average hours worked.

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[5] The number of vintages does not match the number of observation dates because we are missing vintages for January 2006, February 2006, March 2006, and August 2006.
[6] Some common terminology can be found in other work on real-time data such as that produced by the Research Department's Real-Time Data Research Center at http://www.philadelphiafed.org/research-and-data/real-time-center.

- A <u>final revision</u> compares the initial release with the most recent release, which for the purpose of this paper is the release of the June 2012 data.

To analyze the revisions, I take the absolute revision and average over states and vintages. Means and standard deviations are presented for the three variables of interest over the three types of revisions in Table 2.

TABLE 2. Average Absolute Revisions of the Philadelphia Fed State Coincident Indexes				
		1-Month Percentage Change	**3-Month Percentage Change**	**12-Month Percentage Change**
One-Month Revision	**Mean**	0.034%	0.022%	0.011%
	Standard Deviation	0.050%	0.031%	0.018%
Benchmark Revision	**Mean**	0.094%	0.063%	0.034%
	Standard Deviation	0.095%	0.063%	0.037%
Final Revision	**Mean**	0.109%	0.075%	0.048%
	Standard Deviation	0.098%	0.067%	0.048%

As shown in Table 2, the revisions are modest given that these indexes grow roughly 3 percent per year; the annualized average change for the one-month change amounts to 0.4 percent for the one-month revision and 1.3 percent for the final revision; these values were arrived at by multiplying 0.034 percent and 0.109 percent by 12.

The means rise consistently as the vintage moves away from the initial release. In fact, notice that the biggest jump occurs with the benchmark revision; there is more than a 300 percent increase in magnitude from the one-month revision to the benchmark revision.

In addition to real-time data on the coincident indexes, we have real-time data on the inputs for the underlying variables used to construct the indexes. The average absolute revisions for the inputs are displayed in Table 3.

TABLE 3. Average Absolute Revisions of the Inputs Variables		1-Month Percentage Change	3-Month Percentage Change	12-Month Percentage Change
Nonfarm Payroll Employment				
One-Month Revision	Mean	0.037%	0.015%	0.004%
	Standard Deviation	0.049%	0.023%	0.010%
Benchmark Revision	Mean	0.108%	0.050%	0.016%
	Standard Deviation	0.086%	0.042%	0.019%
Final Revision	Mean	0.116%	0.053%	0.016%
	Standard Deviation	0.092%	0.044%	0.019%
Unemployment Rate				
One-Month Revision	Mean	0.011%	0.005%	0.001%
	Standard Deviation	0.037%	0.017%	0.005%
Benchmark Revision	Mean	0.072%	0.033%	0.009%
	Standard Deviation	0.059%	0.026%	0.007%
Final Revision	Mean	0.087%	0.040%	0.011%
	Standard Deviation	0.069%	0.028%	0.008%
Average Hours Worked in Manufacturing				
One-Month Revision	Mean	0.169%	0.066%	0.014%
	Standard Deviation	0.448%	0.173%	0.048%
Benchmark Revision	Mean	0.365%	0.151%	0.034%
	Standard Deviation	0.575%	0.235%	0.066%
Final Revision	Mean	0.398%	0.162%	0.023%
	Standard Deviation	0.778%	0.273%	0.044%

TABLE 3 (Continued). Average Absolute Revisions of the Inputs Variables[7]					
		1-Month Percentage Change	3-Month Percentage Change	12-Month Percentage Change
Wage and Salaries				
One-Month Revision	**Mean**	.	0.030%	0.009%
	Standard Deviation	.	0.060%	0.022%
Benchmark Revision	**Mean**	.	0.092%	0.037%
	Standard Deviation	.	0.091%	0.050%
Final Revision	**Mean**	.	0.120%	0.041%
	Standard Deviation	.	0.099%	0.045%
GDP				
One-Month Revision	**Mean**	.	.	0.009%
	Standard Deviation	.	.	0.029%
Benchmark Revision	**Mean**	.	.	0.030%
	Standard Deviation	.	.	0.050%
Final Revision	**Mean**	.	.	0.084%
	Standard Deviation	.	.	0.069%

Three results can be confirmed from these statistics.

