The methodology of the CEFIS financial condition index

Our aim is to create a latent index representing financial conditions. Among financial and macroeconomic variables, there exists a high covariability. Therefore, we can summarize information of the dataset using a few variables and calculate factor loadings in a straightforward manner. Let Y_t be standardized N monthly series $Y_t = (Y_{1,t}, Y_{2,t}, ..., Y_{N,t})'$. Then, the factor representation of our observed variables Y_t is as follows:

$Y_t = \Lambda F_t + \epsilon_t,$

where Λ is an NxR matrix and represents factor loadings; $F_t = (F_{1,t}, ..., F_{R,t})'$ is the vector of unobserved common factors of R dimensions, and ϵ_t is an Nx1 vector of idiosyncratic disturbances. To estimate common factors, we follow McCracken and Ng (2016) which use the expectation-maximization (EM) algorithm proposed by Stock and Watson (2002). First, data is demeaned and standardized. Missing values are replaced by means of non-missing observations. Then, factors and factor loadings are calculated by using the principal component analysis. Fitted values of the factor model, $\tilde{\Lambda}_t$ and $\tilde{F}_t$, are used to update missing values. This procedure is repeated until estimates of principal components do not change. After this procedure is completed, we obtain weighted loadings by multiplying the variation explained by each factor with fitted loadings as shown by Angelopoulou et al. (2014) and finally acquire the FCI by multiplying each variable with its corresponding weighted loadings.

We use 11 variables to construct the FCI. We compute yearly growth rates or differences of variable in order to have stationary data and deflate variables with the consumer price index to obtain real variables, whenever necessary. A list of variables and applied transformations are provided in the table 1.

The first category of variables included in this paper is related to the money supply, the credit volume, and the interest rate. As Turkish banks have significant role in real economic activities, the credit volume and interest rates are important variables that show the current and the future situation of the Turkish economy. Lown and Morgan (2006) conclude that the real economic activity is negatively affected when credit supply tightens. Furthermore, the increase in the monetary supply generally causes the economic activity to accelerate. To capture the monetary side of financial conditions, we include the real M1 money supply, the real M3 money supply, real consumer loans, the real commercial interest rate, and the real 2 years benchmark interest rate. M1, M3, and the real commercial interest rate are taken from the Central Bank of the Republic of Turkey (CBRT) and real consumer loans are obtained

Table 1: The data set

Group	Variable	Transformation
Credit and money supply	Real consumer loans	Annual growth rate
Credit and money supply	Real M1	Annual growth rate
Credit and money supply	Real M3	Annual growth rate
Credit and money supply	Real commercial credit interest rate	Annual difference
Credit and money supply	Real 2 years benchmark interest rates	Annual difference
Financial Markets	USD/TRY	Annual growth rate
Financial Markets	Real BIST 100	Annual growth rate
Financial Markets	BIST 100 market capitalization (USD)	Annual growth rate
Financial Risk	5 years CDS	Level
Financial Risk	Non-performing loan ratio	Annual growth
Financial Risk	USD/TRY volatility	Level

from the Banking Regulatory and Supervisory Agency (BRSA). The real 2 years benchmark interest rate is retrieved from the Turkish Data Manager (TDM).

Secondly, we focus on variables related to financial markets and the exchange rate. Gauthier and Li (2004) suggest that stock returns follow closely the trend in the total output. The market capitalization is also an important indicator that shows the wealth effect of financial markets (Macroeconomic Advisers, 1998). Finally, the exchange rate is significant for emerging economies. The depreciation of Turkish Lira is usually a negative sign for the Turkish economy as Turkey is an import and consumption driven economy. Osorio et. al. (2011) also show that in Australia, Korea, and Taiwan the exchange rate depreciation affects financial condition negatively. For this group, we use the United States Dollar/the Turkish Lira (USD/TRY) exchange rate, the real Borsa Istanbul (BIST) 100 index and the capitalization of BIST 100 in USD. All financial variables are obtained from the TDM.

