

Tracking Business Conditions in Delaware

To meet the need for a gauge of current regional conditions at high frequency, we have built a real-time daily index to monitor business conditions in Delaware. What are the current conditions in the First State? How have these conditions evolved since the 1990s?

BY JONAS E. ARIAS AND JESÚS FERNÁNDEZ-VILLVERDE

Ever since the first official measure of the U.S. economy, prepared by Simon Kuznets, was submitted to Congress in 1934, substantial resources have been dedicated to developing more precise tools for systematically tracking economic conditions. A major breakthrough in this line of research came in the late 1980s with the development of monthly indexes for monitoring the current state of the economy using modern time series econometrics.¹

These indexes have become an essential part of the toolkit of economists at policymaking institutions and in the private sector because they provide a systematic framework for extracting, in real time, a succinct summary of the state of the economy from the vast and continually evolving economic data. Prominent examples of such summary indexes include the Federal Reserve Bank of Chicago's National Activity Index and the Federal Reserve Bank of Philadelphia's State Coincident Indexes, which track the U.S. and state economies, respectively.

In recent years, the work on monthly indexes has been advanced by Borağan Aruoba, Francis X. Diebold, and Chiara Scotti's development of a methodology for monitoring the state of the economy at even higher frequencies—weekly and daily. This work has evolved into the Philadelphia Fed's Aruoba-Diebold-Scotti (ADS) Business Conditions Index.

To date, this high-frequency approach has been employed exclusively to provide timely information about the national economy. Yet, it has become increasingly clear that economic conditions in a particular region of the country can at times differ from the overall state of the U.S. economy.² Furthermore, state-level real GDP—one of the chief indicators of what is happening to the economy—is typically released with a lag of more than five months. In an attempt to meet the need for a gauge of current regional conditions at high frequency, we have built a real-time daily index to monitor business conditions in Delaware, which along with most of Pennsylvania and southern New Jersey, makes up the Third Federal Reserve District served by the Philadelphia Fed. While similar indexes could also be built for the other two

states, the case of Delaware is interesting because of the high volatility of Delaware's real GDP growth—about twice that of New Jersey and nearly triple that of Pennsylvania, and one of the most volatile growth rates among the 50 U.S. states. This volatility presents a major challenge for households, firms, and policymakers alike when it comes to forming accurate views about what is happening to the economy in the First State.

With this backdrop in mind, we will describe how the index works, examine what it can contribute to our understanding of the evolution of Delaware's economy since the 1990s, and discuss the challenges and limitations of trying to measure the economy in real time.

The Making of a Real-Time Index for Delaware

The index is based on Delaware's readings for seven macroeconomic variables: initial claims for unemployment insurance benefits, nonfarm payroll employment growth, the unemployment rate, an electricity consumption index, new building permits, new car titles, and real personal income growth.³ These economic variables, which are the index's input variables, provide snapshots of different aspects of the economy. Initial jobless claims, employment growth, and the unemployment rate are barometers of labor market conditions. Electricity consumption and the pace of building permit issuance contain information about the health of commerce, construction, and industrial production. New car titles and real personal income growth are reasonable indicators of households' purchasing power.

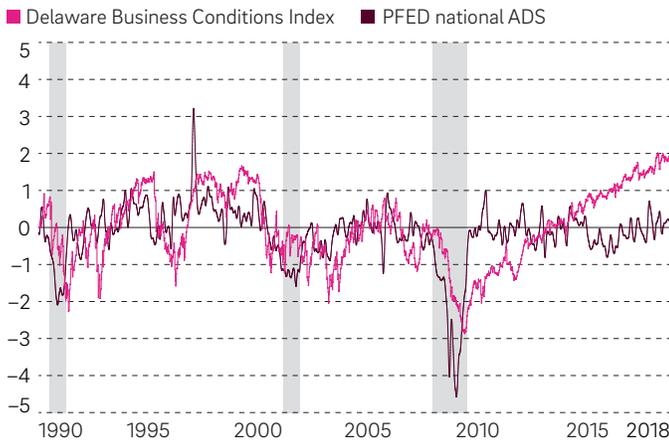
While the input variables depict economic conditions from different angles, they generally move with the underlying state of the economy, or *latent business conditions*. This underlying level of economic activity cannot be directly observed. Instead, it is inferred from the levels and movements of various relevant economic indicators. But different economic indicators can point in different directions at the same time, which suggests that factors other than intrinsic economic activity may be in play.

