FRBSF Weekly Letter

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Probability of Recession

The current economic downturn is now almost two quarters old. Even before the contraction began some commentators were forecasting that a recession was imminent. These predictions were typically based on the notion that the longest expansion in the post-war period, which lasted for seven years, had to run out of steam at some point.

On a more rigorous level, economists have tried to predict economic contractions using recession probability index (RPI) models. Since these models aim to measure the likelihood of a future recession, they rely on leading economic indicators as their underlying sources of information.

This *Letter* presents an overview of two representative RPI models and examines their performance, past and present. At the end of last year, the two models were providing widely divergent estimates of the probability that the economy soon would be in a recession. Thus they did little to mitigate the uncertainty about the duration and severity of weakness in the economy.

NBER model

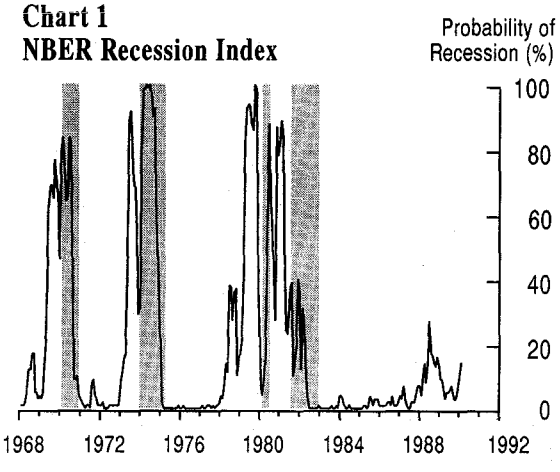
The National Bureau of Economic Research RPI model follows the traditional assumption that expansions and contractions are part of the same stable structure, and are responses to random shocks (policy and others). It is based on two indexes that were created at the NBER by Stock and Watson (1989).

The first is the index of coincident economic indicators (CEI). The CEI is designed to measure the level of current economic activity and comprises four data series: industrial production, real personal income less transfer payments, real manufacturing and trade sales, and employee-hours in nonagricultural establishments.

The second is the index of leading economic indicators, and is designed to predict growth in the CEI six months hence. This index comprises seven data series: the new housing authorization index, a measure of unfilled orders, the exchange value of the dollar, a measure of slack work, and a group of financial variables (interest rates and spreads between different rates). Each set of series is weighted to form an index, where the weights are obtained from state-of-the-art time series analysis.

The recession index (Chart 1) is calculated by combining the two indexes. It measures the probability that the economy will be in a recession in six months.

Chart 1
NBER Recession Index

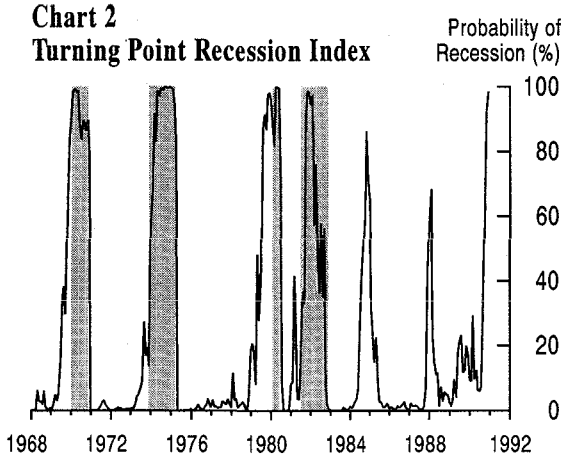


Turning point forecast model

This model is based on different assumptions from the traditional view, and derives from the work of Neftci (1982). It assumes that there are distinct differences in economic patterns between expansions and contractions; therefore, key variables should behave differently in an expansion or a contraction. For example, output tends to inch upward gradually during an expansionary period, whereas it tends to drop very sharply at the beginning of a contractionary period. Consequently, forecasting a recession amounts to predicting a switch in the behavioral mode of the economy from the expansionary to the contractionary phase. This prediction is based on changes in a leading indicator variable.

The turning point index model shown in Chart 2 was developed by Rudebusch and Diebold (1989). The monthly index of Leading Economic Indicators released by the Department of Commerce (DOC-LEI) is its source of information. For each observation of the DOC-LEI, one must calculate the probability whether the new observation represents a shift to a downturn regime or a continuation of a downturn regime. The probability is calculated by applying a Bayesian statistical method.

Chart 2
Turning Point Recession Index



Assessment

The recession probability indexes provide advance information about the general condition of the economy by using various kinds of leading economic indicators. They do so in a more sophisticated way than do common rule-of-thumb methods. For example, one rule-of-thumb method simply looks at the DOC-LEI for three consecutive declines to forecast a future recession. However, RPI models are more systematic because they account for the magnitude of change as well as the temporal direction of change in the leading indicators. And in general, RPI models do substantially outperform rule-of-thumb predictions.

