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Evaluating and Comparing Leading and Coincident Economic Indicators

GAD LEVANON*

This article evaluates which economic indicators are the most useful for signaling recessions. The article uses a modified Markov switching method to compare the timing of recession signals across many indicators. In its present form, it is difficult to use the Markov switching methods for comparing recession signals across indicators. First, the regimes in the Markov switching method do not necessarily align with recession periods. Second, the definitions of the two regimes are likely to be different across indicators. However, if some modifications are made to the Markov switching method, the method can be helpful for comparing recession signals across indicators. This article shows that by converting Markov switching probabilities into percentiles, the Markov switching method can be useful in comparing the quality of recession signals across indicators. Using the method, hundreds of indicators are ranked based on their leading ability during different sample periods. Finally, the performance of the indicators during the current recession is evaluated.
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The forecasting and detection of turning points in the economy is one of the most studied and practiced areas in macroeconomics. Leading and coincident indicators play an important role in signaling the different phases of the business cycle. The existing literature provides several methods for evaluating business cycle indicators. Forecasting important measures of economic activity like GDP or forecasting recessions is one method [Rudebusch and Williams 2007]. Determining turning points in economic indicators and comparing them to the official National Bureau of Economic Research (NBER) recession dates is another method [Bry and Boschan 1971].

In this article, I suggest a new method for evaluating business cycle indicators and comparing their leading abilities. The method uses the Markov switching methodology, which is one of the most commonly used methods for estimating recession probabilities from economic indicators. In its present form, the Markov switching method is not helpful for comparing recession signals across indicators for two principal reasons. First, the regime probabilities associated with each indicator in the Markov method do not necessarily align with recession periods. Second, the definitions of regimes across different indicators are likely to be different.

To mitigate these problems, in this article the Markov switching probabilities from each indicator are first converted into percentiles, which will allow for comparisons across indicators. In order to decide what percentile qualifies as a recession signal, a threshold will then be created that is proportional to the percent of recession months out of all the months in the sample. The result is a new method for extracting recession signals out of indicators.

The second main contribution of this article is to use the new method to systematically compare hundreds of economic indicators and rank them

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*Gad Levanon is a senior economist in the Economics Department at The Conference Board. He oversees a group of economists conducting research in various macroeconomic and labor market topics. His areas of expertise include evaluating and interpreting macroeconomic and labor market indicators in the U.S. economy and forecasting of the U.S. economy. Before coming to The Conference Board, he worked at the Israeli Central Bank, where he participated in the analysis of financial markets and monetary policy. He received his Ph.D. in economics from Princeton University and holds undergraduate and masters degrees from Tel-Aviv University.

by their performance as leading or coincident indicators. To the best of my knowledge, this is the first article that aims at doing that.

This article proceeds as follows: Section 1 describes the Markov switching method. Section 2 analyzes the performance of indicators during the 1959–2009 period, a larger set of indicators during the 1989–2009 period, and the indicators during the current recession. Section 3 provides some concluding comments.