Jonas E. Arias is a senior economist at the Federal Reserve Bank of Philadelphia and **Jesús Fernández-Villaverde** is a visiting scholar from the University of Pennsylvania. The views expressed in this article are not necessarily those of the Federal Reserve.

FIGURE 1

Real Time Business Conditions Index for Delaware

Standardized units; 1990–2018



Note: The years shown on the x-axis correspond to the first day of the year; e.g., 2000 refers to January 1, 2000.

FIGURE 2

Delaware in the BEA Mideast

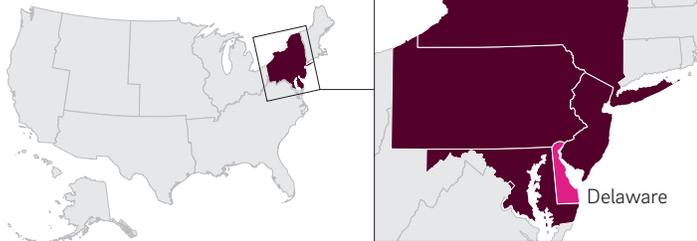
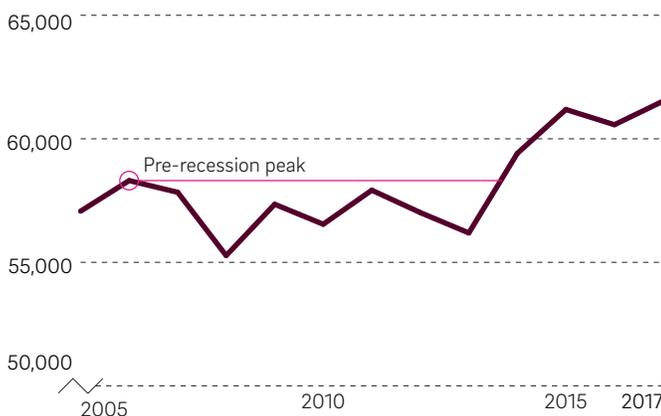


FIGURE 3

Delaware's Real GDP Made a Slow Recovery

Millions of 2009 dollars, seasonally adjusted at annual rates; 2005–2017



What we are after, though, is a measure of economic activity that firms and households can use in their daily decision-making. For example, when firms are deciding whether to expand production or households are deciding whether to purchase big-ticket items such as a house or a car, they often rely—explicitly or implicitly—on a concise summary about the state of the economy based on the information they absorb from the news or other sources.

The approach that firms and households use to extract this succinct measure of economic conditions will vary depending on their budget and experience. Central banks frequently rely on a class of statistical models from which it is possible to optimally extract a reading of what is happening to the economy given the information available this week or even today.

We will follow one of these statistical frameworks to assess the latent business conditions prevalent in Delaware in real time over the past 27 years. In particular, we will use the procedure developed by Aruoba, Diebold, and Scotti.⁴

Assessing Business Conditions in Delaware

By feeding the seven input variables into the statistical model, we obtain an estimate of the evolution of latent business conditions in Delaware since the 1990s (Figure 1).⁵ An informative point of reference for evaluating these conditions is latent U.S. business conditions during the same timespan, as measured by the Philadelphia Fed's ADS index.⁶ Three results stand out.

First, business conditions in Delaware corresponded reasonably closely with those of the nation from the beginning of our sample in January 1990 until the end of the Great Recession in June 2009.^{7,8} The correlation between business conditions in Delaware and in the nation was nearly 0.6 over that period. This fairly close correlation is perhaps not surprising, given that Delaware is located within an important region of U.S. economic activity, the Bureau of Economic Analysis's (BEA's) Mideast Region (Figure 2).⁹ Real GDP for that region equals nearly 20 percent of U.S. GDP, on average.

Second, business conditions in Delaware recovered from the Great Recession more slowly than national business conditions did. While the U.S. overall reached its historical average in July 2009, coinciding with the end of the Great Recession, business conditions in Delaware remained persistently under par, reaching their historical average more than three years later, in February 2013. This historical average corresponds to the normal situation of the economy as determined by the observations. Since in a typical month the U.S. and Delaware economies are growing, readings below average are still compatible with positive GDP growth (just at a slower pace).

