Chicago Fed Letter

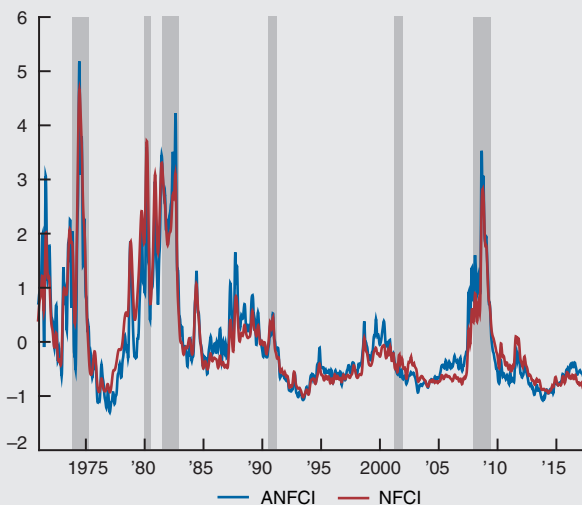## Introducing the Chicago Fed's new adjusted National Financial Conditions Index

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This article introduces improvements to the adjusted National Financial Conditions Index (ANFCI). Compared with the previous version, the new ANFCI uses an enhanced estimation procedure with a broader set of macroeconomic adjustment variables and produces a longer time series history.

Policymakers require reliable measures of financial conditions to gauge the transmission of monetary policy as well as to monitor financial stability.[1] Market participants also increasingly look to such measures for guidance on the health of the economy. As a result, financial conditions indexes, which summarize vast amounts of data on financial activity into a single number, have become useful tools. Because U.S. economic and financial conditions tend to be highly correlated,[2] it is also useful to develop "financial-only" indexes, which adjust financial conditions to account for their regular movement with the state of the business cycle and the level of inflation. At the Chicago Fed, we publish both types of indexes: the National Financial Conditions Index (NFCI) and the adjusted National Financial Conditions Index.

In this *Chicago Fed Letter*, we introduce several improvements to the Chicago Fed's ANFCI, aimed at providing a clearer picture of activity in U.S. financial markets. The new ANFCI (plotted in figure 1) shows that financial conditions remain looser than average by historical standards given current levels of economic growth and inflation—and somewhat more so than the old ANFCI (as shown later). We examine the sources of this finding among the 105 indicators of financial activity that the index summarizes, and discuss the impact of changes we made in the construction of the index.

1. New ANFCI versus NFCI

Notes: Both the new adjusted National Financial Conditions Index (ANFCI) and the National Financial Conditions Index (NFCI) are shown in standard deviation units from their respective means since January 1971. Gray regions indicate U.S. recessions as defined by the National Bureau of Economic Research.
Source: Authors' calculations.

The NFCI and ANFCI

The Chicago Fed's National Financial Conditions Index (also shown in figure 1) provides a comprehensive weekly update on U.S. financial conditions based on 105 measures of financial activity. The index accounts for conditions in money markets, debt and equity markets, and the traditional and "shadow" banking systems, using weekly, monthly, and quarterly data. In constructing the index, weights are calculated to capture the relative importance of each indicator in explaining the index's historical fluctuations. After accounting for the mixed-frequency nature of these indicators, the NFCI is the single common component (or factor) that best predicts the group of indicators as a whole.[3]

