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Chicago Fed National Activity Index turns ten—Analyzing its first decade of performance

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This article discusses how the Chicago Fed National Activity Index has performed as a "real-time" indicator of economic activity and related inflationary pressure.

Entering its tenth year, the CFNAI has proven to be a useful real-time indicator of economic activity and related inflationary pressure.

The Chicago Fed National Activity Index (CFNAI) is a monthly index constructed to summarize variation in 85 data series on U.S. economic activity.[1] It is also an example of a "Goldilocks" index, reflecting deviations around a trend rate of economic growth represented by a zero value of the index. Zero is "just right" and suggests that the U.S. economy is proceeding along its historical growth path; a negative value is "cold" and suggests that growth is below average; and a positive value is "hot" and suggests that growth is above average.

The ability of the CFNAI to capture sustained deviations from trend in economic activity has led to its frequent use as an indicator of business cycles.[2] However, the CFNAI was originally suggested as an indicator for forecasting inflation, based on the relationship between deviations in economic activity from trend and the level of economic slack in the U.S. economy.[3] The more slack (or the more negative the index value), generally the less upward pressure there is on prices; conversely, the less slack (or the more positive the index value), the more upward pressure there is on prices.

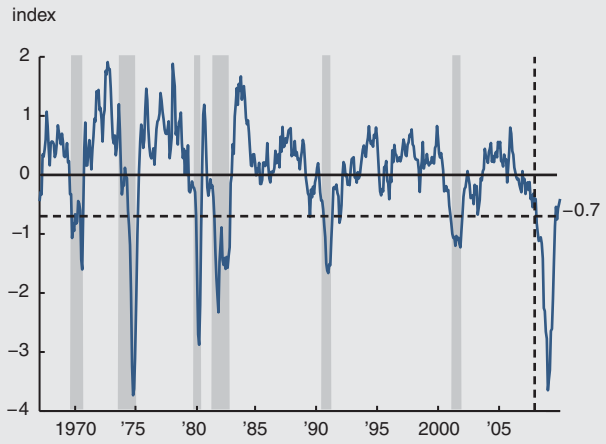
In this *Chicago Fed Letter*, we examine how the CFNAI has performed as an indicator of both economic activity and related inflationary pressure since its initial release in March 2001. With the index reaching its tenth year of publication, we now have a reasonable sample with which to judge its ability to identify recessions and periods of sustained increasing inflation as they are happening. Now we can also more reliably assess its ability to forecast common measures of economic growth, such as gross domestic product (GDP), and measures of inflation, like the Personal Consumption Expenditures (PCE) Price Index. We find that, overall, the CFNAI has proven to be a useful indicator for both purposes over the past decade.

Identifying business and inflation cycles

The CFNAI can be very volatile, since many of the monthly series that make up the index vary significantly from month to month. For this reason, the release of the monthly index is accompanied by a three-month moving average index, i.e., the CFNAI-MA3 , which smoothes these month-to-month variations over time and provides a more consistent picture of variations in economic growth around trend. When the CFNAI-MA3 reaches certain levels that have been identified in previous research as "too hot," the likelihood of a period of sustained increasing inflation rises; when it gets "too cold," the likelihood of a recession rises.

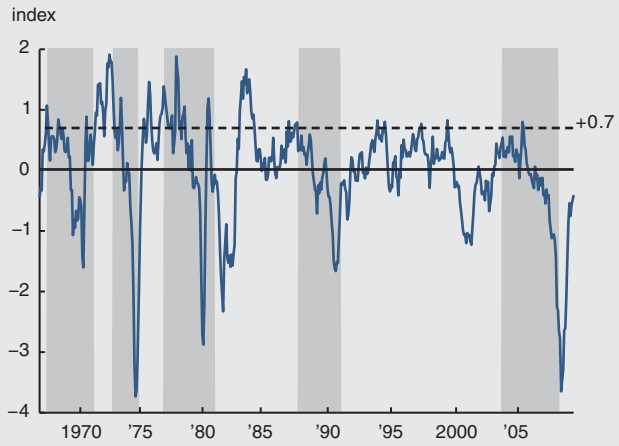
For instance, a CFNAI-MA3 value below –0.7 after a period of economic expansion indicates an increasing likelihood of a recession, as substantial resource slack begins to build up in the U.S. economy. Conversely, a value above –0.7 after a

