

Recent Changes Made to the NFCI and ANFCI

January 12, 2022

This document serves as background information regarding recent changes made to the Chicago Fed's National Financial Conditions Index (NFCI). Based on our continual efforts to evaluate the appropriate mix of variables in the NFCI and the availability of several new data sources, we have implemented the following changes beginning with the February 6, 2013, release of the index.

Variable Composition

Five variables, shown in table 1, have been added to the index and four variables, shown in table 2, were substituted for other data that were either discontinued or no longer available to us, making a total of 105 financial indicators.

Table 1: Variables added to the NFCI

Name	Transformation	Frequency
Bank of America/Merrill Lynch Home Equity ABS/MBS yield spread	level	weekly
CME Eurodollar/CBOT T-Note Futures Market Depth	level	weekly
CME E-mini S&P Futures Market Depth	level	weekly
COMEX Gold/NYMEX WTI Futures Market Depth	level	weekly
Trade-weighted US Dollar Value Index*	log-difference	monthly

*To incorporate the Federal Reserve Board's recent *Revisions to the Federal Reserve Dollar Indexes*, we transitioned to a new variable. This change was implemented starting with the March 6, 2019 release of the NFCI. Additional information can be found in the NFCI indicators list.

Table 2: Variables substituted in the NFCI

Name	Transformation	Frequency
Bank of America/Merrill Lynch 3-5 year AAA CMBS OAS spread	level	weekly
FRB Commercial Property Price Index*	log-difference	quarterly
3-mo. CME Term SOFR-Treasury spread†	level	weekly
1-yr./1-mo. CME Term SOFR spread†	level	weekly

*In February 2013, we were using the NCREIF Commercial Real Estate Transactions-Based Price Index, but later shifted to the Federal Reserve Board's (FRB) Commercial Real Estate Price Index when it became available. The NCREIF and FRB series can be accessed on Haver as NTBIP@USECON and FRBCREPI@USECON, respectively.

†With the January 12, 2022, release, we replaced the LIBOR-based data series in the NFCI and ANFCI with versions spliced with SOFR-based alternatives. Specifically, we trimmed the LIBOR series to end in October 2021, and generated consistent time series by splicing them with the SOFR replacements.

We have also extended the time series for a number of existing indicators by using alternative measures from their primary sources. These include our MZM money supply, 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 new NFCI measures 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_{ask} . The residual amount, $q - q_{ask}$, will be filled to the maximum extent possible at stepwise increasing prices, $p_{ask} + \varepsilon$, $p_{ask} + 2\varepsilon$, etc. (where ε is the tick size), until the earlier of a complete fill or an exhaustion of all limit orders existing above p_{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_{bid} gives a number $PI_{buy}(q)$, which is a *quantity-weighted average price impact for a buy order*. A similar logic applies to a sell order, producing $PI_{sell}(q)$. In symbols, for each t ,

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

and

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

where p_n is the price of execution (equal to $p_{ask} + n\varepsilon$ for a buy or $p_{bid} - n\varepsilon$ 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 ε is the tick size.

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

$$PI_t(q) = PI_{buy,t}(q) + PI_{sell,t}(q).$$

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

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

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, $PI_t(q)$, 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 changes

In figures 1 and 2, the NFCI and ANFCI (index adjusted for the business cycle and inflation) are shown with the previous and new mix of variables from January 1973 through January 2013. Overall, the new mix of variables leads to only small differences in the time series of the NFCI, and the differences tend to be even smaller for the ANFCI. The differences seen 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 previously.

The subsequent set of figures (3-6) repeats this analysis for all of the NFCI subindexes. 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.