- Average hours worked in manufacturing undergoes the largest revisions by far.
- The pattern of revisions for employment, unemployment rates, and average hours worked in manufacturing shows large increases from the one-month to the benchmark revisions, similar to the coincident indexes.
- The coincident index revisions are smaller than the employment revisions, which are the most significant component in the state coincident indexes. This result suggests that there is an

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[7] One-month percentage changes are not applicable for quarterly wage and salary data. One-month and three-month changes are not applicable for annual GDP data.

advantage to using the state coincident indexes over the employment series if one is concerned with the impact of revisions.

We can test for statistical relationships between the inputs and the coincident index revisions using a time series cross-section model. I will focus on the benchmark revisions to the three-month change ($B3$), since they are the most sizable.

Regressing revisions to the coincident indexes (CI) on revisions to employment (EMP), the unemployment rate (UNR), average hours worked in manufacturing (HRS), real wages and salaries (WSD), and gross domestic product (GDP) gives us the following equation:

$$CI_{s,v}^{B3} = \alpha + \beta_1 EMP_{s,v}^{B3} + \beta_2 UNR_{s,v}^{B3} + \beta_3 HRS_{s,v}^{B3} + \beta_4 WSD_{s,v}^{B3} + \beta_5 GDP_{s,v}^{B3} + \varepsilon_{s,v}$$

where s and v are the state and the vintage date, respectively.

We can account for variability in vintages and states by using a fixed-effects model. The estimation results are presented in Table 4.

TABLE 4. Fixed-Effects Results for Benchmark Revisions of the Coincident Indexes (three-month percentage change)		
Variables	**Coefficient Estimates**	**T Statistics**
Constant	0.01	15.83
Employment	0.63	21.43
Unemployment Rate	0.46	13.95
Average Hours Worked in Manufacturing	0.00	1.76
Wage and Salary	0.09	15.39
Gross Domestic Product	0.01	0.72
Goodness-of-Fit Measures		
R-squared		
Total	0.66	
Within	0.28	
Between	0.63	

The R-squared suggests that revisions to the input variables explain the coincident index revisions very well. The coefficients for revisions to GDP and average hours worked in manufacturing are the only

coefficients to lack statistical significance. These two results are not unexpected; GDP data affect only the long-run trend of the coincident index; average hours worked in manufacturing has large revisions but the variable accounts for only a small share of the index movements.

The two most influential revisions come from employment and the unemployment rate. This result has often been cited anecdotally, but it is clearly shown here statistically. Using the average absolute revisions and the coefficient estimates, I calculate that roughly 74 percent of the index revisions are the result of these two variables $[(0.05*0.63 + 0.033*0.46)/0.063 = 0.74]$.

Additionally, revisions to the state coincident indexes are strongly affected by labor market data, especially data after the most recent January release.

The State Coincident Indexes Are Effective Measures of Output

This analysis presented in this report indicates:

On an annual basis, correlation coefficients indicate that the state coincident indexes track GDP quite well. However, the variability across state correlations suggests that better accounting for agriculture and mining industries could prove beneficial in more fully capturing conditions in different regions.

The state coincident indexes are subject to revisions, as are all measures, but the revisions are modest. Revisions to the indexes are mainly caused by benchmark revisions to employment and the unemployment rate, two variables used in constructing the indexes. Indexes that incorporate the benchmark revisions, that is, data prior to January in the current year, are subject to only small revisions. Indexes based on data after the most recent January, which have not incorporated benchmark revisions, must be used with some caution, since they are subject to larger revisions when the benchmark revisions occur.

Overall, the state coincident indexes, which are based on labor market data, provide insight into state economic activity beyond labor activities. The state coincident indexes are important measures for those interested in monitoring states' economies and are better than using employment alone.