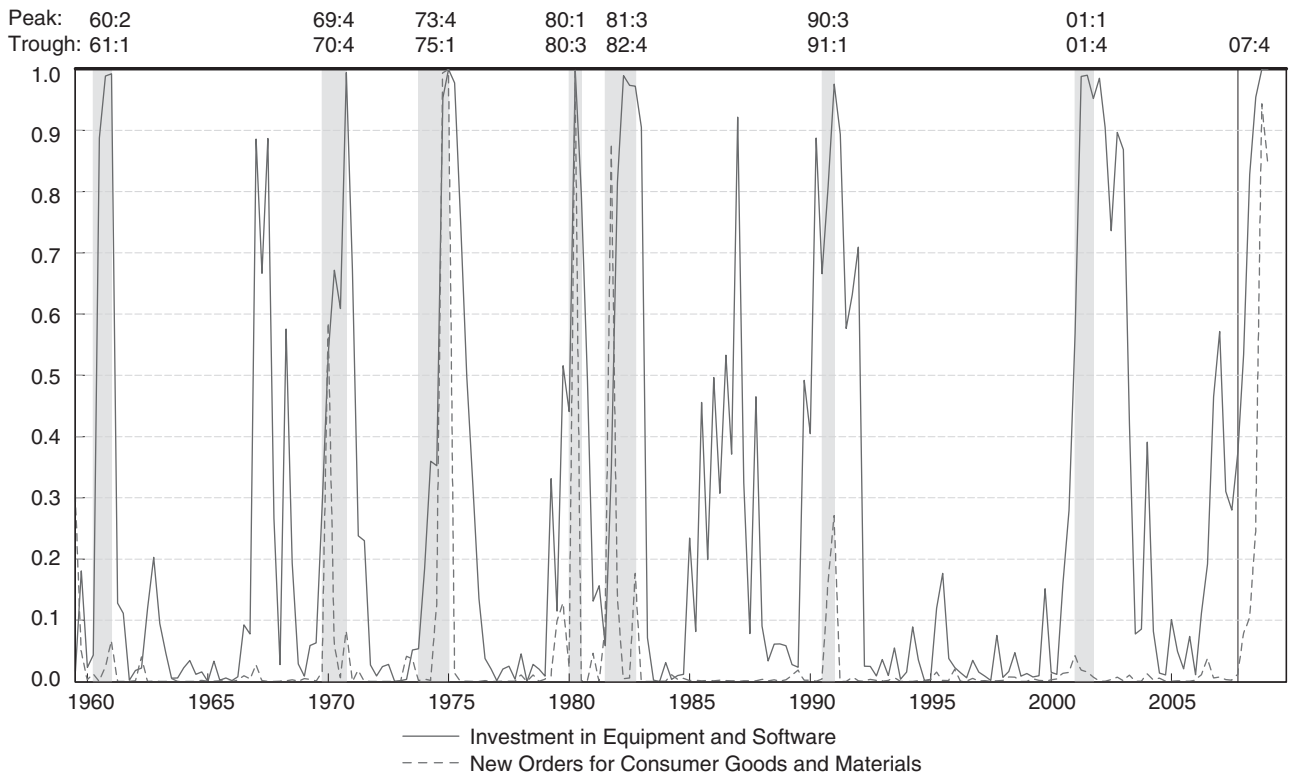
1. The Method

Recessions are the most negative periods of economic activity. An optimal leading indicator provides a recession signal only before or during a recession and should not signal a recession during a period when there is not a recession, or in other words, provide a false signal. In addition, they should not fail to provide a signal when a recession does happen—a missed signal. Similarly, a coincident indicator should provide a recession signal only during a recession.

In the Markov switching method, time-series data are divided into those that are low regime and high regime. The method provides the probability of being in the low regime. For certain indicators, the low regime aligns closely with periods of recessions. Therefore, this method has been extensively used for estimating recession probabilities and dating recessions. However, for many indicators the regimes do not align with periods of recessions, and therefore the probability of being in a low regime is not equal to the recession probability. For these indicators, the Markov switching method does not extract recession probabilities.

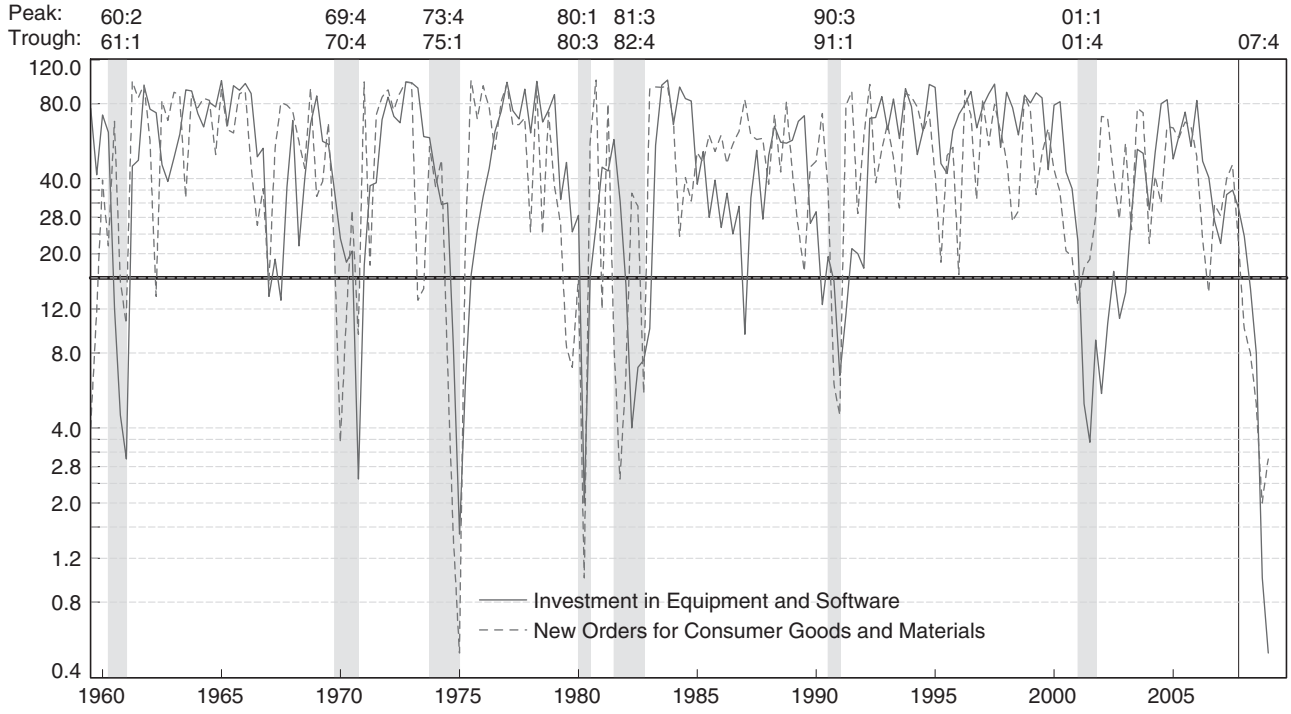
In addition to regimes not aligning with recessions for many indicators, regimes are not defined in the same way across indicators. Therefore, in one indicator a low regime could mean periods of low growth and recessions. In another indicator, a low regime could mean a severe recession. For example, in Figure 1 we see the regime probabilities for two variables: investment in equipment and software and new orders for consumer goods and materials. This figure suggests that the two

Figure 1. Examples of Regime Probabilities



Source: Bureau of Economic Analysis and Census. Shaded areas indicate periods of recession. The lines plot the Markov switching regime probabilities.