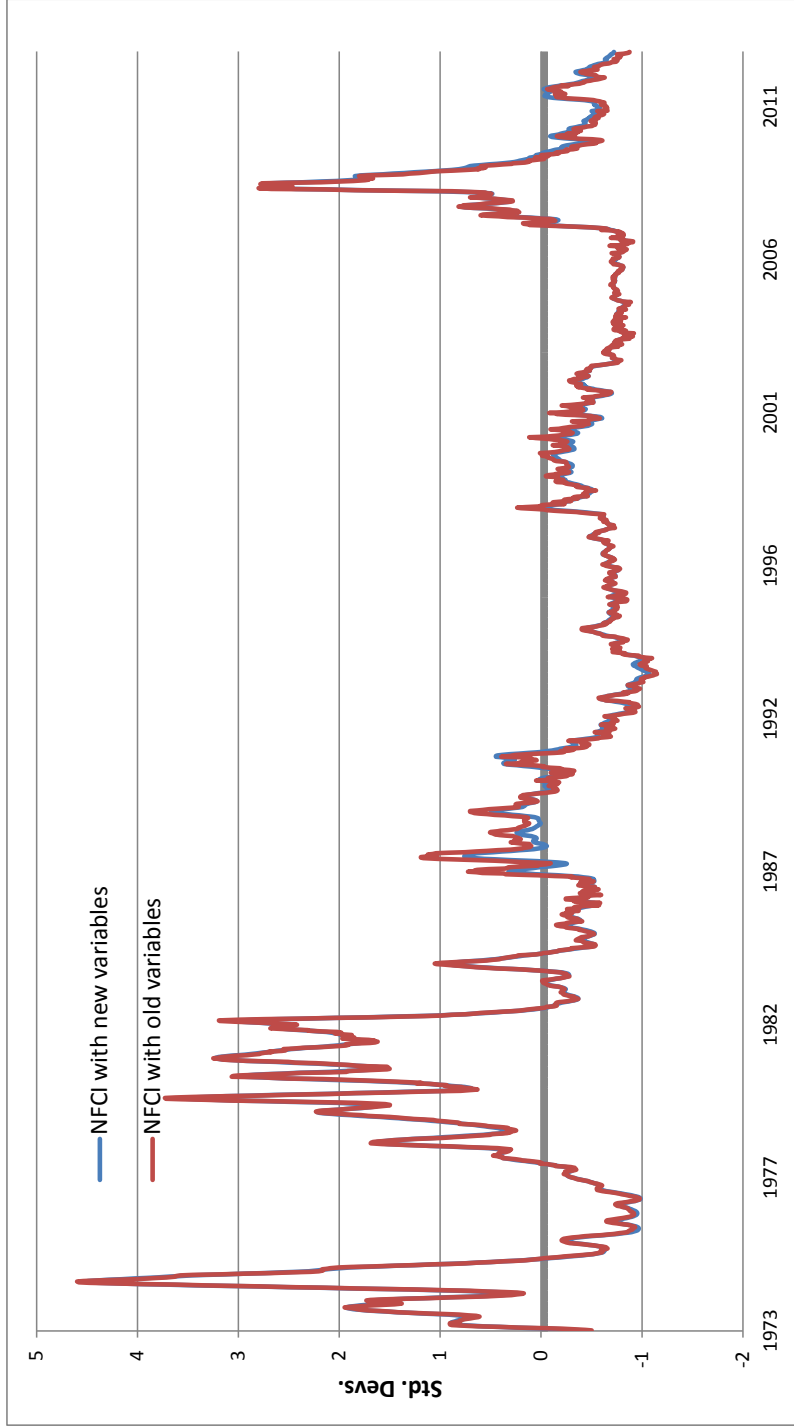


Figure 1: NFI before and after the documented changes

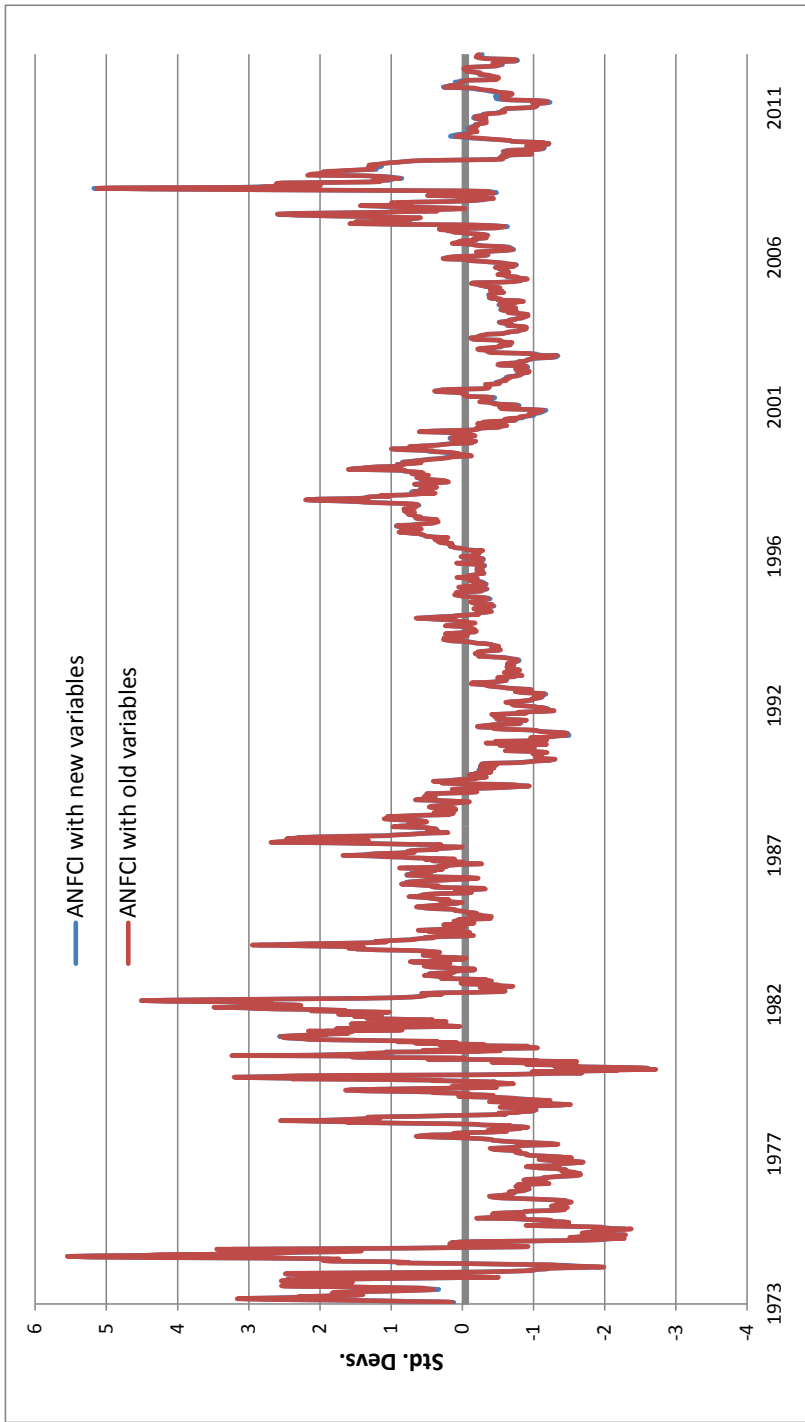