Assessing the accuracy of RPI models is conceptually difficult, however, since the forecasts are in terms of probabilities, which cannot be observed. It's essentially the same problem as assessing the accuracy of predictions about the probability of rain. If the weatherman says there's a 70 percent chance of showers today, and instead it just clouds over, the forecast still may have been accurate. Likewise, though the probability of a recession may be high, it may never materialize. Thus, over a limited sample period, simply correlating the probability with the business cycle is not necessarily a good way to judge the accuracy of the models. For example, a sample period of 10 years would provide over 3,600 observations of daily precipitation, but for the same period there would likely be only a few recession episodes. Of course, the larger the sample, the more appropriate this method of evaluation becomes.

One criterion that is often used to gauge reliability is the frequency of false signals. Leading indicators are notorious for making this mistake—hence, Nobel laureate economist Paul Samuelson's famous remark, "The stock market has predicted nine out of the last five recessions!" A signal is false if the model forecast of an imminent recession is not followed by an actual recession within a reasonable period of time. For example, suppose an assessment criterion interprets the model as signaling a recession when the probability is above 50 percent. Applying this criterion to the post-1968 sample period, the turning point index records two false signals (1985 and 1988), whereas the NBER index has none.

Another criterion is the frequency of failure to predict an ensuing recession with some given lead time (for example, six months). The NBER index has failed completely to predict the current recession, whereas the turning point model has failed twice to signal with any lead time (1974 and 1981). The performance of the latter model in this regard is most likely related to the fact that the DOC-LEI is notorious for having widely varying lead times with the business cycle. For the past 30 years, for example, turning points in the DOC-LEI have led the contractionary turning points of the economy by anywhere from 2 to 20 months. Therefore, the turning point index, which is based on the DOC-LEI, seems to reflect the same characteristic.

Why did the two models differ in this downturn?

Recent predictions of the likelihood of a recession in early 1991 by these models are quite diverse—14 percent by NBER, and 98 percent by the turning point model. These models differ not only in their theoretical underpinnings, but also in that the NBER model includes a set of financial variables, while the turning point model does not. One reason to include financial

variables is that the spread between rates can be a useful predictor of downturns; for example, the spread between short-term commercial paper and T-bills reflects the default risk of the commercial paper, which, in turn, could be sensitive to an expected recession.

Recent research on the changing role of financial variables, however, may explain why models that depend on them for forecasts can miss the mark. Bernanke (1990), among others, found that various interest rates and the spreads between them were substantially more useful in explaining and forecasting key macro variables before 1980 than later.

Before 1980, interest rate spreads, in particular, the spread between short-term commercial paper and T-bills, reflected the stance of monetary policy, which affects the economy by shifting credit conditions. The reflection was particularly clear because banks operated with deposit interest rate ceilings, and because commercial paper and T-bills were imperfect substitutes as portfolio assets.

Monetary tightening tended to raise market rates above deposit rate ceilings. In order to earn a better return, depositors, then, would withdraw their money from banks and invest in market instruments. This "disintermediation" created a "credit crunch" and subsequently an economic contraction. Typically, depositors would purchase T-bills, which can be in relatively small denominations, rather than commercial paper, which is typically in denominations too large for most depositor holders. The inflow of funds to the T-bill market depressed T-bill yields relative to commercial paper rates in periods when the general level of rates is higher. Due to the imperfect substitutability between T-bills and commercial paper, banks would not arbitrage and offset the widening spread. According to this hypothesis, it is relatively easy to explain the diminished role of the spread. Since the early 1980s, the deposit rates were deregulated and more alternative financial assets became available, creating closer substitutability among these assets.

Conclusion

It is likely that the current recession is distinct from others before in terms of both its causes and the way the contractionary effects of the causal factors spread across the economy. For example, some economists point to the deterioration in consumer confidence in conjunction with the Middle East situation as a special factor for this recession. Others cite the diminished credit availability which started last year for reasons related to the weakened condition of the financial institutions and stricter regulations.

These differences may explain why the NBER model, which was designed to conform to the general average characteristics of past economic expansions and contractions, failed to detect the onset of the current economic downturn. More generally, the divergent performance of the two models illustrates the pitfalls of stable linkages among economic indicators that are in fact interrelated in a complicated manner. Movements in these indicators will depend upon which variables caused the downturn in the first place. Thus it is unrealistic to expect the indicators to be correlated consistently with business cycle developments.

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References

Bernanke, Ben S. 1990. "On the Predictive Power of Interest Rates and Interest Rate Spreads." Federal Reserve Bank of Boston *New England Economic Review* pp. 51-68.

Diebold, Francis X., and Glenn D. Rudebusch. 1989. "Scoring the Leading Indicators." *Journal of Business* 64, pp. 369-391.

Neftci, Salih N. 1982. "Optimal Prediction of Cyclical Downturns." *Journal of Economic Dynamics and Control* 4, pp. 225-241.

Stock, James H., and Mark W. Watson. 1989. "New Indexes of Coincident and Leading Economic Indicators." *NBER Macroeconomics Annual* pp. 351-394.

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