Figure 2. Examples of Percentiles of Regime Probabilities



Source: Bureau of Economic Analysis and Census. Shaded areas indicate periods of recession. The lines plot the percentiles of the Markov switching regime probabilities. The vertical axis is in logs.

variables differ significantly in the periods when they signal recession. But if low regimes mean different severity in the weakness of economic activity, then the comparison between the recession signals of these two variables is not valid. The bottom line is that—in its current form—the Markov switching method cannot extract valid recession signals from many indicators and cannot be used for comparing recession signals across indicators. However, the Markov switching method in its current form is useful for comparing recession signals for an individual indicator across time.

I offer the following solution: rather than using the regime probabilities from the Markov switching method, I suggest first converting the regime probabilities into percentiles. Then, a threshold for defining a recession signal will be determined. The X percent highest regime probabilities will be considered recession signals. I assume that in this way, recession signals across different indicators are comparable. In Figure 2, I show the percentiles of the regime probabilities for the same two indicators as in Figure 1. I see that the top percentiles for each indicator usually occur around recessions for both indicators and make the comparison more reasonable.

An additional step is needed to decide what the threshold should be for defining a recession signal. In this article, I set the threshold so that the percent of quarters that are defined as recession signals is equal to the percent of recession periods out of the entire sample, as defined by the NBER. If 15 percent of the months in the sample are determined by the NBER to be recession months, then 15 percent of the quarters with the highest regime probabilities will be recession signals.

The Markov switching model[1]

Since the seminal work of Hamilton [1989], a large body of literature has applied regime switching to various empirical settings. The basic idea has been that the parameters of an econometric model are not constant over time. Allowing them to switch between several regimes would improve a model's fit and

[1]This section of the article draws heavily on Levanon [2008].

forecasting ability. A by-product of this method has been regime-switching probabilities, or filtered probabilities. The filtered probabilities are the probabilities that a given indicator is in a low-mean regime.

I will now briefly describe the Markov regime-switching model that I propose to use in this article.

$$\begin{bmatrix} f_y(1,t) \\ f_y(2,t) \end{bmatrix} = \begin{bmatrix} \frac{1}{\sigma_1}\exp\left\{\frac{-1}{2\sigma_1^2}[y(t)-\rho_{11}y(t-1)-\rho_{12}y(t-2)-\mu_1-\beta_{11}x(t-1)-\beta_{12}x(t-2)]^2\right\} \\ \frac{1}{\sigma_2}\exp\left\{\frac{-1}{2\sigma_2^2}[y(t)-\rho_{21}y(t-1)-\rho_{22}y(t-2)-\mu_2-\beta_{21}x(t-1)-\beta_{22}x(t-2)]^2\right\} \end{bmatrix} \quad (5)$$

Suppose the indicator y has two regimes, "high growth"($S=1$) and "low growth" ($S=2$), which follow a stationary Markov chain. The regimes are unobservable. The dynamics of the indicator y when $S=1$ are characterized by:

$$y(t) = \mu_1 + \rho_{11}y(t-1) + \rho_{12}y(t-2) + \beta_{11}x(t-1) + \beta_{12}x(t-2) + \varepsilon(t) \quad (1)$$

And when $S=2$ by:

$$y(t) = \mu_2 + \rho_{21}y(t-1) + \rho_{22}y(t-2) + \beta_{21}x(t-1) + \beta_{22}x(t-2) + \varepsilon(t) \quad (2)$$

where x is an additional indicator, and

$$\varepsilon(t) \in \begin{cases} N(\sigma_1^2), & S=1 \\ N(\sigma_2^2), & S=2 \end{cases} \quad (3)$$

where σ is the standard deviation of the error term that could also switch across regimes.

In terms of parameters, the transition matrix that governs the evolution of regimes is

$$P = \begin{pmatrix} p & 1-q \\ 1-p & q \end{pmatrix} \quad (4)$$

S_t / S_{t+1}	High	Low
High	p	$1-q$
Low	$1-p$	q

Here, p is the probability that the economy will be in expansion tomorrow, given that today the economy is in an expansion; $1-p$ is the probability that the economy will be in recession tomorrow, given that today the economy is in an expansion. By the same token, q is the probability that the economy will be in recession tomorrow, given that today the economy is in a recession; $1-q$ is the probability that the economy will be in expansion tomorrow, given that today the economy is in a recession.

The conditional density of y in each of the two regimes is given by:

The likelihood value in time t is given by:

$$l(t) = f_y(1,t)\text{Prr}(1,t) + f_y(2,t)\text{Prr}(2,t) \quad (6)$$

where $\text{Prr}(1,t)$ is the probability of being in Regime 1 at quarter t based on the data up to and including quarter $t-1$, and $\text{Prr}(2,t)$ is the corresponding probability of being in Regime 2.

In this method, I estimate simultaneously the parameters for each regime and the recession probability in every period. Moving toward a recession, the low-mean regime's equation fit of the incoming data improves, but the high-mean regime's equation becomes less accurate. In the setting of the log likelihood function, this means that the density from the recession equation becomes larger and the estimated recession probability becomes larger.

The difficulty in the conventional maximum likelihood estimation of this kind of model is that all the possible values of the regimes need to be integrated out. The Expectation-Maximization (EM) algorithm greatly simplifies the computational burden of the estimation, and in this article a specific algorithm was developed for each specification.