Figure 2: ANFCI before and after the documented changes

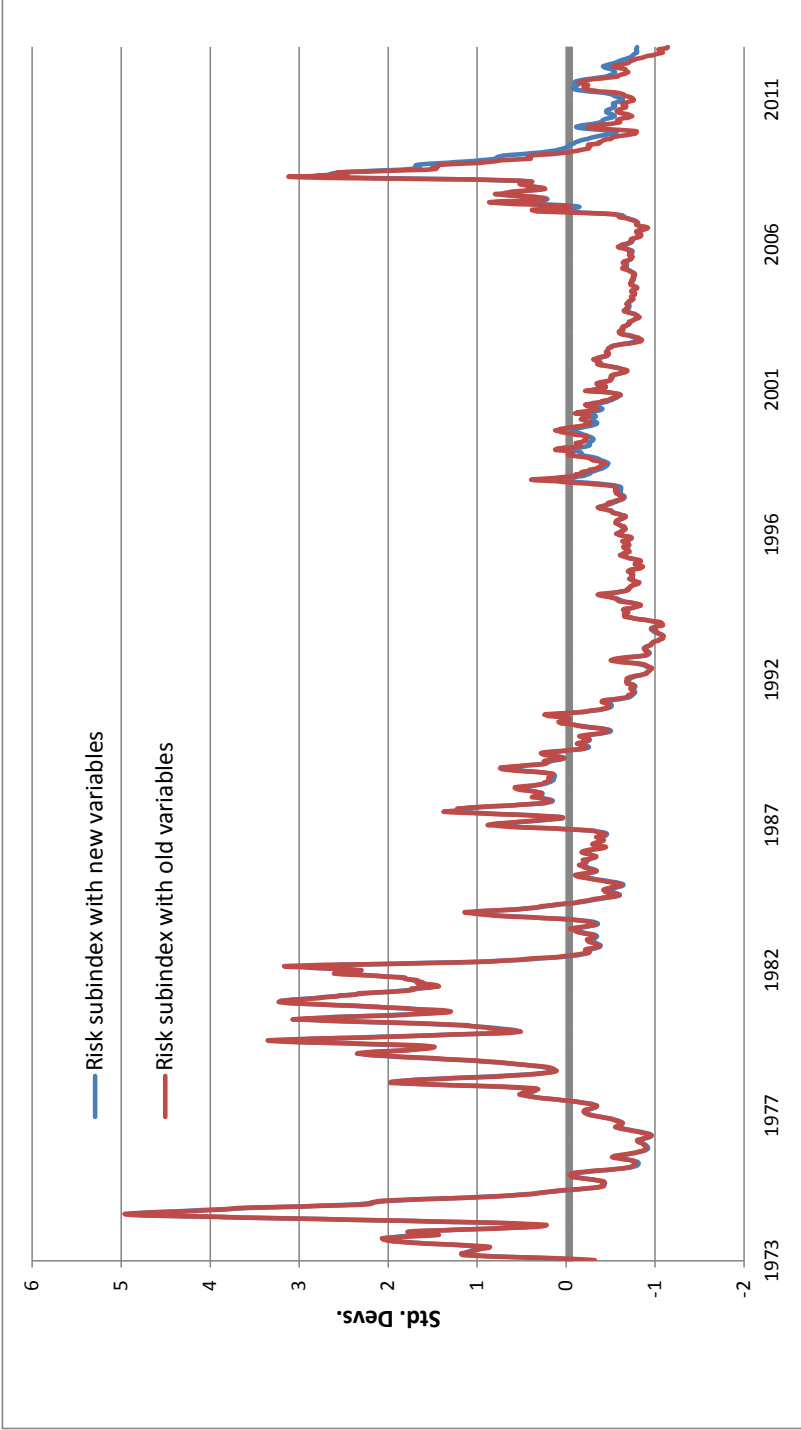


Figure 3: NFCI risk subindex