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Investigating the Relationship Between the Financial Conditions Index with Economic Growth and Net Capital Inflow: Causality Analysis for Türkiye

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ABSTRACT

The global economic crisis, which had a devastating effect worldwide with the bankruptcy of Lehman Brother's investment bank in the United States of America in 2008, revealed that countries should indicate risks and take precautions accordingly. In this sense, the importance of the Financial Conditions Index (FCI), which was created by considering the monetary policy instruments of the country's central banks and various macroeconomic and financial variables as a whole, has also increased. FCI, the index that has taken place in the literature since the 1990s, with the growth of countries, has been investigated in empirical studies conducted after the global economic crisis. In this study, the related index is calculated using Principal Component Analysis (PCA), and the data generated is analyzed with growth and net capital inflow items. According to the results of the related analysis, while there is bidirectional causality between FCI and real gross domestic product (GDP) growth, one-way causality was found between FCI and net capital inflow. The index created accordingly is the Granger cause of the net capital inflow.

Keywords
Financial Conditions Index, Principal Component Analysis, Toda Yamamoto Analysis, Net Capital Inflow

JEL Classification
B26, C38, E52

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Finansal Koşullar Endeksi ile Ekonomik Büyüme ve Net Sermaye Girişi Arasındaki İlişkinin İncelenmesi: Türkiye İçin Nedensellik Analizi

ÖZ

Amerika Birleşik Devletleri'nde Lehman Brother'ın yatırım bankasının 2008 yılında iflas etmesiyle ortaya çıkan küresel ekonomik kriz, ülkelerin riskleri belirlemesi ve buna göre önlem alması gerektiğini ortaya çıkardı. Bu anlamda ülke merkez bankalarının para politikası araçları ile çeşitli makroekonomik ve finansal değişkenler bir bütün olarak ele alınarak oluşturulan Finansal Koşullar Endeksi'nin (FCI) önemi de artmıştır. 1990'lı yıllardan itibaren literatürde yerini alan endeks olan FCI, küresel ekonomik kriz sonrasında yapılan ampirik çalışmalarda ülkelerin büyümesiyle birlikte incelenmiştir. Bu çalışmada ilgili endeks, Temel Bileşenler Analizi (PCA) ile hesaplanmakta ve elde edilen veriler büyüme ve net sermaye girişi kalemleriyle birlikte analiz edilmektedir. İlgili analiz sonuçlarına göre FCI ile reel Gayri Safi Yurtiçi Hasıla (GSYH) büyümesi arasında çift yönlü bir nedensellik bulunurken; FCI ile net sermaye girişi arasında tek yönlü nedensellik bulunmuştur. Buna göre oluşturulan endeksin net sermaye girişinin Granger nedeni olduğu söylenebilir.

Anahtar Kelimeler
Finansal Koşullar Endeksi, Temel Bileşenler Analizi, Toda Yamamoto Analizi, Net Sermaye Girişi

JEL Kodu
B26, C38, E52

1. Introduction

The global crisis drew attention to the issues of measuring the impact of financial shocks on the economy and financial markets and making better predictions for the future with financial and macroeconomic variables. Since the Monetary Conditions Indices (MCI) calculated by the central banks are composed of macroeconomic and monetary policy variables, they could not provide sufficient predictions about financial markets and the forecast of financial crises. The increase in volatility with the increase in capital flows causes the effectiveness of monetary policy instruments to decrease. It raises the importance of monitoring the indicators that can measure the internal impact of external changes (Kara et al., 2015: 42). Therefore, a more comprehensive index was needed to be calculated. The financial conditions index (FCI) was calculated by adding financial variables to MCI. FCI is an extended version of MCI (Angelopoulou et al., 2014:392). FCIs, which include some leading indicators, are calculated to make healthy predictions for the future and show financial markets' expansion and contraction periods.