1. CFNAI-MA3 and business cycles



NOTES: CFNAI-MA3 is the Chicago Fed National Activity Index's three-month moving average. Shading indicates official periods of recession as identified by the National Bureau of Economic Research; the dashed vertical line indicates the most recent business cycle peak. A CFNAI-MA3 value below –0.70 following a period of economic expansion indicates an increasing likelihood that a recession has begun. Conversely, a CFNAI-MA3 value above –0.70 following a period of economic contraction indicates an increasing likelihood that a recession has ended.

2. CFNAI-MA3 and inflation cycles



NOTES: CFNAI-MA3 is the Chicago Fed National Activity Index's three-month moving average. Shading represents periods of substantial inflation increases. A CFNAI-MA3 value above +0.70 more than two years into an economic expansion indicates an increasing likelihood that a period of sustained increasing inflation has begun.

period of economic contraction indicates an increasing likelihood that a recession has ended, as idle resources begin to be put back to use.

The history of the CFNAI-MA3 shown in figure 1 demonstrates that, based on these thresholds, the index has been successful in identifying the beginnings and ends of U.S. recessions since 1967 within one to three months of the dates determined by the National Bureau of Economic Research (NBER). Of course, identifying recessions as they are happening is much trickier. Important data may not yet be available, and the data that have been released are often subject to revision. As a result, the NBER typically determines the beginning and end dates of business cycles several quarters after the event. With its monthly release schedule, the CFNAI serves as a "real-time" measure of the business cycle.

In fact, for the 2001 recession, the CFNAI-MA3 identified the start of the recession as December 2000 in the March 5, 2001, release. Ten months later, the NBER identified the start date of the recession as March 2001. The CFNAI-MA3 then identified the end of the 2001 recession as February 2002 in the March 27, 2002, release. Sixteen months later, the NBER put the end date at November 2001. The index's real-time performance during the recent recession has been even better. In the March 24, 2008, release, the CFNAI-MA3 correctly identified December 2007 as the recession's start date, eight months before the NBER announcement doing the same. While the NBER has yet to identify this recession's end, the CFNAI-MA3 identified the likely end date as September 2009 in the October 26, 2009, release.

Using the index to identify periods of sustained increasing inflation is more difficult. A formal arbiter of such periods, like the NBER, does not exist. Instead, we rely on an algorithm that looks for substantial increases in measures of core inflation (which ignore more volatile food and energy prices) to identify these dates.[4] If we compare them against the CFNAI-MA3 as shown in figure 2, we see that the timing of such signals from the index is often not precise. Unlike business cycles where false positive signals tend to be rare, the index has shown several false positive signals of increasing inflation in its history. Still, it has generally been true that when the CFNAI-MA3 has increased above +0.7 more than two years into an economic expansion, inflation has increased substantially over the following year.

Since its initial release, the CFNAI-MA3 has exceeded +0.7 only twice in real time: for the months of May 2004 (in the June 28, 2004, release) and December 2005 (in the January 23, 2006, release). In subsequent releases, the May 2004 value of the index was revised below +0.7, while the December 2005 value remained above +0.7. These months correspond with the month leading up to and the middle month of this past decade's lone period of sustained increasing inflation that we identify. This contrasts with the previous decade where +0.7 had been reached on several separate occasions without a subsequent sustained rise in inflation.