Assuming that θ is a vector of the model's unknown parameters, the EM algorithm is an iterative procedure that consists of the following "expectation" and "maximization" steps at the k-th step iteration:

1. Given the parameter estimates (θ^{k-1}) obtained from the ($k-1$)-th iteration, expectations of the regimes are formed.
2. Conditional on the expectation of the regimes, the likelihood function is maximized with respect to the parameters of the model, resulting in θ^k, which are the assumed parameters for the next iteration.
3. In my implementation, I will iterate the above two steps, until θ^k converges, that is, when θ^k and θ^{k-1} are close enough.

The filtered probability of a specific date is conditional on the data up to that date, but is computed using parameters that were estimated using the entire sample.

Specification

As in any type of estimation, the results are sensitive to the specification chosen and to the sample period. There are several specifications that could be used for estimating filtered probabilities: Auto Regressive (AR)(0), AR from higher order, and additional regressors. In addition, I can allow for the variance of the error term to vary across states or not. There is no unique specification that is used across the literature for identifying turning points using Markov switching methods. Chauvet and Hamilton [2005] and Diebold and Rudebusch [1996] use an AR(0) specification with constant variance across regimes. Chauvet and Piger [2002] and Hamilton [2005a] use an AR(1) specification when only the constant is allowed to switch across regimes. Hamilton [2005b] uses AR(2) in which only the constant is allowed to switch across regimes. Very few of the articles on this topic allow for the variance to switch across regimes. One such article is Kontolemis [2001].

In deciding which specification to use it is important to keep in mind that at this stage the goal is to estimate useful filtered probabilities, as opposed to forecasting the dependent variable. For that purpose it is less important to get the best possible fit, or highest value of the likelihood function. It is more important that the features that separate between the two states are indeed what separate between recessions and expansions. More than anything else, this is the mean growth rate.

It is not surprising, then, that for most indicators I find that the specification with AR(0) with constant standard deviation produces the best results. I compared between an AR(0) and AR(1), and in most cases the probabilities from the AR(0) specification were clearly closer in timing to the business cycle chronology. In this specification the only difference between the two regimes is the mean growth rate. This is also the specification with the smallest number of parameters, and that reduces the problem of achieving meaningful convergence.

Initial guesses

The results in the Markov switching method could be very sensitive to the initial guesses of the parameters in the likelihood function, especially if the initial guesses are very far from the "true values." This problem is less severe in the predominant specification used in this section. In this specification, only five parameters are estimated: two transition probabilities (P and Q), two means in the two regimes, and the standard deviation of the error term. My choices of the initial guesses were functions of the mean and variance of the dependent variable, as opposed to numbers. That way when the magnitude of the dependent variable changes, the initial guesses change as well.

The initial guesses were:

$$\mu_1 = 0.1 \times (\text{mean } (y))$$
$$\mu_2 = 1.5 \times (\text{mean } (y))$$
$$\sigma = \text{Var}(y)$$

Level versus change

An important part of this exercise is deciding whether the indicator to use should be the level of the indicator or the changes in the indicator. When using nonstationary indicators like GDP or employment, it is clear that in Markov switching estimation one should use changes. But in the case of many indicators, the levels are stationary. In these cases, both levels and changes are used.

2. Results

As described earlier, once I calculate the regime probabilities for each indicator I convert them to percentiles. Then, a threshold for defining a recession signal will be determined. In the 1959–2009 period 15 percent of the months in the sample are determined by the NBER to be recession months. This will be the threshold for defining the recession signals. Fifteen percent of the quarters with the highest regime probabilities will be recession signals.

I then compare the recession signals with the official recession dates to calculate the leading ability of each indicator. In the tables that follow, several terms are used:

- *First and three before first*—The number of quarterly recession signals that occurred either in the first quarter of a recession or in the three quarters that preceded it.
- *Last and two after last*—The number of quarterly recession signals that occurred either in the last quarter of a recession or in the two quarters following it.

- *Coincident*—The number of quarterly recession signals that occurred in quarters during recessions.
- *Other*—The number of quarterly recession signals that occurred in quarters not included in the above three categories.
- *Rank 1*—The first-and-three-before-first category minus the last-and-two-after-last category. A higher number means that the indicator is more leading.
- *Rank 2* is equal to Rank 1, plus the number of quarterly signals in other recession quarters, excluding the first, last and one before last, minus the Other category. This is a useful adjustment to Rank 1 because Rank 1 is not adjusted for missed signals and false signals. Specifically, Rank 1 does not take into account the number of recession signals that occur in periods unrelated to recessions (false signals), and it also does not take into account the number of recession quarters that do not have a recession signal attached to them (missed signals).

1959–2009 analysis

In this sample period, each indicator has 30 quarterly recession signals. In the tables below, we show for each indicator the distribution of recession signals in the different categories mentioned above. Table 1 lists a selected number of economic variables. The indicators are ranked by Rank 1. The variables at the top of the list are the ones that are more leading. The rankings are consistent with the expected lead/lag order during the business cycle. Housing and durable goods variables tend to be more leading and business investment, in particular business investment in structures, tend to be more lagging. In addition, variables reflecting demand tend to lead production variables, which tend to lead employment variables.