Many financial institutions, organizations, and researchers use the weighted sum approach, the principal component analysis (PCA), or the Vector Autoregression Model (VAR) method when creating FCI (Mayes & Viren, 2001; Swiston, 2008; Hatizus et al., 2010: 7; Gumata , Klein, &

Ndou, 2012; Kara et al., 2015). Some organizations that calculate FCI and follow the index closely are; Bloomberg, Citibank, Deutsche Bank, Goldman Sachs, and Kansas City Federal Reserve Bank (Hatizus et al., 2010: 7).

There are three key points in the creation and use of FCI: the selection of the financial indicators to be included in the index, the calculation of the weights of the financial indicators, the creation of the index, and the relationship between the index and economic activities (Koop and Korobilis, 2014: 102).

In this study, the first purpose is to estimate the FCI for Türkiye and reveal the financial conditions within the framework of three purposes: (i) to choose the variables for the calculation of the FCI, (ii) to determine the weights that these variables will take place in the index, (iii) to reveal the relationship between the created financial conditions index and the macroeconomic and financial data determined. The second objective is to test the causality relationship between FCI and economic growth and net capital inflows. Many researches investigate the relationship between FCI and economic growth in the global literature, but few studies have been done in Türkiye. It is expected that this article will be the first study investigating the relationship between FCI and net capital inflow. In this study, the PCA method calculated FCI with dynamic weighting. To test the relationships between the generated FCI and economic growth and between FCI and net capital inflow, we used The Toda-Yamamoto method, which is a Granger Causality model.

There are five chapters in the study. The following section contains a literature review on FCI and a table in which the results are presented chronologically. In the third chapter, Data and methodology are explained in detail. In the next chapter, the findings empirical findings are examined. In the last section, Conclusion and Discussions, the results were interpreted, and the study was completed by giving suggestions.

2. Literature Review

Although studies revealing the relationship between financial conditions and various economic conditions have been studied in the literature since the 1990s, they have been studied more frequently since the beginning of 2000. Since the Monetary Conditions Index (MCI) started to be calculated by institutions such as the Bank of Canada in the early 1990s, but it was created with limited data, the Financial Conditions Index, called the expanded MCI, studied with more extensive data, has come to the fore. When the literature on the Financial Conditions Index is

examined, besides the studies on the index calculation, the relations between the index values and macroeconomic variables are analyzed. By the 2008 global economic crisis, the importance of the index had increased, and it had become an indicator that was calculated by many financial institutions and whose essence was expanding. In this sense, it is an index calculated by institutions such as Bloomberg, Citibank, Deutsche Bank, Goldman Sachs, and Kansas City Federal Reserve Bank (Hatizus et al., 2010: 7). It is seen that different calculated indices use other variables. Kara et al. (2015) used variables such as exchange rate, interest rate, risk premium, and credit conditions while calculating the index. In their study, Kaya and Barut (2020) used variables such as GDP, CDS, loan and deposit volume, and consumer confidence index. Felek and Ceylan (2021) used financial and economic variables while creating an index in their study. Sümer and Aydın (2022) used overnight interest, stocks, and real effective exchange rates.

When the foreign literature is investigated, Zheng and Yu (2014) used money supply, stock value, housing prices, etc., as variables in their study. Goodhart and Hofmann (2001) and Montagnoli and Napolitano (2005) used real interest rates, real effective exchange rates, house prices, and stock prices while calculating the index. On the other hand, Gumata et al. (2012) classified the variables used for the financial conditions index created for South Africa as global and local variables. Accordingly, global variables such as VIX (Chicago Bond Options Exchange Volatility Index) and EMBI (The JP Morgan Emerging Market Bond Index) were also used for index calculation.

According to these explanations, different variables are used instead of a single variable set when calculating the financial conditions index. In this sense, some research studies are given in Table 1 in chronological order.