Forecasting GDP growth and core PCE inflation

To further demonstrate the usefulness of the index, we compared the CFNAI-MA3's ability to forecast current quarter real GDP growth within each quarter from 2001:Q1 through 2009:Q4 relative to forecasts based on other well-known monthly indicators of economic activity. We then did the same for the change in core inflation, as measured by the PCE deflator excluding food and energy prices. All of our forecasts were made in a real-time sense, using the actual data on real GDP, core PCE, the CFNAI-MA3, and the other monthly indicators available at the time the current quarter forecasts would have been made.[5]

Real GDP and core PCE are both quarterly measures. Still, each of these series has a pseudo-monthly release schedule incorporating two rounds of revisions after an initial release; so, if we count

3. Within-quarter forecast performance

		CFNAI-MA3	IP	CUMFG	EM	LR	LRMANUA	ISM	HST
		(MSFE relative to random walk forecast)							
Real GDP growth	2001–03	0.66	0.56	0.36	0.70	0.85	0.98	1.22	0.83
	2004–09	0.36	0.47	0.34	0.54	0.68	0.66	0.87	0.49
Δ Core PCE inflation	2001–03	0.90	0.91	0.91	0.91	0.87	1.09	0.94	0.98
	2004–09	0.91	0.83	0.83	0.89	0.86	0.88	0.82	0.90

NOTES: This figure reports the MSFE (mean squared forecast error) of each monthly indicator's forecast of current quarter GDP growth and the change in core PCE inflation relative to a random walk forecast. The random walk forecasts specify that the current quarter log annualized growth of real GDP and core PCE will be the same as in the previous quarter. Prior to estimation, all of the monthly indicators were transformed in a manner similar to the CFNAI-MA3 by taking a three-month moving average before a stationary transformation was applied. This transformation involved taking the log difference of industrial production (IP) and payroll employment (EM); the arithmetic difference of manufacturing capacity utilization (CUMFG), unemployment rate (LR), and average weekly hours worked in manufacturing (LRMANUA); and the log of housing starts (HST). No stationary transformation was made to the Institute for Supply Management's Purchasing Managers' Index (ISM).

SOURCES: Authors' calculations based on data from the Federal Reserve Bank of Chicago and the Federal Reserve Bank of Philadelphia.

the revisions, each is released within a quarter the same number of times as the CFNAI-MA3. The CFNAI-MA3 is a timelier indicator of economic activity; both real GDP and core PCE experience a lag of one to three months between the time period they describe and the date they are released, whereas the CFNAI-MA3 and all of our monthly indicators lag by only one month. This fact makes it possible to produce current quarter forecasts for each of the three releases within the quarter, using the previous quarter's data on real GDP and core PCE, along with current quarter data on the monthly indicators.

For instance, in any given month when the CFNAI is released, all of the monthly indicators we examine incorporate data up to one month prior to the date of this release. In contrast, the real GDP and core PCE release that corresponds with this same month incorporates data only through the previous quarter. To create our current quarter forecasts, we aligned within the quarter the last available value of real GDP growth and the change in core PCE inflation to the monthly data in accordance with this release schedule. In this way, we used monthly indicators from the first month of a quarter to predict the first release of real GDP and core PCE, the same indicators from the second month to predict the second release, and the same indicators from the third month to predict the third release.

To obtain our monthly forecasts, we then ran a series of regressions of real GDP growth and the change in core PCE inflation on one of their own lags and the contemporaneous value and up to five lags of each of the monthly indicators, where the number of lags was chosen by the Bayesian Information Criterion.[6] The sample period for these rolling regressions began in 1967 and extended to the date of each CFNAI release over the past decade, ending with the November 23, 2009, release (October 2009 being the latest period for which we have matching GDP and PCE data for our forecasts).[7] Using the coefficients from this regression, we then projected forward one quarter using the real-time data to obtain a current quarter forecast.

Figure 3 reports our results.[8] As a benchmark, we used a "random walk" forecast that specified that real GDP growth or core PCE inflation would be the same as in the previous quarter. The evaluation criterion we use in figure 3 is the ratio of the mean squared forecast error (MSFE) of each indicator's forecast relative to the random walk forecast. A value below 1 indicates that the indicator forecast outperformed the random walk forecast, while a value above 1 indicates it underperformed. We consider two subsamples: 2001:Q1–2003:Q4 and 2004:Q1–2009:Q4. We do this to account for the fact that in November 2003 we replaced several of the original 85 CFNAI data series.

