Changes to the NFCI and ANFCI

April 21, 2020

This document outlines all changes that have been made to the Chicago Fed’s National Financial Activity Index (NFCI) since the February 6, 2013, release. This background information will be updated whenever additional changes are implemented.

Variable Composition

Based on our continual efforts to evaluate the appropriate mix of variables in the NFCI and the availability of several new data sources, we added five variables, shown in table 1, to the index beginning with the February 6, 2013, release of the index. Several other variables, which are presented in table 2, were subsequently substituted for other data that were either discontinued or are no longer available to us. This results in a total of 105 financial indicators that are used to estimate the NFCI.

Table 1: Variables added to the NFCI

<table>
<thead>
<tr>
<th>Date Added</th>
<th>Mnemonic</th>
<th>Name</th>
<th>Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-Feb-2013</td>
<td>ABSSPREAD</td>
<td>BofAML Home Equity ABS/MBS yield spread</td>
<td>Haver</td>
</tr>
<tr>
<td>06-Feb-2013</td>
<td>RATELIQ</td>
<td>CME Eurodollar/CBOT T-Note Futures Market Depth</td>
<td>CME</td>
</tr>
<tr>
<td>06-Feb-2013</td>
<td>EQUITYLIQ</td>
<td>CME E-mini S&amp;P Futures Market Depth</td>
<td>CME</td>
</tr>
<tr>
<td>06-Feb-2013</td>
<td>COMMODLIQ</td>
<td>COMEX Gold/NYMEX WTI Futures Market Depth</td>
<td>CME</td>
</tr>
<tr>
<td>06-Feb-2013</td>
<td>USD</td>
<td>Trade-weighted US Dollar Value Index</td>
<td>Haver</td>
</tr>
</tbody>
</table>

Table 2: Variables substituted in the NFCI

<table>
<thead>
<tr>
<th>Date Substituted</th>
<th>Mnemonic</th>
<th>Name (old name)</th>
</tr>
</thead>
<tbody>
<tr>
<td>06-Feb-2013</td>
<td>CMBS</td>
<td>BofAML 3-5 year AAA CMBS OAS spread (Bloomberg 5-year AAA CMBS spread to Treasuries)</td>
</tr>
<tr>
<td>06-Feb-2013</td>
<td>CPH</td>
<td>NRCEIF Commercial Real Estate Transactions-Based Price Index (MIT Center for Real Estate Transactions-Based Commercial Property Price Index)</td>
</tr>
<tr>
<td>05-May-2015</td>
<td>CPH*</td>
<td>FRB Commercial Property Price Index (NRCEIF Commercial Real Estate Transactions-Based Price Index)</td>
</tr>
<tr>
<td>06-Mar-2019</td>
<td>USD**</td>
<td>Advanced Foreign Economies Trade-weighted US Dollar Value Index (Trade-weighted US Dollar Value Index)</td>
</tr>
<tr>
<td>14-Aug-2019</td>
<td>CTABS</td>
<td>ICE BofAML ABS/5-yr Treasury yield spread (FTSE Russell US Global Markets ABS/5-yr Treasury yield spread)</td>
</tr>
<tr>
<td>14-Aug-2019</td>
<td>CTMBS</td>
<td>ICE BofAML Mortgage Master MBS/10-year Treasury yield spread (FTSE Russell US Global Markets MBS/10-year Treasury yield spread)</td>
</tr>
</tbody>
</table>

*In May 2015, we shifted to the Federal Reserve Board’s Commercial Real Estate Price Index.

**To incorporate the Federal Reserve Board’s Revisions to the Federal Reserve Dollar Indexes, we transitioned to the new variable beginning in March 2019.

