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**Economic Research**  
**Global Data Watch**  
September 8, 2016

**J.P.Morgan**

## Economic Research Note

# Forecasting and Nowcasting US GDP

- We introduce a “nowcaster” that estimates US GDP growth based on a wide variety of data
- We compare and contrast the nowcaster with our existing “tracking estimate” of GDP
- The tracking estimate is our best forecast of the GDP number that will be reported by the BEA
- But the nowcaster could be a better gauge of underlying economic activity

Earlier this year, the New York Fed introduced a GDP “nowcaster” that uses a wide variety of data series to predict quarterly GDP growth. Although one could be forgiven for being confused about the difference between the nowcaster and the Atlanta Fed’s “GDPNow” model, we [pointed out](#) that the two models are based on fundamentally different approaches to forecasting. The Atlanta Fed model is based on an “adding-up” approach—it mimics the process that the Bureau of Economic Analysis (BEA) uses to translate underlying source data into the GDP number. The New York Fed approach instead predicts GDP based on a statistical model with many explanatory variables, some of which do not enter the BEA’s GDP calculations at all.

For decades, J.P. Morgan has maintained a “tracking estimate” of GDP growth that takes a similar approach to the Atlanta Fed. And we have also produced a nowcast of global growth since [2012](#). In this note, we introduce a US nowcaster that has much in common with the New York Fed’s. It uses a statistical model to produce a GDP forecast from more than 100 different macroeconomic time series, many of which are not directly used in the estimation of GDP.

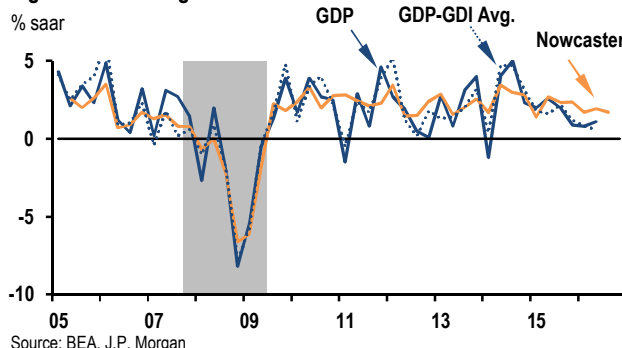
We expect that our tracking estimate will continue to be our best predictor of the number that the BEA will report in the GDP release, particularly late in the quarter when many of the GDP source data are available. But by incorporating more information from a wider variety of data series, our nowcaster could be a better measure of underlying economic activity. At the moment, the nowcaster shows 3Q GDP growth of 1.7%, while our tracking estimate suggests some upside risk to the J.P. Morgan forecast of 2.0%.

## Tracking big game

The BEA assembles its GDP estimates by adding up measures of activity from every part of the economy. Estimates of the components of GDP are often based on data produced by oth-

er agencies like the Census Bureau, or sometimes on private data sources. As one example, the BEA’s estimate of real business investment in warehouses is based on the nominal monthly construction data published by the Census Bureau, along with the PPI for warehouses published by the Bureau of Labor Statistics.

**Figure 1: US GDP growth and JPM Nowcaster**



Our tracking estimate of GDP mimics the adding-up performed by the BEA. Before the construction report and PPI are released for a given month, our estimate for real warehouse spending is based on assumptions for these two series, which could be based on recent trends, related indicators, or other factors like the weather. As source data are released during a quarter, these assumptions are replaced with hard data. Our estimate gradually becomes more of a tracker than a forecast as more of the underlying source data are known.

To understand the potential benefits of the nowcasting approach, consider what would happen if the construction report suffered from measurement error. Suppose, for example, that the sample of firms surveyed by the Census Bureau happened to be a poor representation of the construction taking place around the country. Then the construction report would be a poor measure of overall construction spending, the BEA would incorporate this error into its estimate of investment, and GDP would be mismeasured.

The nowcasting approach hopes to mitigate this problem by incorporating additional data. For example, even if error in the construction report led to a large reported decline in construction spending, we might still see solid construction employment in the payroll report and firm readings from business surveys like the ISM or Philly Fed. Although these data are not directly incorporated in the GDP report (and may include their own measurement error), the nowcaster can still use them to inform its own estimate of GDP. In this situation, we would still expect our tracking estimate to be the best predictor of the BEA’s GDP report, because both will incorporate the same measurement error in the construction data. But the nowcaster might be a more effective method of gauging un-

derlying economic activity because it places less weight on the mismeasured construction data.