For 2001–03, the CFNAI-MA3's GDP forecasts are relatively weak compared with those for production indicators, such as industrial production and manufacturing capacity utilization (first row of figure 3). However, the relatively poor performance of the CFNAI-MA3 during this period was driven substantially by large forecast errors in 2003:Q2. This represents the lone quarter in the past decade that the index registered a false positive in signaling an increasing likelihood of a recession. During that time, the forecasts from several nonproduction indicators underperformed relative to the index and even random walk forecasts.

In contrast, all of the monthly indicators demonstrate much improved forecasting performance over the period 2004–09, when GDP growth was particularly volatile (second row of figure 3). The CFNAI-MA3 forecasts more accurately than all of the other indicators, with the exception of manufacturing capacity utilization, which performs just slightly better. Looking at just the first GDP release within each quarter, the CFNAI-MA3 forecasts are roughly on par with the Philadelphia Fed's *Survey of Professional Forecasters* (SPF) median quarterly forecasts.[9]

The CFNAI-MA3's performance as an inflation indicator during this ten-year period is less impressive, but it's not unlike that of a number of other common inflation indicators. The results in figure 3 (third and fourth rows) are not significantly different across the indicators, but they are uniformly lower than the CFNAI-MA3's in the 2004–09 period. The

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index does, however, outperform the random walk forecast; and only the unemployment rate outperforms the index in both subsamples. In general, the index's performance puts it on par with other common measures of economic slack, such as the unemployment rate and manufacturing capacity utilization.

Conclusion

Entering its tenth year, the CFNAI has performed reasonably well as a real-time indicator of economic activity and related inflationary pressure. In conjunction with the publication of this article, we are releasing the complete real-time history of the index. We hope this will encourage additional research on its real-time properties.[10]

[1] For details, see www.chicagofed.org/cfnai.

[2] Charles L. Evans, Chin Te Liu, and Genevieve Pham-Kanter, 2002, "The 2001 recession and the Chicago Fed National Activity Index: Identifying business cycle turning points," *Economic Perspectives*, Federal Reserve Bank of Chicago, Vol. 26, No. 3, Third Quarter, pp. 26–43; and Scott Brave, 2009, "The Chicago Fed National Activity Index and business cycles," *Chicago Fed Letter*, Federal Reserve Bank of Chicago, No. 268, November.

[3] James H. Stock and Mark W. Watson, 1999, "Forecasting inflation," *Journal of Monetary Economics*, Vol. 44, No. 2, October, pp. 293–335; and Jonas D. M. Fisher, 2000, "Forecasting inflation with a lot of data," *Chicago Fed Letter*, Federal Reserve Bank of Chicago, No. 151, March.

[4] This algorithm is described in detail at www.chicagofed.org/digital_assets/publications/cfnai/background/cfnai_background.pdf.

[5] We obtained the real-time GDP and PCE inflation data from the Federal Reserve Bank of Philadelphia's real-time database at www.phil.frb.org/research-and-data/real-time-center. We focus on quarterly PCE inflation instead of the monthly value in order to make use of real-time data. We took real-time data for the CFNAI and each of the monthly indicators from our own CFNAI archives.

[6] Real GDP growth was de-meaned prior to estimation by using estimates of the mean shifts prior to 2001 implied in Robert J. Gordon, 2003, "Exploding productivity growth: Context, causes, and implications," *Brookings Papers on Economic Activity*, Vol. 34, No. 2, pp. 207–298.

[7] The CFNAI archives begin in March 2001. As a result, the unemployment rate, housing starts, average weekly hours worked in manufacturing, and the Institute for Supply Management's Manufacturing Purchasing Managers' Index forecast results do not include January and February of 2001. The other series were obtained for these months by using the Federal Reserve Bank of Philadelphia's real-time database.

[8] We excluded forecast months that were impacted by benchmark revisions to GDP. We also considered excluding forecasts impacted by annual revisions to GDP; however, doing so did not much alter the results.

[9] The SPF forecasts are available only once each quarter and most closely correspond to the first release of real GDP and core PCE.

[10] The full real-time history of the CFNAI can be found at www.chicagofed.org/digital_assets/others/research/data/cfnai/cfnai_realtime.xls.