

Uzbekistan's Financial Conditions Index

Abstract

This methodological framework examines international experience in developing Financial Conditions Indices (FCIs), focusing on the general methodology, model selection criteria, and the identification of effective indicators for constructing an FCI for Uzbekistan. The FCI for Uzbekistan incorporates indicators reflecting conditions in the banking sector, domestic currency market, external sector, and overall financial system, selected with consideration of the specific characteristics of Uzbekistan's financial system and international practices. The objective of this article is to develop an early-warning tool for assessing potential changes in Uzbekistan's real economy based on the relationship between financial conditions and economic activity.

Keywords: AUROC model, correlation, financial system, real economy, subindex.

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The main difference between FCI and FSI lies in their objectives. Specifically, the FCI aims to assess the impact of changes in the financial system on the country's economy, highlighting the connection between the financial system and the real economy. In contrast, the primary purpose of the FSI is to identify periods of crisis or instability in the financial system, without explicitly considering the impact of financial stress on the real economy over a given period¹. Additionally, unlike the FSI, the FCI incorporates quantitative indicators, prices, and other macroeconomic variables that help predict a country's future economic activity². The calculation of the FCI involves selecting and standardizing effective indicators that can anticipate the effects of financial system changes on the economy. These standardized indicators are then grouped into subindices, with their respective weights determined based on their significance. Finally, the values and weights of the subindices are used to compute the FCI.

Selection of Effective Indicators.

The selection of effective indicators that represent the relationship between the financial system and the real economy is the first and most crucial step in calculating the FCI. These indicators can be chosen based on the specific characteristics of a country's financial system or the experiences of other countries.

Additionally, in line with the purpose of the FCI, indicators that reflect changes in the financial system and exhibit a non-weak correlation with real economic growth are used in the index calculation (e.g., Colombia³, Austria⁴). Furthermore, assessing the significance of indicators using econometric models enhances the effectiveness of the FCI. In particular, the AUROC model⁵ is widely applied to evaluate how well the indicators provide early warnings of crisis periods.

¹ P. Monin. (2017). The OFR Financial Stress Index. Office of Financial Research in U.S. Department of the Treasury.

² Hatzius, J., Hooper, P., Mishkin, F., Schoenholtz, K., & Watson, M. (2010). Financial Conditions Indexes: A Fresh Look after the Financial Crisis. National Bureau of Economic Research.

³ Esteben, G., Andres, M., & Nancy, Z. (2011). Financial Conditions Index: Early and Leading Indicator for Colombia. Central Bank of Colombia.

⁴ Ernest, G., Maria, T., & Walter, W. (2019). Financing conditions in Austria since the introduction of the euro. Oesterreichische Nationalbank.

⁵ The AUROC model methodology is presented in is presented in the Methodological Framework of Central Bank.

Standardization of Indicators

To enable comparison and aggregation, indicators are first standardized using various methods.

The Z-score method (used in Chile⁶, Colombia, and Germany⁷) is the most common approach for standardizing indicators in the FCI. It measures how much an indicator's current value deviates from its arithmetic mean in terms of standard deviations.

Alternatively, indicators can be standardized using the cumulative distribution function (CDF) method (used in Uruguay⁸). This method involves ranking indicator values in ascending order and assigning ordinal numbers based on their position. The standardized value is then obtained by dividing the assigned order number by the total number of observations in the time series⁹.

Aggregation of Indicators into a Subindex

Standardized indicators are grouped into subindices based on their representation of different financial system sectors. The value of subindices can be determined using PCA (used in Germany and France¹⁰) or by calculating the arithmetic mean of the indicators.

PCA applies a linear transformation to reduce the dimensionality of multiple correlated indicators while preserving maximum variance¹¹. This process merges multiple indicators into a single representative measure.

Alternatively, standardized indicators can be directly incorporated into the final index without forming subindices (as seen in Uruguay and Chile). However, dividing indicators into subindices allows for a more detailed analysis of which financial system sectors impact the index, improving its overall efficiency.

Estimating the Weights of Subindices

To compute the final FCI, subindices representing different financial system segments must first be weighted. Various models can be used for this purpose:

⁶ Nicolas, A., Antonia, F., & Andres, S. (2021). Economic Growth at Risk: An Application to Chile. Central Bank of Chile.

⁷ Norbert, M. (2022). Technical Paper. A composite indicator of Financial Conditions for Germany. Deutsche Bundesbank.

⁸ Elizabeth, B. (2017). Financial conditions and monetary policy in Uruguay: An MS-VAR Approach. Inter-American Development Bank.

⁹ Hollo, D., Kremer, M., & Lo Duca, M. (2012). CISS – A composite indicator of systemic stress in the financial system. European Central Bank.

¹⁰ Anna, P., & Jean-Guillaume, S. (2019). A new Banque de France Financial Conditions Index for the euro area. Banque de France.

¹¹ James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An Introduction to Statistical Learning: With Applications in R.

- PCA (applied in Malaysia¹², Norway¹³, Greece¹⁴)
- Dynamic factor model (DFM) (used in Romania¹⁵)
- Vector autoregression (VAR) (used in Poland¹⁶).

Additionally, subindex weights in the final index can be determined by considering the number of indicators in each subindex or by assigning equal weights (as done in Sweden)¹⁷.

The original IMF methodology for the global financial conditions index used time-varying weights from the DFM. However, these were later replaced with fixed weights derived from PCA. This adjustment simplified the process of determining each indicator's influence on the final index and improved the stability of parameters when updating the index¹⁸.