In Table 2, economic indicators are listed, as opposed to the actual economic variables that were listed in Table 1. Table 2 is ranked by Rank 2, which adjusts for false and missed signals. In this table there are three main groups of indicators.

Table 1. Economic Variables Ranking 1959–2009

	Other	First and Three before First	Coincident	Last and Two after Last	Rank 1	Rank 2
Housing starts	5	11	20	2	9	13
Housing permits	7	10	18	2	8	9
GDP: PCE: Clothing and shoes	10	7	17	0	7	6
Initial claims for unemployment	2	8	23	3	5	16
GDP: Residential investment	5	7	22	2	5	13
GDP: PCE: Durable goods	10	8	13	3	5	0
Average weekly hours—Manufacturing	9	6	18	2	4	5
GDP: PCE: Furniture and household equipment	1	9	24	6	3	11
New orders of consumer goods and materials	4	8	20	5	3	9
GDP: PCE: Nondurable goods	5	7	19	5	2	6
INDL prod—Consumer goods	3	6	24	5	1	8
GDP: PCE: Services	9	5	17	4	1	1
Manufacturing and Trade Sales	1	5	26	6	−1	10
GDP: Personal consumption expenditures	1	5	25	7	−2	9
INDL prod—Construction supplies	4	5	24	7	−2	4
GDP: Imports	7	4	18	6	−2	0
New orders for nondefense capital goods	7	4	18	6	−2	0
Industrial production—Total index	0	4	27	8	−4	7
Employed—Construction	4	3	21	9	−6	−1
Change in U.S. unemployment rate	0	2	28	9	−7	5
Gross domestic product	0	2	26	10	−8	4
GDP: Investment: Equipment and software	5	1	19	11	−10	−7
Employed—Manufacturing	5	0	21	11	−11	−8
Hours worked nonfarm business	4	1	21	12	−11	−9
Personal income less transfer payments	6	0	19	11	−11	−10
Employed—private service-providing	7	0	17	11	−11	−10
Employed—Nonfarm total	4	0	21	12	−12	−8
GDP: Structures	12	0	10	12	−12	−21
INDL prod—Equipment	2	0	20	14	−14	−7

Table 2. Economic Indicators Ranking 1959–2009

	Other	One-Three before First and First	Coincident	Last and Two after Last	Rank 1	Rank 2
The Conference Board Leading Economic Indicators Index	3	12	22	1	11	19
Interest Rate Spread-10-Yr Treas Bond Less Fed Funds	5	17	12	1	16	16
Michigan Cons.Sentiment: Economic Outlook, 12 Months	5	6	22	4	2	8
Change In ISM Employment Index	8	8	17	2	6	7
Michigan Cons.Sentiment: Personal Finances, Expected	6	7	17	4	3	7
Michigan Cons.Sentiment: Economic Outlook,5 years	8	6	17	3	3	4
Michigan Consumer Sentiment—Expectations	7	5	19	4	1	4
ISM New Orders	4	5	23	7	−2	3
U.S. Standard & Poor's 500	10	2	18	2	0	2
Michigan Cons.Sentiment: Personal Finances, Current	6	6	16	7	−1	1
ISM Production	2	4	25	9	−5	1
Money supply M2	12	8	12	2	6	−1
ISM Supplier Delivery	6	6	16	9	−3	−3
The Conference Board's Coincident Index	3	0	24	10	−10	−3
Change ISM Supplier Delivery	15	5	12	2	3	−7
ISM Employment	8	0	19	10	−10	−12
ISM Inventories	6	2	15	14	−12	−14
The Conference Board's Lagging Index	11	1	6	16	−15	−25

The first group is The Conference Board's Leading Coincident and Lagging Index. As expected, the order of the lead/lag relationship of these indicators is reflected in the ranking.

The second group of indicators in Table 2 is financial indicators. The interest-rate spread indicator is by far the most leading indicator among all indicators. Over half of its recession signals occur in the first quarter of a recession or in the three quarters preceding it. However, during several recessions there were quarters in which this indicator missed signals. Money supply is one of the most leading indicators. However, 40 percent of its recession signals occur in periods unrelated to recessions, especially in the past 20 years. The S&P 500 stock index is not among the most leading indicators, and it also suffers from having many recession signals in periods unrelated to recessions.

The third group of indicators in Table 2 is indicators from the University of Michigan Survey of Consumers and the Institute of Supply Managers (ISM) survey. In both of those surveys, the distinction between the levels of the indicators and their changes are important. For example, the ISM indicators are built in such a way that levels below 50 are associated with recessions and levels above 50 are associated with expansions. Therefore, the natural way to use the ISM indicators is to use their levels. However, it is also possible that the changes in the ISM indicators are also good recession signals if before and during recessions the declines in the ISM indicators are especially large compared with other periods. As the table shows, the most leading ISM indicator was the change in the employment index. When used in levels, the ISM indicators tended to be more lagging than leading. The most leading component of the Michigan survey is the economic outlook 12 months into the future.

Table 3 shows a selected number of economic variables and indicators sorted by the coincident category. The variable that is ranked the highest is the change in the unemployment rate. Twenty-eight out of its 30 recession signals occur during recession quarters. Other variables that are highly ranked are industrial production, manufacturing and trade sales, and GDP. For total nonfarm employment, only 21 recession signals occurred during recessions. Several recession signals occur after the end of recessions.