The slow recovery documented by the index is consistent with Delaware's feeble real GDP readings in the aftermath of the financial crisis. It took more than four years after the end of the Great Recession for Delaware's GDP to exceed its precrisis peak (Figure 3). The cumulative growth rate of Delaware's real GDP from 2010 to 2013 (i.e., the change in real GDP from 2009 to 2013) was about -2 percent, a worrying performance when compared with the cumulative growth rate of U.S. real GDP over the same period of about 8 percent. In addition, there is narrative evidence

supporting the Delaware index's poor readings following the Great Recession.¹⁰

Third, business conditions in Delaware have hovered well above their historical average during the past four years, which is in line with the sharp increase in real GDP from 2013 to 2017 (Figure 4). Real GDP increased nearly 10 percent over that span, propelled by the strong growth in 2014, the largest increase in Delaware's real GDP since 1999.

Real GDP's dull performance from 2009 until 2013 and ensuing pickup were predominantly in sync with the Delaware index. But did this tight relationship between latent business conditions and real GDP hold over our full sample? Studying the longer-term relationship is challenging. To begin with, the earliest data point for real GDP for Delaware corresponds to 1997.¹¹ In addition, whereas directly comparing the index with real GDP over short periods such as 2007–2017 can be informative, to meaningfully compare the index with GDP over longer periods requires distinguishing fluctuations in GDP from its trend by transforming the GDP data into growth rates—which are more than twice as volatile as those of the nation. Despite these challenges, the Delaware index captures fairly well the big-picture patterns of real GDP growth (Figure 4).

More concretely, real GDP growth was remarkably high during 1998 and 1999, coinciding with strong latent business conditions. Afterward, GDP growth performed poorly until 2013. The mean rate of real GDP growth over 2000–2013 fluctuated somewhat below par, with pronounced declines in 2002 and 2008. Similarly, the index registered low readings over this period. Notably, business conditions were well into negative territory before the two largest declines in real GDP growth occurred and the index bottomed out in the subsequent year. Since 2014, the mean rate of real GDP growth has been about 0.1 percentage point above average. This latest period of four years of slightly higher than average growth is in tune with—though much more muted than—the values of the Delaware index, which have not been so high since 1999.

There are two main takeaways from our analysis. First, business conditions in Delaware recovered slowly from the Great Recession, reaching their historical average in February 2013, more than five years after the onset of the recession. Second, business conditions have been consistently above average since 2014. Altogether, the evidence suggests that the index can be a useful, timely benchmark for assessing economic conditions in Delaware.

The Relationship Between Index and Inputs

How do the index values compare with those of each of the seven variables used to construct it? Examining these relationships will help us determine whether the index is reliably picking up on key signals that are coming from different corners of the economy. Recall that the Delaware index is a summary indicator—that is, it is based on data about different parts of the economy. For the most part, a summary indicator will move in tandem with its input variables.

Indeed, examining the relationship between the Delaware business conditions index and its labor market components clearly shows this comovement. It is evident that, when viewed over a number of years, from January 1990 through September 2018, initial jobless claims have moved in line with the index (Figure 5). The correlation between the data points and the index is about 0.6, and there are definite similarities in the cyclical movements of the series. Notwithstanding, there were periods in which the index was clearly below or above the negative of initial claims, indicating that other forces were in play that were determining the state of Delaware's economy.

The method of extracting latent business conditions from the observation of several macroeconomic variables is a particular application of a class of techniques known as filtering. These techniques are widespread in the natural sciences and engineering and have become popular in economics since the 1970s.

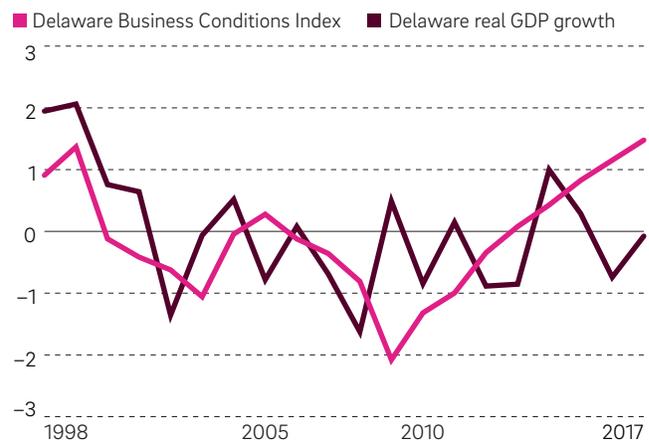
Filtering consists of updating our knowledge about an unobserved variable in a system as new information arrives. To grasp a deeper notion of how it works, consider a two-equation linear system in which the first equation describes how an observed variable y relates to an unobserved variable α , and the second equation describes how the unobserved variable evolves. Applying filtering techniques to this system provides the best statistical guess of the value of the unobserved variable at each point in time given all the information available. Formally, such a best guess is the expected value of the unobserved variable at time t given the current and past observed variables, i.e., $E(\alpha_t | y_1, y_2, \dots, y_t)$.

