# Texas Manufacturing Survey Offers Advance Look at State and National Economies

*By Franklin D. Berger*

*Business tendency surveys such as TMOS are increasingly used worldwide to monitor economic activity.*

Manufacturing commands special attention because of its size and importance to the economy as well as its strong reflection of the business cycle. The Federal Reserve Bank of Dallas has published its Texas Manufacturing Outlook Survey (TMOS) since fall 2005.[1] Federal Reserve Banks in Philadelphia, New York, Richmond and Kansas City also conduct manufacturing surveys. The Federal Reserve monitors regional economic conditions as part of its monetary policymaking role.

TMOS canvasses manufacturers monthly to learn of changes in activities and attitudes, including ones relating to production, employment, the volume of shipments and new work orders, the cost of raw materials and finished goods prices. The results, seasonally adjusted since August 2009, are presented as "balance indexes"—the difference between the percentage of respondents reporting increased activity and the percentage reporting a decrease. Positive readings indicate business expansion; negative ones, contraction.[2]

Business tendency surveys such as TMOS are increasingly used worldwide to monitor economic activity. The Institute for Supply Management produces the most closely followed national review. Because of a relative dearth of regional data, the Reserve Banks' surveys are particularly valuable and often provide timelier information than headline economic indicators that are prone to revision as data are refined. Business tendency survey responses, because they are a measure of sentiment, aren't revised.

## Manufacturing in Texas

Texas manufacturers employed almost a million workers and accounted for nearly 10 percent of U.S. manufacturing output in 2008, the last year for which output data are available. Although contributing a smaller share to the Texas economy than it did 45 years ago, manufacturing remains vital and growing (*Table 1*). As a result of technological change boosting worker productivity, the sector's share of total employment has declined more than its share of overall output even as the amount produced has increased.

## TMOS and the Texas Economy

Texas, like the nation, has experienced a sharp recession and nascent recovery. It's interesting to look back on how TMOS measures behaved. Declining economic activity and the subsequent rebound are

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### Table 1

### Changes in Texas Manufacturing Output and Employment, 1963 to 2008

| | Average annual growth rate (percent) | Manufacturing share of total (percent) | |
| --- | --- | --- | --- |
| | | 1963 | 2008 |
| Output | 4.8 | 18 | 13 |
| Employment | 1.4 | 18 | 9 |

NOTES: Growth rate of output is based on Texas gross domestic product in constant dollars. Output shares are calculated using nominal data.

SOURCES: Bureau of Economic Analysis (state gross domestic product); Bureau of Labor Statistics (payroll employment); author's calculations.

## Chart 1
### Texas Manufacturing Outlook Survey Reflects the Recent Recession

Index*

Legend:
- Production
- Employment
- New work orders
- General business activity
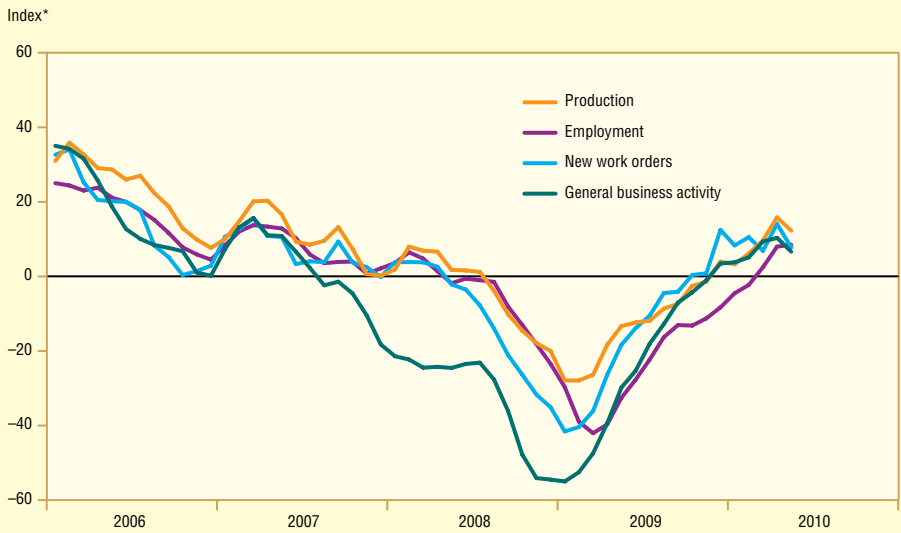
*Three-month, centered moving average.
SOURCE: Federal Reserve Bank of Dallas.