To help interpret movements in the NFCI, we classify each of the 105 financial indicators into one of three types: risk, credit, or leverage. Risk indicators are measures that capture volatility and funding risk (i.e., the expected loss due to rising funding costs or insufficient funding) in the financial sector. Credit indicators are measures of household and nonfinancial business credit conditions. And leverage indicators are generally measures of debt relative to equity. Risk indicators tend to receive positive weights in the NFCI (i.e., they are positively correlated with the index), while credit and leverage indicators tend to receive negative weights.[4] That is, "tight" financial conditions are associated with increasing risk and decreasing credit and leverage. We use this pattern as the basis for the overall index's interpretation: Positive values of the NFCI have been historically associated with tighter-than-average financial conditions, while negative values have been historically associated with looser-than-average financial conditions.
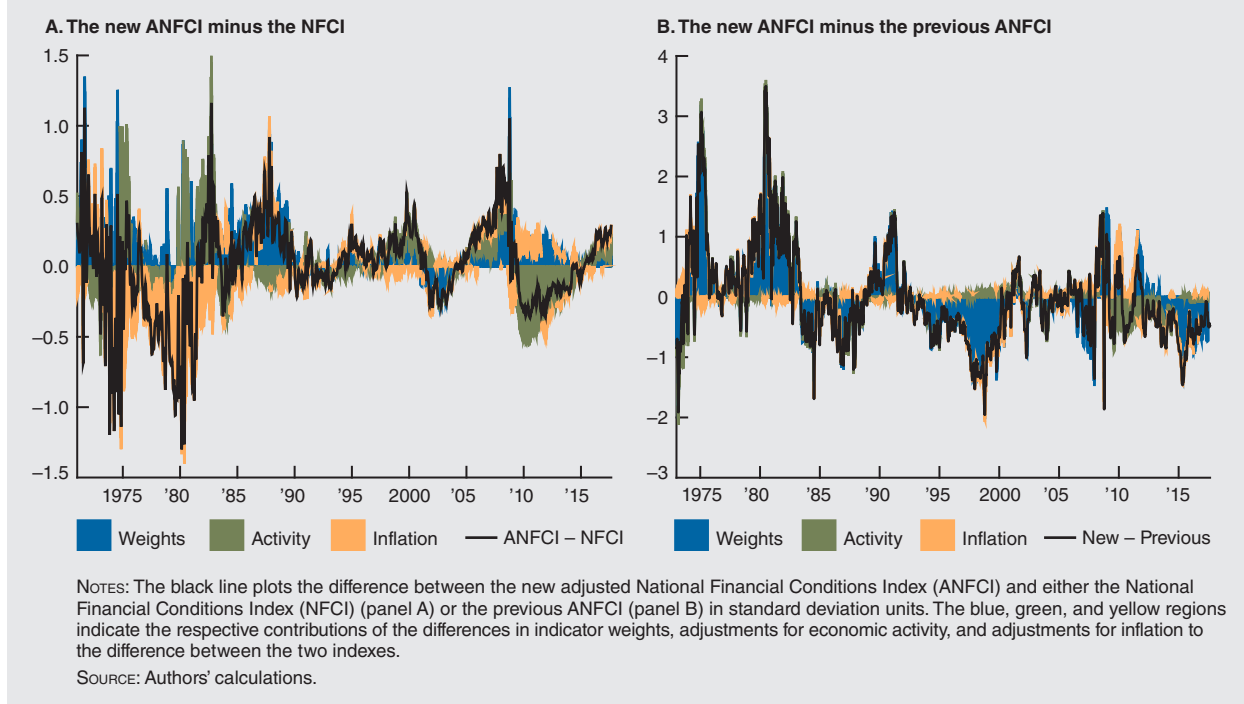
The ANFCI is constructed to take into account prevailing macroeconomic conditions as measured by the Chicago Fed National Activity Index (CFNAI) and the Personal Consumption Expenditures (PCE) Price Index.[5] As such, it isolates a financial-only element of conditions, which adjusts for the state of the business cycle and the level of inflation. If, for instance, economic growth were weaker than average, as during a recession, financial conditions would be expected to be tighter than average as a result. The ANFCI provides a view of financial conditions that is conditional on such an expectation. Thus, positive values of the ANFCI have been historically associated with financial conditions that are tighter than what would be typically suggested by growth in economic activity and inflation, while negative values have been historically associated with the opposite.