Importantly, filtering is an objective procedure. Applying this methodology to infer Delaware's business conditions results in an indicator that complements heuristic judgments that one can make about what is occurring in the economy.

FIGURE 4

Business Conditions, Real GDP Growth Tell Broadly Similar Story

Standardized units; 1998–2017



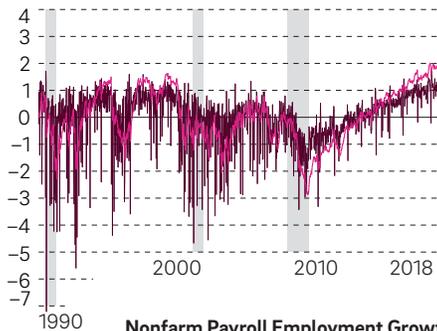
Note: The annual value for the Delaware Business Conditions Index is the average value of the index throughout the year.

FIGURE 5

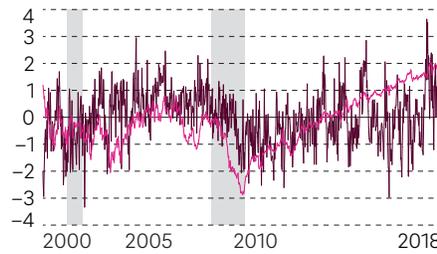
The Index Tracks Most Input Variables

Standardized units ■ Delaware Business Conditions Index ■ Data

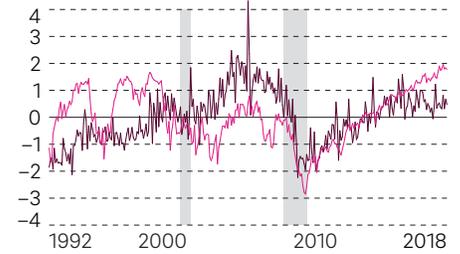
Negative of Initial Jobless Claims
13 January 1990–22 September 2018



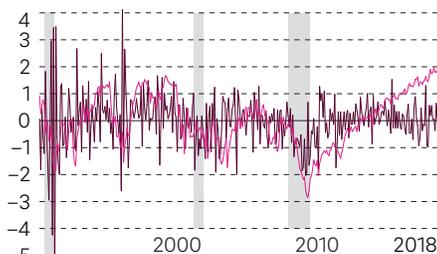
Electricity Consumption Indicator
15 January 2000–15 September 2018



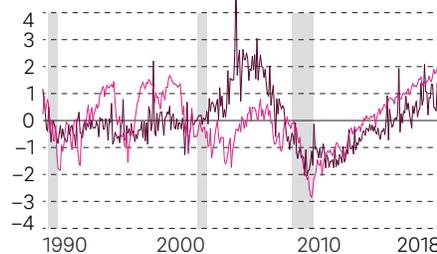
New Car Titles
31 August 1992–31 August 2018



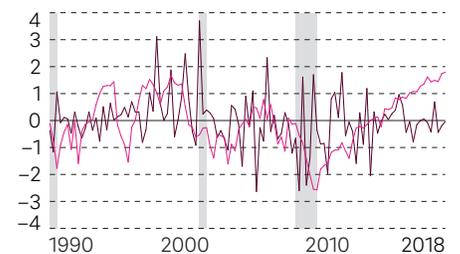
Nonfarm Payroll Employment Growth
31 March 1990–31 August 2018



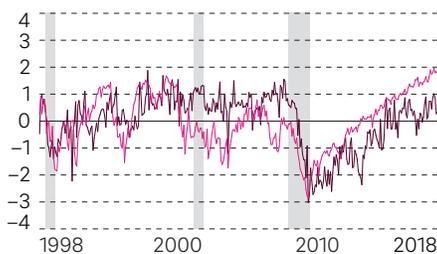
New Private Housing Units Authorized (Permits)
28 February 1990 – 31 August 2018