before and after the documented changes

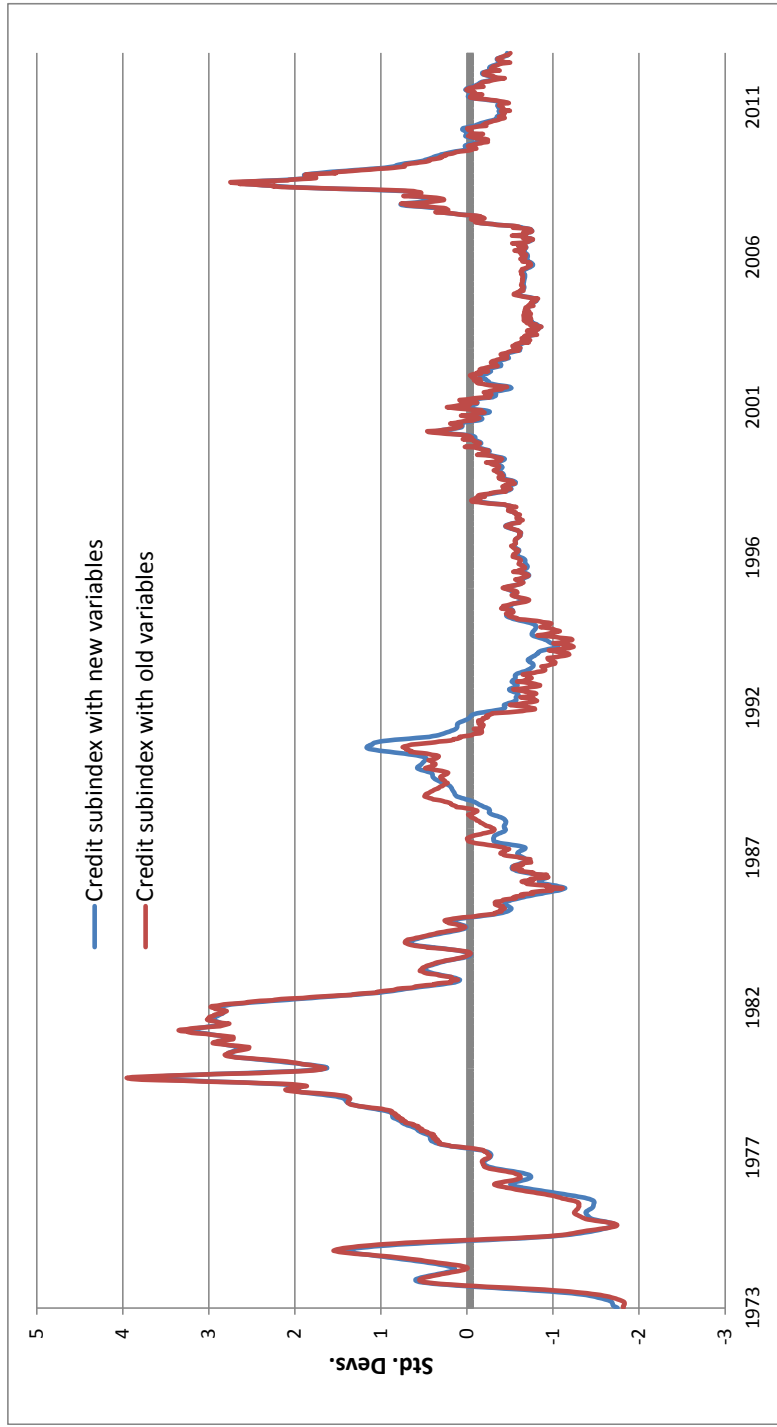


Figure 4: NFCI credit subindex before and after