Updating the ANFCI

We make three improvements to the estimation procedure used to construct the ANFCI as described in past work.[6] First, instead of the previous two-step procedure, we use a new simultaneous estimation procedure (see the technical appendix) that better accounts for correlations between the weight given to each financial indicator and the adjustments for economic activity and inflation. Second, we include an unemployment rate gap (i.e., the gap between the actual and natural rates of unemployment) as an adjustment variable to improve our business cycle adjustment and a commodity price inflation measure to ensure that we do not put too much weight on the impact of commodity price spikes on inflation.[7] Finally, we extend the time series history of the index back from 1973 to 1971 to capture another historical period of financial stress.[8]

A distinct pattern emerging from our macroeconomic adjustments sheds light on the difference between the ANFCI and NFCI. Above-average inflation and growth in economic activity have been historically associated with looser financial conditions, while below-average inflation and growth in economic activity have been associated with the opposite. As can be seen in figure 1, these correlations result in the ANFCI tending to be below the NFCI during the high-inflation periods of the 1970s and early '80s and during the recessions of 1980, 1990–91, and 2001. In contrast, the ANFCI tended to be above the NFCI during recessions where tight financial conditions were above and beyond the usual cyclical effects that our adjustment process accounts for (e.g., the 1973–75, 1981–82, and 2007–09 recessions).[9]

2. Decompositions of the new ANFCI versus the NFCI and previous ANFCI

A. The new ANFCI minus the NFCI

B. The new ANFCI minus the previous ANFCI

Legend panel A: Weights | Activity | Inflation | —— ANFCI – NFCI

Legend panel B: Weights | Activity | Inflation | —— New – Previous

NOTES: The black line plots the difference between the new adjusted National Financial Conditions Index (ANFCI) and either the National Financial Conditions Index (NFCI) (panel A) or the previous ANFCI (panel B) in standard deviation units. The blue, green, and yellow regions indicate the respective contributions of the differences in indicator weights, adjustments for economic activity, and adjustments for inflation to the difference between the two indexes.

SOURCE: Authors' calculations.

To investigate the sources of the difference between the ANFCI and NFCI, we use a decomposition that attributes each index's value to the individual financial indicators (and the adjustments for macroeconomic conditions in the case of the ANFCI) such that the contributions by indicator sum to the current value of the index. The contributions capture both what a given indicator reveals about current financial conditions and, through its weight in the overall index, how related that indicator is to the other measures of financial activity. While some measures on their own may indicate substantially tighter or substantially looser financial conditions, their contributions to the index may be modest if these measures receive small weights in the index. Moreover, measures that indicate only modestly tighter or modestly looser financial conditions may have substantial contributions to the index if these measures receive large weights.

Using these contributions, we see that most of the difference between the updated ANFCI and the NFCI in panel A of figure 2 can be attributed to the adjustments for prevailing macroeconomic conditions. Roughly 30% of the difference between the new ANFCI and the NFCI is attributable to the economic-activity-based adjustments and about another 30% is attributable to the inflation-based adjustments.[10] The remaining difference between the two indexes—approximately 40%—comes from a reweighting of the financial indicators based on prevailing macroeconomic conditions. When accounting for macroeconomic conditions, the ANFCI tends to put less weight (in absolute terms) on credit indicators and a little more weight on both risk and leverage indicators than the NFCI.[11] This feature can sometimes give the ANFCI a bit of a lead on the NFCI in the run-up to a period of financial stress, as seen in figure 1 for much of the second half of the sample when both indexes were above zero.[12]

We can use this same approach to also capture the difference arising from the changes we made in the construction of the updated ANFCI in figure 2, panel B. Compared with the old ANFCI, the new ANFCI indicates financial conditions were somewhat tighter during the '70s and '80s, somewhat looser during the '90s, moderately tighter in the aftermath of the 2007–08 financial crisis, and modestly looser in recent times. The majority of the changes we observe between the new ANFCI and the previous version (seen in the differences in the indicators' weights) come from our new estimation procedure (80%), while the inclusion of the unemployment rate gap (12%) and commodity price inflation (8%) in the activity- and inflation-based adjustments has smaller effects.