Real Personal Income Growth
30 September 1990–30 June 2018



Negative of the Unemployment Rate
28 February 1998–31 August 2018



Turning to another labor market component of the index, nonfarm payroll employment growth, we can see that despite the apparent comovement between employment growth and the index, these series have diverged since mid-2009. Following the Great Recession, employment growth reached its historical average earlier than the Delaware business conditions index did, suggesting that other variables (such as the unemployment rate) were exerting a drag on the economy during this period. More recently, nonfarm payroll employment growth has been moderate, but the remaining data convey positive signals about the economy. As a consequence, business conditions readings have scored above the growth rate of nonfarm payroll employment during the past two years.

The remaining labor market indicator, the negative of the unemployment rate, very visibly decoupled from business conditions during certain periods such as the mid-2000s. Yet, in the decade following the onset of the financial crisis, from 2007 to 2017, this variable plunged and recovered in tandem with business conditions.

Similarly, the Delaware index has moved in line with both electricity consumption and the issuance of building permits since the onset of the Great Recession (Figure 5). Electricity consumption dropped significantly around mid-2009 and recovered gradually thereafter. A similar view emerges when looking at new building permits. These patterns were in tune with the Delaware index, which bottomed out in June 2009 and regained strength at a sluggish pace. Interestingly, when looking at the period before the Great Recession, the comovement between the Delaware index and these two variables was less pronounced, especially for new building permits, which conspicuously decoupled from business conditions three times. The first two times—from March 1993 until March 1995 and from January 1997 until January 2000—correspond to periods during which the index indicated that latent business conditions were about

one standard deviation above average, but new building permits were nearly flat. The third occurred in the early and mid-2000s, when new building permits gradually increased, peaking at more than two standard deviations above their historical average. In hindsight, our indicator tells us that during this period new building permits were at their highest point with respect to our sample and had become disconnected from the overall state of Delaware’s economy.

The relationship between the index and its input variables related to household purchasing power—new car titles and real personal income growth—exhibits some of the features that we have observed for the previous variables (Figure 5). The evolution of new car titles is remarkably similar to the evolution of new building permits. Accordingly, the index has closely tracked new car titles since the onset of the Great Recession but did not during the precrisis period. Real personal income growth is a volatile series, and it is the variable that has the lowest correlation with the Delaware index. Even so, the index broadly follows the patterns of real personal income growth, save for certain episodes such as that of the past few years, during which real personal income growth

has been somewhat below average while business conditions have been at their highest level since 1999.

Understanding the Main Drivers

We have just seen how the input variables relate to the index, but can we assess how much each variable is contributing to the index's value at a given point in time or to the change in the index's readings during a certain period? Are some variables more important for revealing underlying economic conditions than others?

The methodology behind the index implicitly assigns weights to current and past data points for each input variable in the underlying statistical model. These filtering weights answer the above questions by allowing us to compute a statistical decomposition that reveals the main drivers behind our assessment of latent business conditions at any point in time. The filtering weights also tell us about the (statistical) source of fluctuations in those conditions over time. To illustrate these points, we first compute each variable's contribution to the index readings throughout October 2005 and January 2018. Next, we compute each variable's cumulative contribution to the change in business conditions over the course of each month. The rationale behind the selection of these months is that they demonstrate an important feature of the index: Initial jobless claims were usually the chief determinant of the overall index value as well as a main driver of its fluctuations.

The central role that initial claims play for the value of the Delaware index can be seen in the average weekly contribution of the three input variables that contributed the most to the value of the index during January 2018 (Figure 6). Initial claims contributed nearly 100 percent of the value of the Delaware index between January 1 and January 5 (first column). The contribution of initial claims dropped slightly below 95 percent between January 6 and January 12 and remained at about that level for the remaining weeks (remaining four columns). Importantly, the contributions can be negative. For example, the average

contribution of nonfarm payroll employment growth to the index was -4 percent during January, indicating that payroll employment has been a moderate drag on the index.

Undoubtedly, initial claims were the overwhelming force behind the index values during January 2018. That is frequently the case throughout our sample, suggesting that initial claims contain crucial information about economic conditions in Delaware. This finding resonates with former Federal Reserve Chairman Alan Greenspan's view on the influential role of initial claims for understanding current economic conditions. He once referred to initial claims as "the earliest indicator of what's happening to the economy."