the documented changes

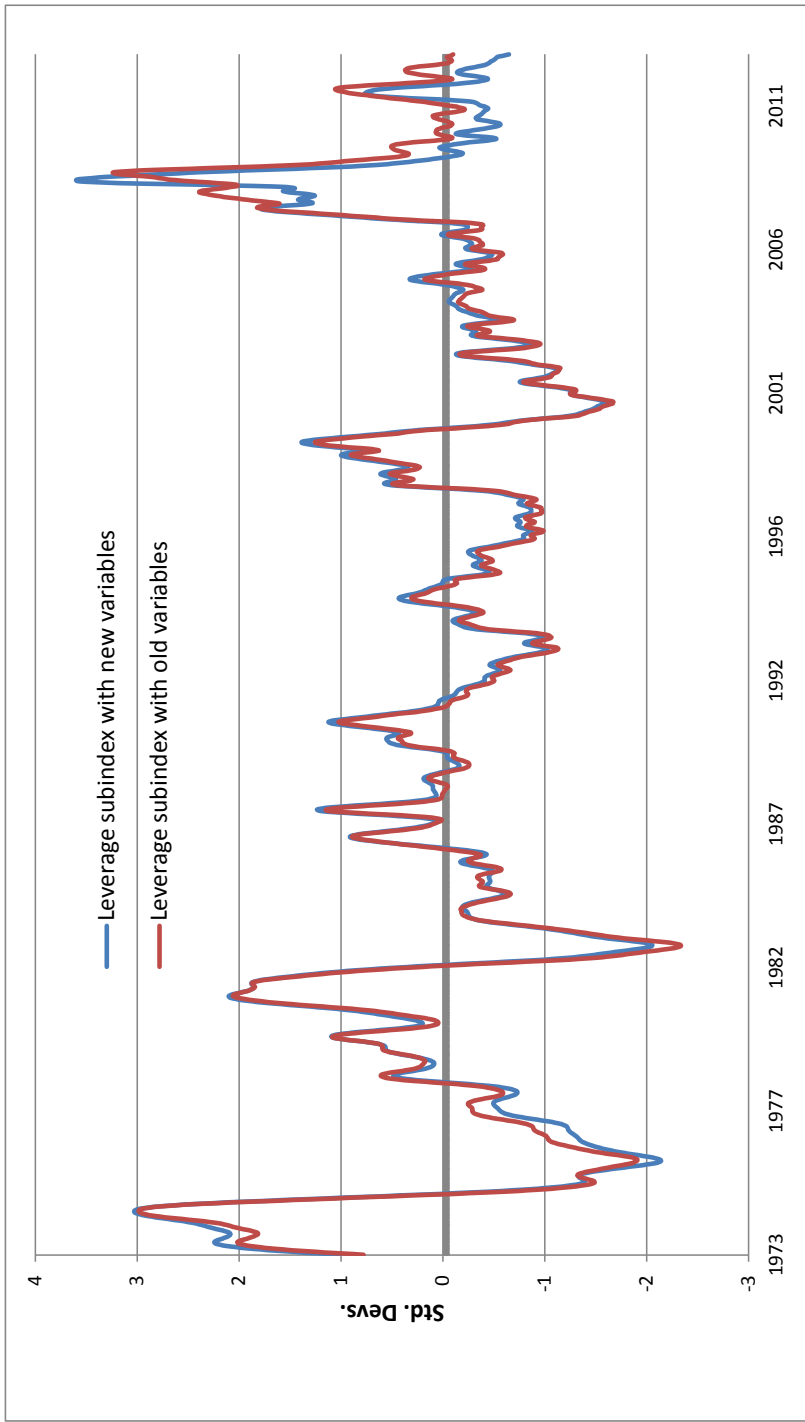


Figure 5: NFCI leverage subindex before and after the documented changes