*The business activity index led the other indicators heading into the recession, most likely reflecting respondents' perception that national business conditions were worsening before those in Texas.*

clearly reflected in several key indicators (*Chart 1*). The underlying trends are visible in the chart, which uses a three-month moving average to minimize the impact of volatility. Because positive indicator values depict growth and negative values contraction, a positive though declining index indicates growth is still occurring but decelerating. When an index is negative but increasing, the economy continues contracting but at a diminishing rate.

In the recent business cycle, each indicator signaled contraction and subsequent recovery, though the timing varied (*Table 2*).

The business activity index led the other indicators heading into the recession, most likely reflecting respondents' perception that national business conditions were worsen-
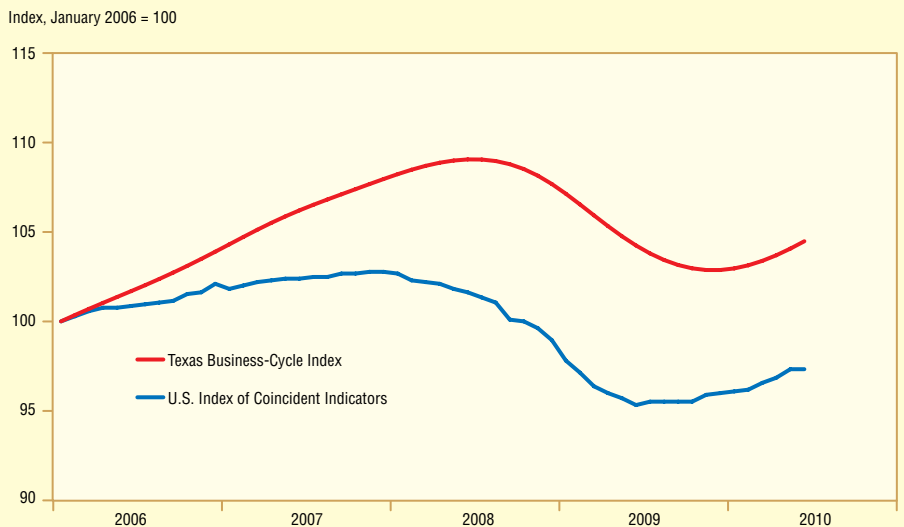
ing before those in Texas. The Conference Board's Index of Coincident Indicators, a similar national barometer, peaked in November/December 2007 (*Chart 2*). That wasn't long after the TMOS business activity indicator turned negative.[3] The National Bureau of Economic Research, the body that officially dates recessions and expansions, designated the start of the U.S. recession as December 2007

## Table 2
### Expansion or Contraction?

|  | Entered contraction | Began expansion |
|---|---|---|
| Business activity | August 2007 | November 2009 |
| Production | August 2008 | November 2009 |
| New work orders | May 2008 | September 2009 |
| Employment | May 2008 | March 2010 |

SOURCE: Federal Reserve Bank of Dallas.

## Chart 2
### Texas and U.S. Have Different Business Cycles

Index, January 2006 = 100

Legend:
- Texas Business-Cycle Index
- U.S. Index of Coincident Indicators

SOURCES: Conference Board; Federal Reserve Bank of Dallas.