1989–2009 analysis

In addition to the 1959–2009 analysis, I decided to conduct additional analysis on a shorter period that starts in 1989. Many indicators were created after 1959 and are often cited and used. By starting an analysis in 1989, I am able to include newer indicators in the analysis. The drawback of this shorter sample is that it includes only three recessions, and the most recent one is still in progress. In total, there are only 10 quarterly recession

Table 3. Economic Indicators Ranking 1959–2009, Sorted by Coincident

	Coincident	Other	One-Three before First and First	Last and Two after Last
Change in unemployment rate	28	0	2	9
Industrial production—Total	27	0	4	8
Manufacturing and trade sales	26	1	5	6
Gross domestic product	26	0	2	10
Gross domestic income	26	2	1	8
GDP: Personal consumption expenditures	25	1	5	7
ISM manufacturers survey: Production	25	2	4	9
INDL prod—Consumer goods	24	3	6	5
The Conference Board's Coincident Index	24	3	0	10
ISM new orders	23	4	5	7
Michigan Economic Outlook, 12 months	22	5	6	4
Employed—Nonfarm total	21	4	0	12
Hours worked of all persons—Nonfarm business	21	4	1	12
INDL prod—Equipment	20	2	0	14
GDP: Investment: Equipment and software	19	5	1	11
Personal income less transfer payments	19	6	0	11
Michigan consumer sentiment—Expectations	19	7	5	4
ISM Employment Index	19	8	0	10
GDP: Imports	18	7	4	6
GDP: PCE: Services	17	9	5	4

signals for each indicator. Therefore, the results of this analysis should be treated with caution.

In Table 4, selected economic variables are presented. The results are quite similar to Table 1. The most notable change is the addition of one variable: the number of employees in temporary help services, which is ranked close to the top of the list.

Table 5 ranks tendency indicators. The table shows that some of the newer indicators are ranked very high in this list. The two indicators that are ranked the highest are the Conference Board's CEO Confidence Survey's own-industry expectations and The National Association of Home Builders/Wells Fargo confidence index. Several indicators from the Conference Board Consumer Confidence Survey were also located at the top of the list. Among the Consumer Confidence Survey's indicators, the ones related to the present situation provide better results when used as changes, and the ones related to expectations provide better results when used as levels. The indicators from the National Federation of Independent Business (NFIB) survey were not among the most leading indicators.

Table 6 presents a list of financial indicators. The indicator that ranks the highest is the two-year swap rate. Half of its recession signals occurred during the first quarter of a recession or in the three quarters preceding it. None of its recession signals occurred in the last quarter or in the two quarters following it. Only one of its recession signals occurred in a period unrelated to recessions. The spread between the one-year Treasury bond and the federal funds rate seems to be slightly better than the spread between the 10-year bond and the federal funds rate. The spreads between the LIBOR and the financial commercial papers and the three-month Treasury bills are ranked high on the list, but that is mostly as a result of the liquidity crisis in the past two years of the sample. The change in the high-yield treasury spread was also ranked high. On the other hand, the levels of the corporate-treasury spreads and the implied volatility in the stock market were ranked low.

The results of the 1989–2009 analysis show that since the 1960s many new economic indicators have been created that can help signal recessions. In particular, business and household surveys such as the NFIB survey, the Consumer Confidence Survey, the CEO Confidence Survey, the number of employees in the temporary help industry, several financial indicators, and others. Many indicators taken from this list were ranked as some of the best leading indicators in the last three recessions.

Table 4. Economic Variables Ranking 1989–2009

	Other	One-three before First and First	Coincident	Last and Two after Last	Rank 1	Rank 2
Employed—Employment Services	0	2	9	2	0	6
Housing starts	1	4	8	1	3	6
New orders of consumer goods and materials	1	1	10	1	0	5
Industrial production—Materials	0	2	10	2	0	5
Employed—Temporary help services	0	2	9	2	0	5
Initial claims for unemployment	0	2	10	2	0	5
Housing permits	3	3	6	0	3	4
GDP: Personal consumption expenditures	2	1	9	1	0	4
GDP: Residential construction	2	3	7	1	2	4
Industrial production—Total	1	1	10	2	−1	3
Manufacturing and trade sales	2	1	9	1	0	3
GDP: Imports	1	1	10	2	−1	3
INDL prod—Construction supplies	3	2	8	1	1	2
GDP: Durable goods	2	4	5	2	2	2
GDP: Furniture and household equipment	2	3	6	2	1	2
Average weekly hours—Manufacturing	5	2	5	0	2	1
Change in unemployment rate	0	1	9	4	−3	1
Change in part time for economic reasons	3	1	7	2	−1	1
New orders for nondefense capital goods	1	2	7	4	−2	0
INDL prod—Consumer goods	4	1	7	1	0	0
GDP: Nondurable goods	4	0	7	1	−1	0
Hours worked—Nonfarm business sector	1	0	8	4	−4	−1
GDP: Equipment and software	1	0	7	5	−5	−2
Change in office vacancies	3	1	6	3	−2	−2
Employed—Nonfarm industries	2	0	7	4	−4	−3
Personal income less transfer payments	4	0	5	4	−4	−6
GDP: Investment in structures	3	0	4	6	−6	−8