In February 2013, we also extended the time series for a number of existing indicators by using alternative measures from their primary sources. These include our high-yield bond spread and several other interest rate spreads measured relative to Treasury notes and bonds. Additional information can be found at www.chicagofed.org/digital_assets/others/research/data/nfci/nfci_indicators_list.pdf
Construction of Futures Market Depth Measures

Three of the NFCI measures that were added to the index in February 2013, stem from our calculations based on data provided by the Chicago Mercantile Exchange (CME). Using data from the order books of futures contracts, the CME has designed a liquidity measure called “Price Impact,” which jointly reflects the bid-ask spread (width), the ability of the market to absorb larger trades (depth), and the price deterioration due to these block trades (resiliency).

For a given futures contract, this measure is calculated according to the following logic. Suppose an order to purchase \( q \) contracts is placed in the market at time \( t \). The order will be filled, to the extent possible, at the ask price \( p_{\text{ask}} \). The residual amount, \( q - q_{\text{ask}} \), will be filled to the maximum extent possible at stepwise increasing prices, \( p_{\text{ask}} + \varepsilon, p_{\text{ask}} + 2\varepsilon, \ldots \) (where \( \varepsilon \) is the tick size), until the earlier of a complete fill or an exhaustion of all limit orders existing above \( p_{\text{ask}} \).

By summing all of these prices, weighting by the amount filled at each price, and then dividing by \( q \), we calculate the quantity-weighted average price for a buy order. Subtracting \( p_{\text{bid}} \) gives a number \( PI_{\text{buy}}(q) \), which is a quantity-weighted average price impact for a buy order. A similar logic applies to a sell order, producing \( PI_{\text{sell}}(q) \). In symbols, for each \( t \),

\[
PI_{\text{buy}}(q) = \sum_{n=0}^{\infty} p_n \times \min \{ q(p_n), \max \{ q_n, 0 \} \} - p_{\text{bid}},
\]

and

\[
PI_{\text{sell}}(q) = p_{\text{ask}} - \sum_{n=0}^{\infty} p_n \times \min \{ q(p_n), \max \{ q_n, 0 \} \},
\]

where \( p_n \) is the price of execution (equal to \( p_{\text{ask}} + n\varepsilon \) for a buy or \( p_{\text{bid}} - n\varepsilon \) for a sell), \( q \) is the total desired quantity or hypothetical trade size, \( q_n = q - q_{n-1} \) denotes the quantity desired at price \( p_n \) (with \( q_{-1} = 0 \)), \( q(p_n) \) is the quantity available at price \( p_n \) (i.e., from the order book), and \( \varepsilon \) is the tick size.

The formula for \( PI_{\text{sell}}(q) \) is symmetric to that of \( PI_{\text{buy}}(q) \) around \( n = 0 \). Thus, the total (round-trip) price impact measure is

\[
PI_t(q) = PI_{\text{buy},t}(q) + PI_{\text{sell},t}(q).
\]

This measure is calculated each minute, and the intraday measures are averaged to obtain a daily measure. If either a buy or sell order of size \( q \) was impossible to execute at any sampled time in the day, the daily measure will be missing, \( PI_t(q) = \infty \). The price impact measures we use in the NFCI are calculated for the futures products listed in Table 3.

Table 3: Futures products used in the market depth NFCI measures

<table>
<thead>
<tr>
<th>Short Name</th>
<th>Description</th>
<th>Contract Size</th>
<th>Tick Size</th>
<th>( q )</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED</td>
<td>one-year-away CME 90-day Eurodollar futures contract</td>
<td>$1,000,000</td>
<td>$6.25</td>
<td>500</td>
</tr>
<tr>
<td>TY</td>
<td>nearest-month CBOT 10-Year U.S. Treasury Note futures contract</td>
<td>$100,000</td>
<td>$15.625</td>
<td>200</td>
</tr>
<tr>
<td>SP</td>
<td>nearest-month CME E-Mini S&amp;P 500 futures contract</td>
<td>$50 \times p_{\text{emini}}</td>
<td>$12.50</td>
<td>200</td>
</tr>
<tr>
<td>GC</td>
<td>nearest-month COMEX Gold futures contract</td>
<td>100 gold ounces</td>
<td>$10</td>
<td>10</td>
</tr>
<tr>
<td>CL</td>
<td>second-nearest-month NYMEX WTI Crude Oil futures contract</td>
<td>1,000 oil barrels</td>
<td>$10</td>
<td>10</td>
</tr>
</tbody>
</table>