## Table 3

### Quality of Fit for Texas Target Variables
(adjusted R-squared)

| | Target variables | | |
| --- | --- | --- | --- |
| | Manufacturing employment | Manufacturing industrial production | Manufacturing business-cycle index |
| Lagged dependent variables only | 0.76 | 0.02 | 0.82 |
| with TMOS employment | 0.79* | 0.17* | 0.85* |
| with TMOS business activity | 0.78* | 0.18* | 0.84* |
| with TMOS production | 0.78* | 0.19* | 0.84* |
| with TMOS new work orders | 0.80* | 0.23* | 0.86* |

NOTES: An asterisk next to the R-squared value indicates the survey variable is statistically significant at the 0.05 level. Seasonal and other adjustments by the Federal Reserve Bank of Dallas.
SOURCES: Bureau of Labor Statistics; Federal Reserve Bank of Dallas.

*Studies have indicated there exists a significant statistical relationship among the various Federal Reserve tendency surveys and regional and national data.*

and the end as June 2009. The Dallas Fed's Texas Business-Cycle Index didn't peak until June 2008, closer to the peaks of the other TMOS indicators, suggesting Texas went into recession about six months after the nation.

The TMOS employment index's behavior around the recession and recovery is consistent with the historical pattern of jobs responding more slowly than output at business-cycle turning points. Employers cautiously hire and fire when demand for their products fluctuates. Firms, uncertain about future conditions, adjust the number of hours worked and vary the number of temporary workers before significantly changing permanent staffing. Decisions to hire or fire occur only when employers decide that demand change seems to be long-lasting.

## TMOS Explanatory Power

Studies have indicated there exists a significant statistical relationship among the various Federal Reserve tendency surveys and regional and national data.[4] TMOS, having amassed about six years of data, can now be investigated to see how well it measures economic conditions.

Several Texas and national factors were tested to see if one or more TMOS balance indexes can explain their movements. The factors of interest (or dependent variables) are referred to as "target" variables and the balance indexes as "survey" variables. Target variables are expressed as a percentage change. Survey variables tested were employment, production, new work orders and general business activity.[5]

Statistical analysis can determine if survey variables are significantly related to target variables over and above any ability

of the target variables to explain their own behavior. Often a good predictor of what happens this month is what occurred last month. But we are interested in the extent of the survey variables' explanatory power once such forward momentum in the target variables is accounted for.[6] Explanatory power is captured in the statistical measure R-squared,[7] which calculates how much of the variation in the target variable is accounted for by explanatory data. A perfect match would have an R-squared of 1; no power is zero. If a survey variable doesn't explain a significant amount of variation in the target variable, after controlling for lags of the target variable, then the survey variable is ineffective at providing insight.

Three target variables were investigated: manufacturing employment, the manufacturing component of the Texas Industrial Production Index and a specially constructed version of the Texas Business-Cycle Index pertinent to the manufacturing sector.[8]

Limited regional data are available, and payroll employment, published by the Bureau of Labor Statistics, is probably the most closely followed. The Texas Industrial Production Index, produced by the Dallas Fed since 1958, estimates output on the basis of employment, hours worked and some production data. The Texas Business-Cycle Index is produced by the Dallas Fed using methodology similar to what the Conference Board uses in its national Index of Coincident Indicators.

## TMOS and Texas Data

In Table 3, the first row shows the result of including two lagged values of the target variable—the predictive power of past performance—without any survey variables

included. Low R-squared in manufacturing production reflects that its lagged values poorly explain future movement. High R-squared values in the manufacturing employment and the manufacturing business-cycle index suggest that lagged values are highly correlated with current outcomes. As for the TMOS indexes, new work orders, with the highest R-squared, provides the most explanatory power for each of the target variables. It explains 80 percent, 23 percent and 86 percent of the variation of the target variables, respectively.

All survey variables are statistically significant at the conventional 0.05 threshold, meaning there is at least a 95 percent likelihood each survey variable has explanatory power.

## TMOS and National Data

TMOS variables also shed light on the Fed's U.S. manufacturing industrial production data and the Institute for Supply Management's Composite Manufacturing Index (also known as the Purchasing Managers Index), a leading indicator of national manufacturing (*Table 4*).

For U.S. manufacturing production, both the TMOS general business activity and new work orders variables are statistically significant, adding explanatory power over and above what past performance of the national measure explains on its own. Only the TMOS employment variable doesn't improve the fit, though the improvement offered by TMOS production is negligible.