3. Recent movements in the NFCI and new ANFCI

A. NFCI

B. New ANFCI

Risk · Credit · Leverage — NFCI

Risk · Credit · Leverage · Adjustments — ANFCI
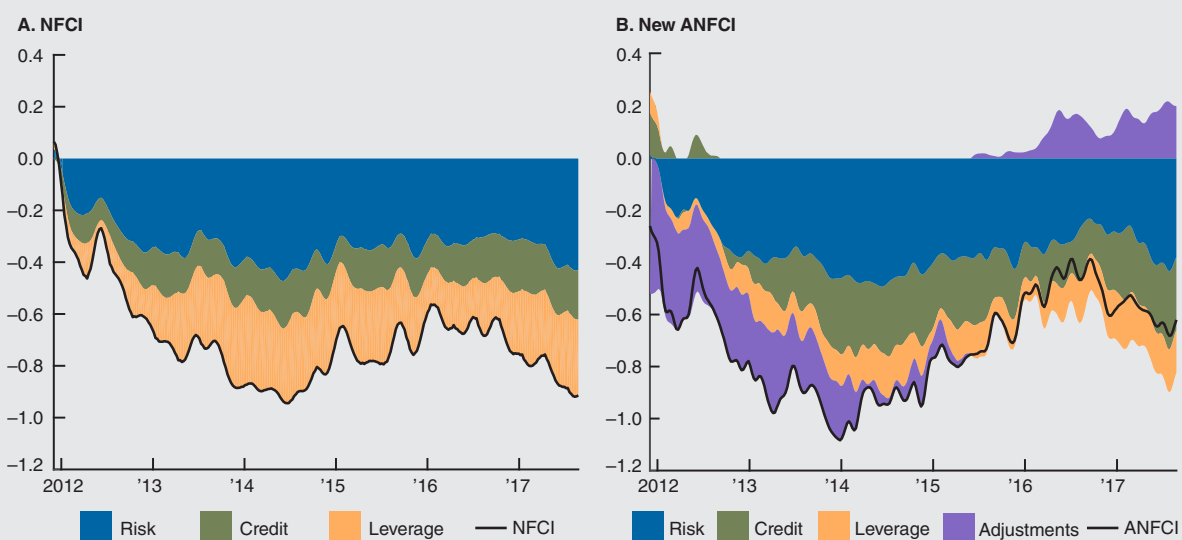
NOTES: The black line plots the National Financial Conditions Index (NFCI) or new adjusted National Financial Conditions Index (ANFCI) in standard deviation units since January 2012. The blue, green, and yellow regions indicate the respective contributions of risk, credit, and leverage indicators to each index. Additionally, the purple region indicates the contribution of the adjustments for economic growth and inflation to the ANFCI.

SOURCE: Authors' calculations.

Moreover, compared with the old ANFCI, the updated index puts slightly less weight (in absolute terms) on the credit indicators and a little more weight on the leverage indicators.

Current financial conditions

Comparing our improved ANFCI, along with the new decomposition of the sources of movements in it, and the (unadjusted) NFCI allows for a more detailed examination of the current state of financial conditions. For instance, as of the week ending August 25, 2017, the NFCI was at its lowest point since July 2014 (figure 3, panel A). All three categories of indicators and 102 of the 105 individual indicators for the index made negative contributions to the NFCI in this week. The contributions from the three categories of indicators were fairly evenly split: The risk, credit, and leverage categories made contributions of –0.43, –0.29, and –0.19, respectively.[13] Over the past several years, all three categories have continued to suggest financial conditions are looser than average historically.

For the week ending August 25, the ANFCI also suggested financial conditions were looser than average historically, but slightly less so than the NFCI after accounting for prevailing macroeconomic conditions (figure 3, panel B). Among the ANFCI's 105 indicators, 101 made negative contributions to the index in this week. The three categories of indicators for the ANFCI pointed to conditions quite similar to those of the NFCI: The risk, credit, and leverage categories made contributions of –0.38, –0.28, and –0.16 to the ANFCI, respectively. However, the macroeconomic adjustments pushed the index higher by 0.20, suggesting that financial conditions are a bit tighter than what historically has been the case at current levels of growth and inflation. On balance, the ANFCI has risen by about 0.5 standard deviations from its recent low in December 2013, standing at about the same level as in early December 2015.