Moreover, even during periods in which the relevance of initial claims for the index's value declined significantly, claims explained most of the change in its readings. For example, consider the average weekly contribution of the three input variables that contributed the most to the index during October 2005 (Figure 6). Initial claims contributed about 65 percent of the value of the index between October 1 and October 7 (column 1). The contribution of initial claims to the index's values dropped to about 10 percent between October 8 and October 14 (second column), a period during which the electricity consumption index took over as the main factor behind the index's value. Payroll employment growth and the remaining input variables also contributed significantly to the index value throughout October. The large shifts in the contribution of initial claims during October 2005 can be attributed almost entirely to new data showing a slump in the readings for this variable. As will become clear below, the decrease in the contribution of claims reduced the index's value, which in turn increased the role played by the remaining variables.¹²

This decline in the contribution of claims to the index's value does not imply that this variable is unimportant for explaining fluctuations in business conditions. In fact, when decomposing the cumulative change in the value of the Delaware index throughout October 2005 (Figure 7), it becomes evident that by and large claims account for the weekly deterioration of business

FIGURE 6

With Exceptions, Initial Claims Central to Index Level...

Historical decomposition of contributions to the Delaware Business Conditions Index

Standardized units; January 2018 and October 2005

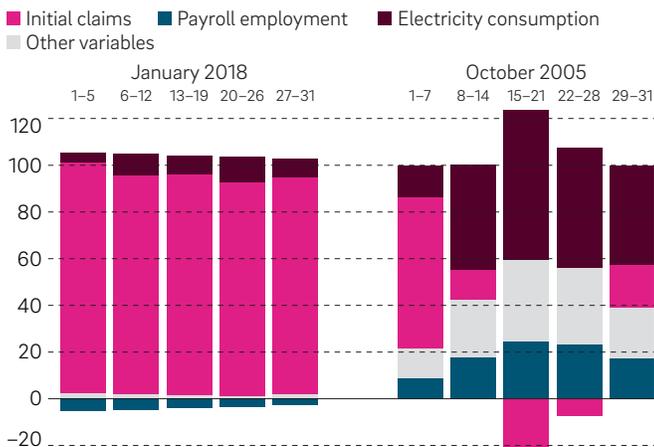
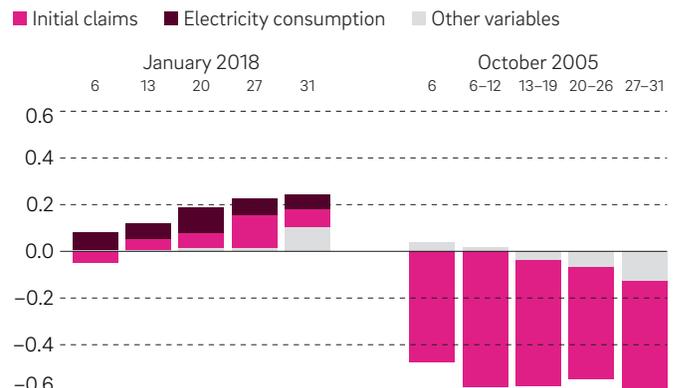


FIGURE 7

...As Well as to Its Changes

Cumulative changes in the Delaware Index

Standardized units ; throughout January 2018 and October 2005



conditions over the course of the month. Likewise, simply that initial claims were the dominant determinant of the index's readings in January 2018 does not necessarily mean that claims were the overwhelming determinant of the changes in those readings. A decomposition of the cumulative changes in index values during January 2018 (Figure 7) shows that electricity consumption was the main driver of these changes, suggesting that our model was taking some positive economic signal from a rise in electricity consumption. Although this finding elucidates that variables other than initial claims can also shed light on how business conditions evolve, it should be regarded with caution given the extreme weather in early January.¹³

Concluding Remarks

Overall, our analysis attributes a major role to initial jobless claims in revealing business conditions in Delaware. Yet, it has also shown that, in order to grasp a deeper understanding of which facets of the economy are exerting a drag on or fostering business conditions, it is important to continuously update the contribution of the input variables to the index's value as well as to its changes.