## A nowcaster just for us

We have already developed models for producing nowcasts, and we have published nowcaster estimates for Canada since [May](#). But we introduce a nowcaster for the US for the first time here. Our model is a simplified version of the Dynamic Factor Models (DFMs) developed in a long academic literature and incorporated in the nowcasters used by the New York Fed, the IMF, and others. We summarize the information in a potentially long list of data series into a smaller number of “factors,” which we estimate via principal component analysis. Then we use the dynamic relationships among the factors, along with the betas of the data series to the factors, to forecast any not-yet-released data from recent months and to forecast the factors forward into the coming months. Finally, we use the historical relationship between GDP and the factors to turn our factor estimates into a nowcast of quarterly GDP growth.

Even with this framework in place, there are many choices to make in constructing the nowcaster. One key decision is which variables to include, and a second is how many factors to use to summarize the information in these variables. For reasons detailed below, we settle on a nowcaster using about 120 different monthly or weekly variables, summarized into three factors.

The 120 variables include at least one data series from almost all of the economic releases that we follow, with several important component series chosen from major reports like payrolls, retail sales, and industrial production. The list of data series includes “hard data” like retail sales and capital goods shipments, which often directly enter the estimation of GDP, along with labor market data and surveys of businesses and consumers, which do not. We exclude financial and inflation data from the GDP nowcaster, although we could pursue additional related nowcasters in the future.

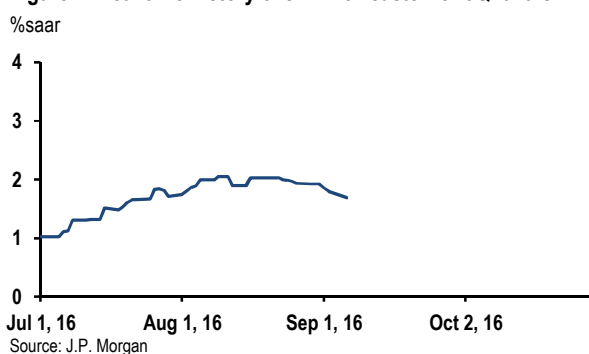
Figure 1 shows the nowcaster results alongside the BEA’s estimate of GDP since 2006 (using the current vintage of data on all monthly series and on GDP). The nowcaster lines up with many of the major moves in GDP over this period, and explains GDP growth with an  $R^2$  of 0.69. But it certainly does not capture every quarterly wiggle in GDP. Of course, this may be a feature and not a bug—the nowcaster likely smooths through some of the measurement error that affects GDP.

Figure 1 also compares the nowcaster to the average growth rate of GDP and GDI (gross domestic income), which has been proposed as an alternative activity measure that could mitigate measurement problems in GDP. The nowcaster is

still smoother than the GDP-GDI average, but a nowcaster fit to this average has a somewhat higher  $R^2$  of 0.75.

Figure 1 also shows that the nowcaster currently looks for 1.7% growth in 3Q, and Figure 2 shows how the nowcast of 3Q has evolved over the last few months. When the quarter started at the beginning of July, the nowcaster was pessimistic, looking for about 1.0% GDP growth. This estimate drifted up toward 2.0% by early August. But a string of disappointing releases, including retail sales and a run of weak business surveys, have since pulled it back down to 1.7%, just below our 2.0% official forecast.

**Figure 2: Real-time history of JPM nowcaster for 3Q2016 GDP**



The New York Fed’s nowcaster followed a similar pattern, revising up from July to August before edging down in recent weeks. But the level of the Fed’s nowcaster has been somewhat higher throughout, and currently stands at 2.8%. As our nowcaster differs from the Fed’s in the selection of data used and likely in the choice of factor structure, differences of this magnitude or larger should not be surprising. And, as we will see in the next section, the standard errors around the nowcaster forecasts are considerably wider than this difference.

Note that we do not view our nowcaster as an attempt to do “better” than the Fed’s. Rather, it will provide a second opinion against which to judge its model and our own forecasts. And we will be able to update our nowcaster immediately as new data are released, while the Fed nowcaster is released only on Fridays outside of FOMC blackout periods.