Finally, we add financial risk/stress variables. Financial stress increases the uncertainty in an economy. Especially, a high financial stress triggers large capital outflows from an economy and eventually a sudden stop plus a recession. For this group, we use 5 years CDS, the non-performing loan ratio and 3 months averages of the USD/TRY volatility. The non-performing loan ratio is obtained from the BRSA. 5 years CDS and the USD/TRY volatility are taken from the TDM.

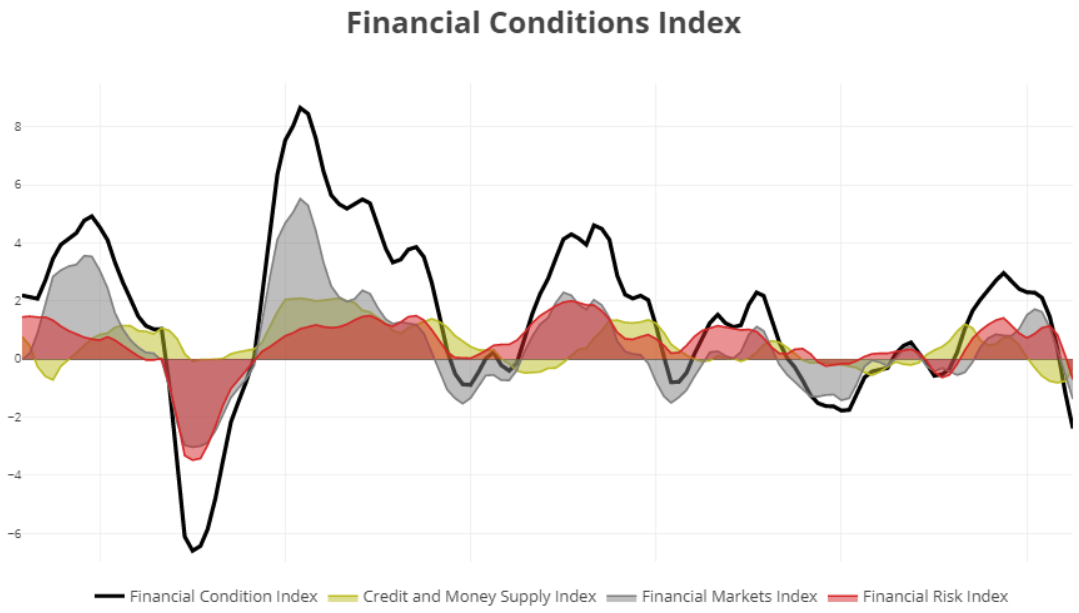
By using the methodology and the data set explained above, we calculate the contribution of each series to the first 3 factors with the share of total variance explained by each factor and weighted loadings of all variables with the total variance explained by all factors and

Table 2: Individual factor loadings and weighted loadings for the FCI

Variable	F1	F2	F3	Weighted Loadings
Real consumer loans	-0.018	1.868	-0.280	0.342
Real M1	-0.282	0.715	2.279	0.348
Real M3	-0.850	1.080	1.491	0.091
Real commercial credit interest rate	-1.024	0.518	-0.974	-0.432
Real 2 years benchmark interest rates	-0.997	1.107	-0.446	-0.226
USD/TRY	-1.268	-0.746	0.804	-0.547
Real BIST 100	1.380	0.149	0.961	0.709
BIST 100 market capitalization (USD)	1.446	0.345	0.258	0.680
5 years CDS	-1.162	-0.878	-0.050	-0.649
Non-performing loan ratio	0.163	-1.657	0.762	-0.175
USD/TRY volatility	-1.084	-0.357	0.369	-0.453
Share of total variance explained	0.396	0.207	0.137	0.740

present them in the table 2. [1] At the end by using weighted loadings, we construct the FCI and its sub-indeces[2]. They are shown in the figure 1.

Figure 1: The financial condition index and its sub-indeces



[1] We consider the total variance explained by each factor on deciding the number of factors in our analysis. As it can be seen from the table 2, the total variance explained by three principal components is 74%, which means that these three components are able to summarize most of information in the data set. Furthermore, Angelopoulou et al. (2014) also use three principal components in a similar study.

[2] Sub-indices are calculated according to variable groups presented in the table 1

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