Finally, as we mentioned, in small states such as Delaware, real GDP growth tends to be more volatile than for the rest of the nation, and economic indicators can point in different directions. These factors can complicate the task of measuring business conditions using summary indexes. In such an environment, readings of business conditions could be sensitive to several modeling choices. For example, just by removing or adding an input variable, one could reach a very different conclusion about what is happening to the economy during a particular period of time or about which variable reveals the most about current economic conditions. Therefore, it is crucial to complement the computation of the index value with a comprehensive analysis of all the available evidence, including plots of the input variables, statistical decompositions, traditional measures of the economy such as real GDP, and even the narrative evidence, as we have done in this article. 

Notes

- 1** These indexes were developed by James Stock and Mark Watson, building on pioneering work by John Geweke, as well as by Thomas Sargent and Christopher Sims.
- 2** Maria Arias, Charles Gascon, and David Rapach compute monthly economic activity indexes across metropolitan statistical areas (MSAs) in the U.S. and find differences in business cycles across these regions. James Hamilton and Michael Owyang find that in spite of a common national component across most recessions in the U.S., there is considerable geographic heterogeneity in the timing of recessions—i.e., when a recession started and ended. See also the research by Jason Brown.
- 3** All variables except for the unemployment rate, new car titles, and electricity consumption are downloaded from Haver Analytics. The unemployment rate series was computed using data from the Current Population Survey (CPS) that is conducted by the U.S. Census Bureau for the Bureau of Labor Statistics (BLS). Data on new car titles were provided by the Delaware Department of Transportation. The electricity consumption indicator is a measure of residential and nonresidential electricity consumption—net of weather conditions and technological progress—in the Delmarva Peninsula (the smallest geographic unit containing Delaware for which electricity consumption data are publically available) built using data from PJM and the National Oceanic and Atmospheric Administration (NOAA). The Delmarva Peninsula encompasses Delaware and parts of Maryland and Virginia, but the population of Delaware is about 70 percent of the Peninsula population. As a result, the bulk of the information contained in the electricity consumption index corresponds to the First State.
- 4** Such framework belongs to the class of dynamic factor models (DFMs) that constitute the backbone of index construction in macroeconomics. Even so, whereas most DFMs are based on a large number of variables (typically more than 100 variables) evolving at monthly frequency, Aruoba, Diebold, and Scotti's DFM focuses on a few variables evolving at different frequencies including weekly or even daily data. The performance of large-data monthly DFMs relative to small-data high-frequency DFMs has been unexplored in the literature, in part because of the fact that the true underlying state of the economy is never observed.
- 5** The Philadelphia Fed has no immediate plans to release monthly readings of Delaware business conditions but is exploring the possibility of doing so, including business conditions for the other states of the Third District, provided that data on industrial electricity consumption and new car titles are made available.
- 6** The latent business conditions in Delaware as measured by our index (which we often refer to as the Delaware Business Conditions Index) and the Philadelphia Fed's

ADS index are reported in standardized units. This means that the average value of each index is zero and that positive values indicate better-than-average conditions, whereas negative values indicate worse-than-average conditions. For example, a value of the Delaware Business Conditions Index equal to 2 indicates that business conditions in Delaware are two standard deviations above the historical average of the index.

7 The term Great Recession refers to the recession associated with the financial crisis of 2007 and 2008, the deepest recession since WWII. The National Bureau of Economic Research (NBER) estimates that the Great Recession began in December 2007 and ended in June 2009.

8 Occasional updates to the Delaware Business Conditions Index are available at <https://sites.google.com/site/jonasarias/>.

9 This region covers the District of Columbia, Delaware, Maryland, New Jersey, New York, and Pennsylvania.

10 See, for example, the article "The First State Comes Last" in *The Economist* magazine on April 4, 2015.

11 The BEA reports real GDP data for years before 1997. However, this time series cannot be combined with post-1997 GDP data to form a single time series. This is because while the former is consistent with the BEA's definition of U.S. gross domestic income, the latter is consistent with the BEA's definition of U.S. gross domestic product, which is a related but different time series.

12 Theoretically, the shifts in the contribution of the input variables to the index's value can be attributed to either new data or the filtering weights, or a combination of both. For instance, with respect to new data, a turning point in one of the variables affects the overall contribution of such variable to the index. Moreover, in some cases the reversal could be large enough to turn the variable in question into a drag for business conditions or vice versa. The filtering weights implicit in our methodology separate information that is pertinent to business conditions from noise or measurement error.

13 Even though our electricity consumption index is designed to be robust to weather fluctuations, it is possible that it does not fully capture the intricate relationship between electricity consumption and extreme weather.

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