For the Purchasing Managers Index, only the TMOS employment variable fails to add significant explanatory power, and once again, new work orders fits a little better than the other variables.

## TMOS Usefulness

Business tendency surveys are designed to provide more timely information on economic conditions than otherwise available. TMOS variables have broad explanatory power for Texas and national economic indicators. TMOS for a given reference month is available up to a month before other Texas data are available. The survey figures appear to measure what they were intended to measure. Moreover, although TMOS was designed for—and is most useful in—understanding the Texas economy, it can also contribute to explaining national developments.

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## Notes

[1] See"A New Barometer for the Texas Economy," by Fiona Sigalla, Franklin D. Berger, Thomas B. Fomby and Keith R. Phillips, Federal Reserve Bank of Dallas *Southwest Economy*, no. 6, 2005.

[2] Additional methodological information, a copy of the survey questionnaire, the latest release and historical data for TMOS can be found at www.dallasfed.org/data/outlook/index.cfm.

[3] The Conference Board's Index of Coincident Indicators is the principal indicator of the overall performance of the U.S. economy. The Texas Business-Cycle Index is produced by the Dallas Fed using methodology similar to that used by the Conference Board.

[4] See the following selected research articles:

"The Predictive Abilities of the New York Fed's Empire State Manufacturing Survey," by Richard Deitz and Charles Steindel, Federal Reserve Bank of New York *Current Issues in Economics and Finance*, Second District Highlights, vol. 11, no. 1, 2005.

"Using Manufacturing Surveys to Assess Economic Conditions," by Matthew Harris, Raymond E. Owens and Pierre-Daniel G. Sartre, Federal Reserve Bank of Richmond *Economic Quarterly*, vol. 90, no. 4, 2004.

"What Can Regional Manufacturing Surveys Tell Us? Lessons from the Tenth District," by William R. Keeton and Michael Verba, Federal Reserve Bank of Kansas City *Economic Review*, Third Quarter, 2004.

"Taking the Measure of Manufacturing," by Timothy Schiller and Michael Trebing, Federal Reserve Bank of Philadelphia *Business Review*, Fourth Quarter, 2003.

[5] These are the most closely watched and probably the most useful among the TMOS indicators of economic activity.

[6] A second-order autoregressive distributed lag model was estimated. Because no autocorrelations were found, the model was estimated with ordinary least squares.

[7] We report adjusted R-squared, which corrects for the fact that R-squared will always increase as independent variables are added.

[8] A version of the Texas Business-Cycle Index specific to the manufacturing sector has been calculated. Although unpublished, this series is available on request. For information on the methodology used, see "A New Monthly Index of the Texas Business Cycle," by Keith R. Phillips, Federal Reserve Bank of Dallas, Research Working Paper no. 0401, January 2004. The paper can be found at www.dallasfed.org/research/papers/2004/wp0401.pdf. Optimally, the target variables we choose would represent what the survey variable is designed to measure. For example, if a government agency produced a measure of Texas manufacturing production that was not very timely but measured very accurately, we could use that measure for the period where they both exist to gauge the predictive power of the TMOS production index. Unfortunately, we only have such a measure for manufacturing employment. For the other target variables, we use measures calculated in a fashion different from the survey, but they do not necessarily represent a more accurate measure. This is a weaker, yet still important, method to gauge the usefulness of the survey series.

## Table 4
### Quality of Fit for U.S. Target Variables
(adjusted R-squared)

| | Target variables | |
| --- | --- | --- |
| | **Manufacturing industrial production** | **Purchasing Managers Index** |
| Lagged dependent variables only | 0.27 | 0.87 |
| with TMOS employment | 0.26 | 0.86 |
| with TMOS business activity | 0.33* | 0.88* |
| with TMOS production | 0.28 | 0.88* |
| with TMOS new work orders | 0.31* | 0.89* |

NOTE: An asterisk next to the R-squared value indicates the survey variable is statistically significant at the 0.05 level.

SOURCES: Federal Reserve System; Institute for Supply Management; Federal Reserve Bank of Dallas.