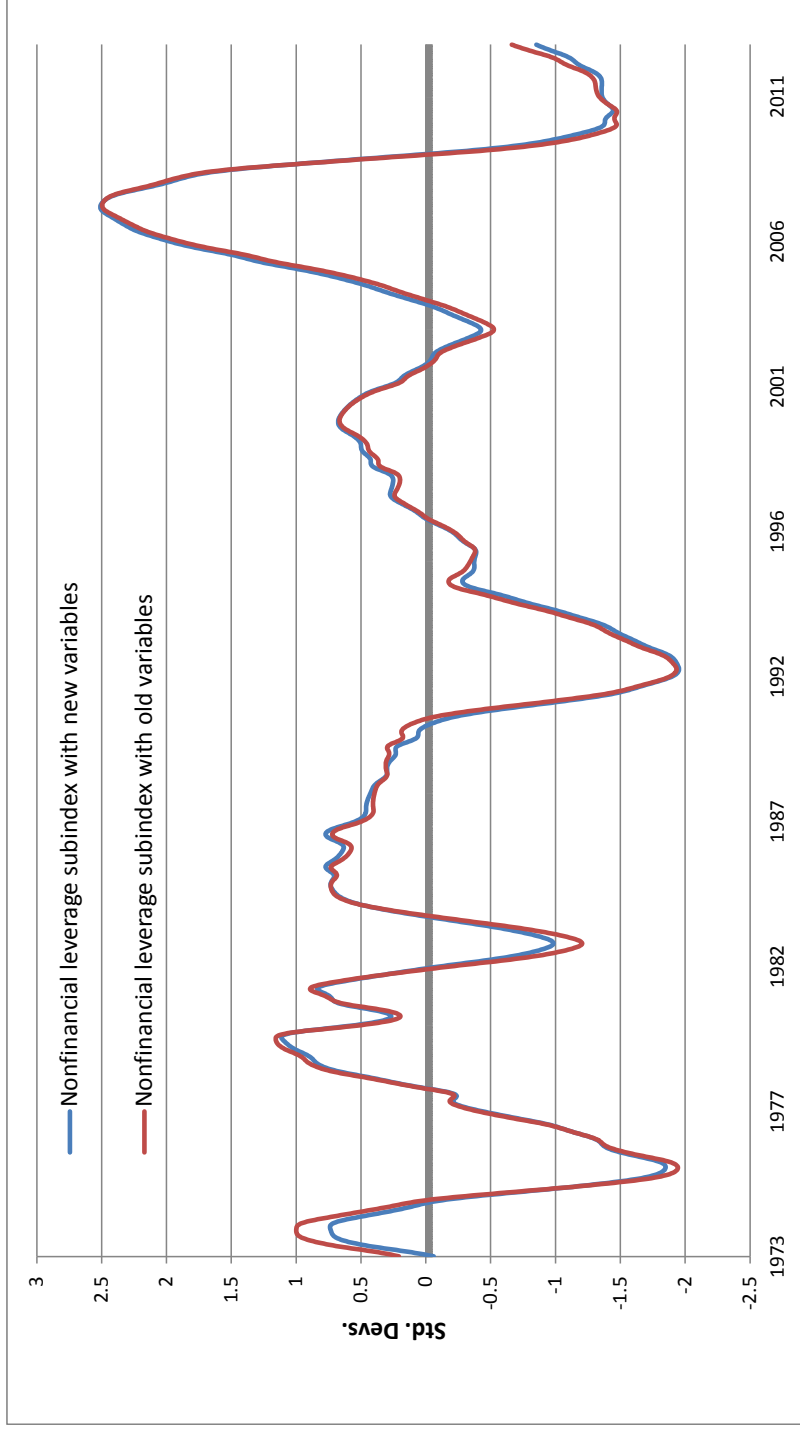


Figure 6: NFCI nonfinancial leverage subindex before and after the documented changes