Table 5. Economic Indicators Ranking 1989–2009

	Other	One-Three before First and First	Coincident	Last and Two after Last	Rank 1	Rank 2
CEO confidence industry expectations	2	4	6	0	4	6
Home builders survey	1	3	8	1	2	6
Change in consumer confidence business conditions good	0	2	11	2	0	5
Consumer confidence in 12 months—Stock prices increased	2	2	9	0	2	5
Philly outlook new orders	0	2	11	2	0	5
Change in consumer confidence in six months income decreased	2	2	9	1	1	4
Consumer confidence in six months—Jobs more	2	2	9	1	1	4
Change in University of Michigan consumer sentiment—Current conditions	3	3	8	0	3	4
NFIB survey: % expectations inventories	3	2	7	0	2	4
CEO confidence industry current	0	1	10	3	−2	3
Michigan economic outlook, 12 months	3	1	8	1	0	2
ISM new orders	2	2	9	2	0	2
NFIB Small Business Optimism Index	3	1	8	1	0	2
NFIB expecting higher sales	2	1	9	2	−1	2
ISM supplier delivery	2	2	6	2	0	1
Change in ABC consumer comfort	3	0	7	2	−2	0
ISM production	2	1	8	3	−2	−1
ISM employment	2	0	7	4	−4	−3

Table 6. Financial Indicators Ranking 1989–2009

	Other	One-Three before First and First	Coincident	Last and Two after Last	Rank 1	Rank 2
Two-year treasury swap rate	1	5	7	0	5	9
Three-month LIBOR treasury	3	3	6	0	3	5
One-year treasury—FFR	3	5	5	0	5	4
Change in high yield—10-year treasury	3	4	4	0	4	4
10-year treasury—FFR	4	7	1	0	7	3
Three-month financial CP treasury	4	2	6	0	2	3
Standard & Poor's 500	3	1	7	2	−1	0
Moody BAA—Treasury 20–30	2	1	7	3	−2	0
High yield—10-year treasury	3	2	7	2	0	−1
Three-month nonfinancial CP-Treasury	5	2	5	1	1	−2
VXO	6	1	5	1	0	−4

Table 7. Performance in the Current Recession, Economic Variables

	'07-I	'07-II	'07-III	'07-IV	'08-I	'08-II	'08-III	'08-IV	'09-I	Total
GDP: Residential	1	0	1	1	1	0	1	1	1	7
Housing starts	1	0	1	1	1	0	1	1	1	7
GDP: Personal consumption expenditures	0	0	0	1	1	1	1	1	1	6
Housing permits	0	0	1	1	1	0	1	1	1	6
U.S. employed—Employment services	0	0	1	0	1	1	1	1	1	6
Gross domestic product	1	0	0	1	0	0	1	1	1	5
New orders of consumer goods and materials	0	0	0	0	1	1	1	1	1	5
INDL prod—Construction supplies	0	0	0	1	1	1	0	1	1	5
Gross domestic income	0	0	0	1	1	0	1	1	1	5
Employed—Temporary help services	0	0	1	0	0	1	1	1	1	5
Change in part time for economic reasons	0	0	0	0	1	1	1	1	1	5
GDP: Nondurable goods	0	0	0	0	1	0	1	1	1	4
GDP: Imports	0	0	0	0	0	1	1	1	1	4
Industrial production—Total	0	0	0	0	0	1	1	1	1	4
Employed—Total private	0	0	0	0	0	1	1	1	1	4
INDL prod—Consumer goods	0	0	0	0	0	1	1	1	1	4
Change in unemployment rate	0	0	0	0	0	1	1	1	1	4
Manufacturing and trade sales	0	0	0	0	1	0	1	1	1	4
Initial Claims for Unemployment	0	0	0	0	0	1	1	1	1	4
GDP: Furniture and household equipment	0	0	0	0	0	0	1	1	1	3
GDP: Equipment and software	0	0	0	0	0	0	1	1	1	3
Hours worked nonfarm business	0	0	0	0	0	0	1	1	1	3
Average weekly hours—Manufacturing	0	0	0	0	0	1	0	1	1	3
Employed—Nonfarm industries total	0	0	0	0	0	0	1	1	1	3
Average weekly hours—Total private nonfarm	0	0	0	0	0	0	1	1	1	3
GDP: Durable goods	0	0	0	0	0	0	1	1	0	2
New orders for nondefense capital goods	0	0	0	0	0	0	0	1	1	2
Personal income less transfer payments	0	0	0	0	0	0	1	0	1	2
Change in office vacancies	0	0	0	0	0	0	0	1	1	2
GDP: Structures	0	0	0	0	0	0	0	0	1	1

The 2008–2009 recession

Next, I evaluate the performance of the indicators presented above during the most recent recession, which as of August 2009 is still in progress. Using the quarterly recession signals from the 1989–2009 sample, I analyzed the success of each indicator in signaling the current recession. In Tables 7–9, I indicate in which quarters between 2007:Q1 and 2009:Q1 a specific indicator signaled a recession. In