Aggregation of Subindices into the Final Index

In the final step of FCI calculation, subindices are aggregated into the final index. This is done using PCA (as applied by IMF¹⁹, Singapore²⁰, Turkey²¹, Chile) and DFM (used in Australia²², Brazil²³, Mexico²⁴). Alternatively, the final index can be calculated by summing or averaging the weighted subindices (as seen in Iceland²⁵).

¹² Zul-Fadzli, A. B., & Imam, B. (2017). Financial Conditions Index for Malaysia. Central Bank of Malaysia.

¹³ Frida, B., Karsten, R., Nicolo, M., & Helene, O. (2023). A high-frequency financial conditions index for Norway. Central Bank of Norway.

¹⁴ Jonathan, M., & Maral, S. (2015). A Financial Conditions Index for Greece. International Monetary Fund.

¹⁵ Andreea, M. (2015). Building a financial conditions index for Romania. National Bank of Romania.

¹⁶ Giang, H., & Yinqiu, L. (2013). A Financial Conditions Index for Poland. International Monetary Fund.

¹⁷ Jan, A., Magnus, L., & Tommy, B. (2020). An index for financial conditions in Sweden. Riksbank.

¹⁸ International Monetary Fund. (2018, October). Global Financial Stability Report, Online Annex 1.1 Technical Note.

¹⁹ International Monetary Fund. (2018, October). Global Financial Stability Report, Online Annex 1.1 Technical Note.

²⁰ Monetary Authority of Singapore. (2019, November). Financial Stability Review.

²¹ Abdullah, K., Halil, I., & Muhammed, H. (2019). Composing High-Frequency Financial Conditions Index and Implications for Economic Activity. Central Bank of Türkiye.

²² Luke, H., & Michelle, W. (2021). Financial Conditions and Downside Risk to Economic Activity in Australia. Reserve Bank of Australia.

²³ Wagner, P., & Waldyr, D. (2017). Financial Conditions Indicator for Brazil. Inter-American Development Bank.

²⁴ Julio, C., & Ana Laura, G. (2021). The COVID-19 Economic Crisis in Mexico through the Lens of a Financial Conditions Index. Banco de México.

²⁵ Eysteinn, E., Stella, E., Tomas, D., & Vedis, S. (2023). A Financial Conditions Index for Iceland. Central Bank of Iceland.

Selection of Effective Indicators for Uzbekistan's FCI

The effective indicators used to calculate Uzbekistan's FCI were selected based on the following criteria from over 350 indicators included in 44 FCIs developed by international financial organizations and central banks:

1. Ability to capture the specific features of Uzbekistan's financial system.
2. Availability of a sufficient time series of data.
3. Effectiveness in providing early warnings of crises, as measured by the AUROC model.
4. Direct correlation with the country's economic growth²⁶;
5. Presence of a non-weak correlation ($r_{i,j} > 0,5$) between indicator time lags and economic growth.
6. Absence of strong correlation ($rr_{ii,jj} > 0,7$) between selected indicators to prevent multicollinear²⁷.

Using the AUROC model²⁸, indicator performance was assessed based on error rates—specifically, whether an indicator failed to warn of an actual crisis or gave misleading warnings during stable periods. The AUROC value ranges from 0 to 1, where a higher value indicates better crisis prediction accuracy. An AUROC value of 0.5 suggests that the indicator provides only random crisis warnings.

To evaluate the effectiveness of indicators, it was necessary to define crisis periods. Since Uzbekistan has not experienced a full-scale financial crisis, the significant economic downturn from Q2 2020 to Q1 2021, when real GDP growth lagged considerably due to the COVID-19 pandemic, served as a reference.

The AUROC model was applied to test whether indicators with sufficient data and relevance to Uzbekistan's financial system signaled crises effectively. The results showed that the most effective indicators for signaling a crisis two quarters in advance were:

- a. Loan-to-deposit ratio (AUROC=0.84)
- b. Difference between interest rates on loans and treasury bonds (AUROC=0.84)
- c. Consumer price index (AUROC=0.83)
- d. VIX index (AUROC=0.73)

For crisis prediction four quarters in advance, the most effective indicators were:

²⁶ The direct correlation sign is the same as the direction of the correlation between indicators based on the economic characteristics of a certain indicator.

²⁷ Multicollinearity refers to a high correlation between two or more variables in a regression model.

²⁸ The AUROC model methodology is presented in is presented in the Methodological Framework of Central Bank.

- a. Spread between interest rates on loans and treasury bonds (AUROC=0.98)
- b. Exchange market pressure index (AUROC=0.93)
- c. Consumer price index (AUROC=0.93)
- d. Annual real growth rate of demand deposits within the broad money supply (AUROC=0.86)
- e. Loan-to-deposit ratio (AUROC=0.73)

These results indicate that these indicators provide reliable early warnings of financial crises.

On the other hand, indicators such as changes in loan volume, gold price growth, real effective exchange rate, NPL volume and share in total loans, return on capital and assets, and LCR had AUROC values below 0.5, suggesting they do not offer meaningful crisis warnings.

A key criterion for selecting effective indicators was the existence of a non-weak and direct correlation between changes in these indicators and economic growth, with real GDP growth showing an inverse relationship with CAR, NPL volume and its share in total loans, ROE and ROA, annual growth of total loans and deposits, and LCR two and four quarters prior.

In addition, an inverse relationship was observed between the real GDP growth and the real effective exchange rate, the realized volatility of the UZS-USD exchange rate, which represents changes in the domestic FX market, and as financial indicators, the values of the annual growth of the gold price two and four quarters earlier.

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