Conclusion

The Chicago Fed's new and improved ANFCI uses an enhanced estimation procedure with a broader set of macroeconomic adjustment variables than the old version while producing a longer time series history. The updated ANFCI shows that financial conditions remain looser than average by

historical standards given current levels of economic growth and inflation—and somewhat more so than the previous ANFCI. This result is broad-based across its 105 indicators of risk, credit, and leverage in the U.S. financial system. However, financial conditions according to the new ANFCI are not quite as loose as conditions observed without adjusting for prevailing macroeconomic conditions. This finding demonstrates why making (and refining) this adjustment is vital for policymakers when interpreting the current state of financial activity. From now on, we plan to make public our updated ANFCI estimates and decompositions by category and indicator with each week's release of the NFCI available online, https://www.chicagofed.org/nfci.

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[1] See, e.g., Marco Bassetto, Luca Benzoni, and Trevor Serrao, 2016, "The interplay between financial conditions and monetary policy shocks," Federal Reserve Bank of Chicago, working paper, No. 2016-11, October, available online, https://www.chicagofed.org/~/media/publications/working-papers/2016/wp2016-11-pdf.pdf, and Scott Brave and R. Andrew Butters, 2012, "Diagnosing the financial system: Financial conditions and financial stress," *International Journal of Central Banking*, Vol. 8, No. 2, June, pp. 191–239.

[2] See, e.g., Jan Hatzius, Peter Hooper, Frederic S. Mishkin, Kermit L. Schoenholtz, and Mark W. Watson, 2010, "Financial conditions indexes: A fresh look after the financial crisis," National Bureau of Economic Research, working paper, No. 16150, July, available online, http://www.nber.org/papers/w16150.

[3] For more details on the NFCI, see the index's FAQs, https://www.chicagofed.org/~/media/publications/nfci/nfci-faqs-pdf.pdf.

[4] An exception to this rule is the nonfinancial leverage indicators, which instead receive positive weights in the NFCI; see Scott A. Brave and R. Andrew Butters, 2012, "Detecting early signs of financial instability," *Chicago Fed Letter*, Federal Reserve Bank of Chicago, No. 305, December, available online, https://www.chicagofed.org/publications/chicago-fed-letter/2012/december-305.

[5] Specifically, we use the three-month moving average of the CFNAI (CFNAI-MA3) and three-month total inflation as measured by the PCE price index (see the technical appendix).

[6] Scott A. Brave and R. Andrew Butters, 2011, "Monitoring financial stability: A financial conditions index approach," *Economic Perspectives*, Federal Reserve Bank of Chicago, Vol. 35, First Quarter, pp. 22–43, available online, https://www.chicagofed.org/publications/economic-perspectives/2011/1q-brave-butters.

[7] Specifically, we use the difference between the U.S. Bureau of Labor Statistics' civilian unemployment rate (U-3 rate) and the Congressional Budget Office's estimate of the long-run natural rate of unemployment and three-month commodity price inflation as measured by the KR-CRB Spot Commodity Price Index (see the technical appendix for more details).

[8] This period corresponds historically with disruptions in money markets that accompanied the collapse of the Bretton Woods fixed exchange rate system; more details are available online, https://www.imf.org/external/about/histend.htm.

[9] See the timeline of events in Brave and Butters (2011, figure 3, pp. 30–33).

[10] These calculations are based on the difference in the absolute variations.

[11] A full list of indicators and their factor loadings for the two indexes is available online, https://www.chicagofed.org/~/media/publications/nfci/nfci-indicators-list-pdf.pdf.

[12] This leading feature was also evident in the old ANFCI as described in Brave and Butters (2011).

[13] The contributions from each indicator to the latest reading of the index are available online, https://www.chicagofed.org/research/data/nfci/current-data.

Appendix

The estimation of the NFCI is based on the following state-space representation for a single-index dynamic factor model:

$$X_t = \Gamma F_t + \varepsilon_t,$$
$$F_t = AF_{t-1} + \nu_t,$$

where F_t represents a $1 \times T$ latent factor capturing a time-varying common source of variation in the $N \times T$ matrix of standardized financial indicators X_t, Γ is their $N \times 1$ vector of loadings onto this factor, A is the transition matrix describing the evolution of the factor's AR(p) dynamics with $p = 15$ weeks (corresponding to roughly one quarter), and ε_t and ν_t are error terms.[i] To address the mixed frequencies of observation in X_t (weekly, monthly, quarterly), we follow the procedure by Harvey,[ii] including additional state variables that evolve deterministically to adjust for temporal aggregation of monthly and quarterly data series. The expectation maximization (EM) algorithm is used to estimate F_t, with the NFCI corresponding to its Kalman smoothed estimate from a panel of 105 mixed-frequency financial indicators with a time series history extending back to 1971 (previously 1973).