## Let’s get technical

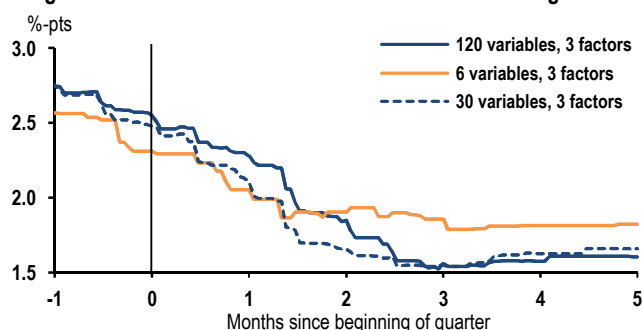
One could construct a nowcaster in many different ways, given the many thousands of available data series measuring different aspects of the US economy. But, as has been shown in prior academic work, bigger is not always better when it comes to choosing the list of variables to include in a nowcaster. And similarly, increasing the number of factors used to summarize the data will always permit a better fit to

GDP, but risks overfitting and poor out-of-sample forecasting performance.

To evaluate performance of different nowcasters, we perform a quasi-real-time forecasting exercise over the period from 2006 to 2015. We use a stylized calendar of the order in which data releases are typically received over the month to simulate the configuration of data that would have been available for forecasting in real time (although we use current vintage data, as first prints are not available for many series). We then calculate the root-mean-squared-error (RMSE) of the nowcaster in forecasting GDP as of each point before, during, and after the quarter.

Figure 3 shows the RMSEs of nowcasters based on a few different sets of variables. It is striking how high these RMSEs are—even well after the quarter is over, a typical forecast miss for the best nowcaster is about 1.6%-pts. And before the quarter begins, the nowcasters are only moderately better than a trailing long-run average of GDP growth, which has an RMSE of about 3.0%-pts (not shown). The figure also shows that a smaller nowcaster based on just the six variables included in the JPM global nowcaster can do better than our full 120-variable nowcaster early in the quarter, a result reminiscent of the [finding of our European colleagues](#) that a smaller model is better early in the quarter. Later in the quarter, however, our full nowcaster does do better.

**Figure 3: RMSEs of alternative nowcasters in forecasting GDP**

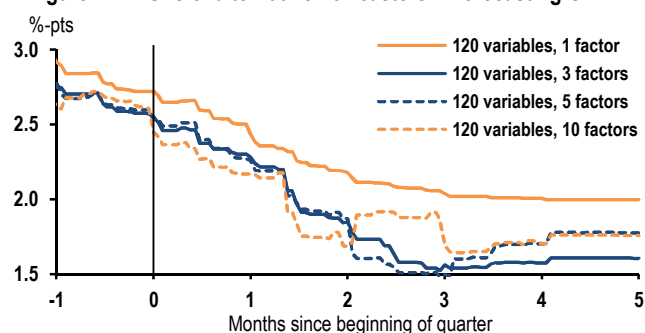


Source: J.P. Morgan

We also find that we can reduce our forecast RMSEs by cutting our variable list to eliminate variables that added little forecasting power in this test. But the gains from these cuts seem relatively modest and may raise the risk of overfitting our nowcaster to the last recession. We thus stick with our 120-variable list, which has the benefit of incorporating at least some aspect of almost every data release we follow. Thus our nowcaster should be better-prepared to detect the next downturn, even if it begins in a different part of the economy than the last one.

Figure 4 plots the RMSEs of 120-variable nowcasters that summarize the variables into different numbers of factors (both for forecasting the yet-to-be-released variables and for translating the factor estimates into the GDP forecast). There is a clear benefit in moving from one factor to three, as the out-of-sample RMSE from the three-factor nowcaster is lower than that from the one-factor nowcaster at every forecast horizon. But the benefits of adding factors beyond three are less clear, as RMSEs are always higher at some forecasting horizons.

**Figure 4: RMSEs of alternative nowcasters in forecasting GDP**



Source: J.P. Morgan

We thus choose the 120-variable, three-factor nowcaster as the official J.P. Morgan US nowcaster that we will publish and discuss. But we will continue to watch other versions of the nowcaster as a means of monitoring risks.

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