For the NFCI, we first select a hypothetical trade size (i.e., the \( q \) in the preceding formulas) for each product. The \( q \) values are displayed in the final column of Table 3. Then, we aggregate the daily price impacts, \( PI_t(q) \),

\footnote{These measures include RATELIQ, EQUITYLIQ, and COMMODLIQ.}
for each product into weekly measures by averaging the available cases each week. Finally, we create three summary measures, $PI_{rate}$, $PI_{equity}$, and $PI_{commod}$, from the six products that are then used as inputs into the NFCI:

$$PI_{rate} = \frac{q_{ED}PI_{ED}(q_{ED}) + q_{TY}PI_{TY}(q_{TY})}{q_{ED} + q_{TY}},$$

$$PI_{equity} = PI_{SP}(q_{SP}),$$

$$PI_{commod} = \frac{q_{GC}PI_{GC}(q_{GC}) + q_{CL}PI_{CL}(q_{CL})}{q_{GC} + q_{CL}}.$$  

**The NFCI before and after the 2013 and 2019 changes**

Figures 1 and 2 plot the NFCI and ANFCI (index adjusted for the business cycle and inflation) with the previous and new mix of variables. This is done separately for changes implemented in the February 2013 release (panel A) and for those made in August 2019 (panel B).\(^2\)

In February 2013, the change in variable composition leads to only small differences in the time series of the NFCI, and differences tend to be even smaller for the ANFCI. The differences between the NFCI constructed with the old and new variables in the late 1980s and early 1990s can largely be traced back to the extension of the time series for the high-yield bond spread. In contrast, those that occur near the end of the sample period derive mostly from the addition of the five variables described in table 1. Revisions due to changes made in August 2019 are even less pronounced.

The subsequent set of figures (3-6) repeats this analysis for all of the NFCI subindexes. This is also done separately for changes made in February 2013, and August 2019.

Like with the overall index, revisions in 2013 are more evident - the influence of the longer time series for the high-yield bond spread can again be seen in the credit subindex, with an additional impact in the late 1970s from some of the other interest rate spreads that now have longer time series. In contrast, the differences in the risk and leverage subindexes highlight the information gained from the five new variables in the latter half of the sample as well as the impact of the variable substitutions. Finally, while none of the variables used in the nonfinancial leverage index changed, the resulting change in the estimated weights for these variables did in fact cause some slight changes in the history of this subindex. The changes in August 2019 only affected variables in the risk subindex, but minor changes in each subindex can be seen, and are the result of changes in the estimated weights.

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\(^2\)This does not include revisions due to the transitions to the Federal Reserve Board’s Commercial Property Price Index and to the Advanced Foreign Economies Trade-weighted US Dollar Value Index, for the May 5, 2015, and March 6, 2019, releases, respectively. However, the impact of these changes was minimal.
Figure 1: NFCI before and after the documented changes

A. 2013
standard deviations

B. 2019
standard deviations
Figure 2: ANFCI before and after the documented changes

A. 2013
standard deviations

B. 2019
standard deviations
Figure 3: NFCI risk subindex before and after the documented changes

A. 2013
standard deviations

B. 2019
standard deviations
Figure 4: NFCI credit subindex before and after the documented changes

A. 2013

B. 2019
Figure 5: NFCI leverage subindex before and after the documented changes

A. 2013

B. 2019
Figure 6: NFCI nonfinancial leverage subindex before and after the documented changes

A. 2013

standard deviations

B. 2019

standard deviations