Before the update described in this article, the ANFCI pretreated X_t by a vector of macroeconomic indicators, Z_t. This occurred prior to the estimation of the dynamic factor model's other parameters by regressing each of the 105 financial indicators in X_t on current and lagged values of a measure of economic activity—namely, the three-month moving average of the Chicago Fed National Activity Index—and a measure of inflation—specifically, three-month total inflation according to the Personal Consumption Expenditures Price Index.[iii] The indicators in Z_t were transformed so as to match the frequency of observation of X_t, where for weekly financial variables we assumed only lagged values enter the regression and that these values were constant over the weeks of the month.[iv] The standardized residuals from these regressions were then used as X_t in the second-step estimation of the latent factor, with the ANFCI corresponding to the new Kalman smoothed estimate of F_t.

In the update, we make several changes to the way that the ANFCI is estimated. First, we forgo the two-step estimation procedure in favor of simultaneous estimation of the factor model, ΓF_t, and the adjustment for macroeconomic conditions, βZ_t, where β is an $N \times M$ matrix of regression coefficients for the financial indicators on the set of macroeconomic indicators Z. That is,

$$X_t = \Gamma F_t + \beta Z_t + \varepsilon_t,$$
$$F_t = AF_{t-1} + \nu_t.$$

The frequency of the macroeconomic adjustment series is still matched to the frequency of each financial indicator as in the previous estimation. Next, we fix the lag order of the adjustment and project end-of-sample missing values of Z_t where necessary.[v] Then, we expand the list of macroeconomic indicators to include a measure of the unemployment rate gap (the U.S. Bureau of Labor Statistics' U-3 unemployment rate minus the Congressional Budget Office's long-run NAIRU[vi]) and three-month commodity price inflation (as measured by the KR-CRB Spot Commodity Price Index).

To decompose the ANFCI (or NFCI) into the contributions from individual indicators and the macro-economic adjustments, we construct the Kalman smoothing weights (ω_{jt}^X and ω_{jt}^Z) corresponding to the smoothed factor as described by Durbin and Koopman:[vii]

$$\hat{F}_t = \sum\nolimits_{j=1}^{T} \omega_{jt}^X X_j + \omega_{jt}^Z Z_j.$$

By selecting the weights associated with a series of interest, we can construct a partial sum over the data such that when all data series have been accounted for, their sum will add up to the index. These partial sums are the series plotted in figures 2 and 3.

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[i] When necessary, the financial indicators are also seasonally adjusted and transformed prior to being standardized. A full list of transformations is available online, https://www.chicagofed.org/~/media/publications/nfci/nfci-indicators-list-pdf.pdf.

[ii] Andrew C. Harvey, 1989, *Forecasting, Structural Time Series Models and the Kalman Filter*, Cambridge, UK: Cambridge University Press.

[iii] The number of current and lagged values was previously chosen for each variable using the Bayesian information criterion.

[iv] This construction is consistent with the fact that news on economic conditions comes out with a lag, so that prices in forward-looking financial markets in any week are reacting to data from the previous month.

[v] The lag orders are now set at 15 weeks, three months, or one quarter depending on the frequency of observation; and AR(3) models are used to project missing end-of-sample values for the monthly adjustment variables.

[vi] NAIRU stands for nonaccelerating inflation rate of unemployment and is one notion of the natural rate of unemployment. The natural rate of unemployment represents the unemployment rate that would prevail in an economy making full use of its productive resources.

[vii] James Durbin and Siem Jan Koopman, 2012, *Time Series Analysis by State Space Methods*, 2nd ed., Oxford, UK: Oxford University Press, pp. 104–107.