Table 8. Performance in the Current Recession, Economic Indicators

	'07-I	'07-II	'07-III	'07-IV	'08-I	'08-II	'08-III	'08-IV	'09-I	Total
Home builders survey	0	1	1	1	1	1	1	1	1	8
Consumer confidence in six months—Plans to buy auto	1	0	0	1	1	1	1	1	1	7
Consumer confidence in six months—Plans to buy home	0	0	0	1	1	1	1	1	1	6
NFIB Small Business Optimism Index	0	0	0	1	1	1	1	1	1	6
NFIB survey: % expecting higher sales	0	0	0	1	1	1	1	1	1	6
CEO confidence industry expectations	0	1	0	1	0	1	1	1	1	6
Consumer Confidence Index—Expectations	0	0	0	0	1	1	1	1	1	5
Change in Consumer Confidence Index—Present SIT.	0	0	0	0	1	1	1	1	1	5
NFIB Small Business Optimism Index	0	0	0	0	1	1	1	1	1	5
NFIB survey: % of firms with higher earnings	0	0	0	0	1	1	1	1	1	5
Michigan expectations	0	0	0	0	1	1	1	1	1	5
Change in Michigan consumer sentiment—Current conditions	0	0	0	1	1	1	0	1	0	4
ABC News Index: Buying climate	0	0	0	0	0	1	1	1	1	4
Change in ABC News Index: Consumer comfort	0	0	0	0	0	1	1	1	1	4
Change in NFIB: % of firms with hard to fill jobs	0	0	0	0	0	1	1	1	1	4
Philly outlook new orders	0	0	0	0	0	1	1	1	1	4
CEO Conf current industry	0	0	0	0	0	1	1	1	1	4
ISM New Orders Index	0	0	0	0	0	0	1	1	1	3
ABC News Index: Personal finances	0	0	0	0	0	0	1	1	1	3
Change in ABC News Index: State of economy	0	0	0	0	0	1	1	0	1	3
NFIB Credit Hard	0	0	0	0	0	0	1	1	1	3
ISM Employment Index	0	0	0	0	0	0	0	1	1	2
ISM Production Index	0	0	0	0	0	0	0	1	1	2
ISM Supplier Delivery Index	0	0	0	0	0	0	0	1	1	2
ISM Inventories Index	0	0	0	0	0	0	0	0	1	1

Table 9. Performance in the Current Recession, Financial Indicators

	'07-I	'07-II	'07-III	'07-IV	'08-I	'08-II	'08-III	'08-IV	'09-I	Total
Three-month LIBOR treasury	0	0	1	1	1	1	1	1	1	7
Three-month financial CP treasury	0	0	1	1	1	1	1	1	1	7
Two-year treasury swap rate	0	0	0	1	1	1	1	1	1	6
Change in high yield—10-year treasury	0	0	1	0	1	0	1	1	0	4
Standard & Poor's 500	0	0	0	0	0	0	1	1	1	3
Spread-10-year treasury bond less FFR	1	1	1	0	0	0	0	0	0	3
Moody BAA—Treasury 20–30	0	0	0	0	0	0	1	1	1	3
Three-month nonfinancial CP treasury	0	0	0	1	1	0	0	1	0	3
One-year treasury—FFR	0	0	1	1	1	0	0	0	0	3
High yield—10-year treasury	0	0	0	0	0	0	0	1	1	2
VXO	0	0	0	0	0	0	0	1	1	2

Table 7, I present the economic variables. As the decline in the housing market started before the recession, the earliest signals came from housing-related variables. Personal consumption signaled recession as early as the first quarter of 2007. Leading labor market indicators such as employment services, temporary help services, and working part-time involuntarily due to economic reasons also gave early signals.

The recession, according to the NBER, officially started in December 2007. However, the majority of the indicators did not signal a recession in the fourth quarter of 2007 and the first quarter of 2008. In particular, only one of the five main

indicators of recession according to the NBER—manufacturing and trade sales—signaled a recession in 2008 Quarter 1. Only one indicator—industrial production—signaled a recession in 2008 Quarter 2. The other three main indicators—GDP, employment, and personal income—did not provide recession signals in the first half of 2008.[2] Therefore, it is not surprising that many economists did not consider the first half of 2008 as a recessionary period.

In Table 8, I present the economic indicators. As expected, indicators related to housing and autos provided the earliest signals. In general, indicators from the NFIB, the Consumer Confidence Survey and the Michigan survey signaled a recession throughout 2008. On the other hand, ISM indicators started signaling recession only in the second half of 2008.

In Table 9, I present the financial indicators. Indicators related to the banking sector gave a very early recession signal. The term spreads provided very early signals, but by early 2008 were no longer signaling recession. Other indicators, such as stock prices, corporate-treasury spreads and implied volatility in the stock market did not provide recession signals before the second half of 2008. Thus, after evaluating a large list of indicators, it seems that only in the third quarter of 2008 did the large majority of economic variables and indicators signal a recession.

3. Conclusion

The two main contributions of this article are to create a new method for extracting recession signals out of indicators, and to use the new method to systematically compare hundreds of economic indicators and rank them by their performance as leading or coincident indicators.

Future research could be conducted along several lines. First, the new method could be used for evaluating leading indicators separately for leading peaks and troughs. There are some indicators that may be especially successful in signaling peaks but not troughs and vice versa. Second, the method for ranking the indicators could become more sophisticated and accurate. Third, the analysis could be extended to monthly frequency as opposed to quarterly frequency, as used in this article. Fourth, sensitivity analysis could be conducted with respect to the threshold for recession signals. Finally, once the method is improved, it could be used for creating new types of leading indexes and for estimating recession probabilities at different time horizons.

[2]Many would argue that any decline in nonfarm employment is a strong recessionary signal.

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