Table 1

Literature Review

Author(s)	Sample Period and Data	Method	Key Findings
Mayes and Viren (2001)	- 1985:Q1- 2000:Q3. - GDP, real Exchange rate, real interest rate, house prices, stock prices	-Weighted average approach	- The study demonstrates how to use an FCI for Finland.
Gauthier, Graham, Liu (2004)	- Monthly data between 1981 and 2000. - Equity prices, housing prices, and bond yield risk premiums.	-IS-curve-based model, -Generalize impulse-	The FCI calculated using US stock prices and high-yield bond margins outperformed the FCI calculated using

		response functions,	Canadian stock prices and bond margins. The FCI was significantly strong in predicting economic growth.
Swiston (2008)	- 1990-2008. - 3-month LIBOR, 5-10 year bond yield, real GDP, the GDP deflator, oil prices, equity earns, REER	- VAR, -Impulse Response Function (IRF).	The FCI for the USA was established in the article. The generated FCI is an accurate forecast of GDP growth.
Hatzius, Hooper, Mishkin, Schoenholtz, Watson (2010)	- 1970:Q2- 2009:Q4. Wide range of Interest Rates, Prices, Quantities, Surveys and second moments	- The balanced panel, decomposition tests.	The FCI constructed in the study works better in times of unusual financial stress. The FCI level estimated at the end of 2009 is even tighter than the tight credit conditions.
Gumata, Klein, & Ndou (2012)	- 1999:Q1- 2011:Q4. - VIX, S&P 500, EMBI, LIBOR and etc.	- PCA and Kalman Filter	FCI index calculated with PCA and Kalman Filter predicts GDP growth well. The predictive power of the FCI is high in the estimation of short-term economic growth.
Ho & Lu (2013)	-2004: Q1-2012: Q4 -Lending standards, 3-month WIBOR Rate, corporate loan spread, 5-year government bond yield, REER, URIBOR-OIS spread, VIX.	-Factor analysis and vector auto-regression approach	The FCI for Poland is an important indicator in estimating short-term economic growth.
Angelopoulou, Balfoussia and Gibson (2014)	- 2003-2011. - Wide range of loans, prices, interest rate spreads, policy variables, market volatility, etc.	-Weighted-sum approach	According to the FCI result calculated for the countries after the global crisis, while conditions worsened in countries such as Greece and Portugal,
Koop, & Korobilis (2014)	- 1970: Q1-2013: Q3. - Financial variables include asset prices, volatility, loans, liquidity, and macroeconomic variables such as unemployment rate and GDP.	-TPV-FAVAR model, -FAVAR model.	The FCI developed in the study increases its usefulness as an estimation tool by working with a wide range of variables.
Charleroy & Stemmer (2014)	-2001: M1-2013: M3 -EMBI, S&P500, FTSE100, Hang Seng, SGX, Tokyo Stock Exchange, TED spread, US FFR, VIX, Credit, NEER, Domestic Stock Exchange Indices, Domestic Bank Stock Indices, Domestic Interbank Rate, M1, Reserve Requirements, Foreign Reserves	-VAR	For each BRICS country, it is associated with economic growth through the main financial transmission channels.

Kara, Özlü, Ünalmış (2015)	- 2006: Q2- 2014: Q2 - Variables such as GDP, Real Effective Exchange Rate, BIST Return Index, Money Supply and Interest Rates	-VAR generalized impulse-response functions (to construct the FCI)	- The relationship between FCI and economic growth has changed over time. GDP volatility has significantly decreased despite the increasing volatility in financial conditions and capital flows, especially since 2011,.
Davis et al. (2016)	-1970: Q1-2014: Q4 -Real GDP growth, real long-term interest rate, real short-term interest rate, REER, Loan Survey Results, Real House Prices, and share prices, Bond yield spreads between corporate and government bonds	-Panel, Granger Causality	Although the FCI is effective in economic growth, it has yet to have solid economic antecedents.
Balcılar et al. (2016)	-1966:M2-2012:M1 -Measure of Output Growth, Inflation, CPI, 3-month Treasury Bill yield, Stock Exchange Volatility (South Africa), US Consumer Sentiment Index, FTSE South Africa, Absa House Price Index, Credit Extended to Domestic Private Sector, Rand-US Dollar Exchange rate, S&P500 Composite Price Index, Johannesburg Stock Exchange dividend yield, US FFMR, House Price Volatility, Government Bond Volatility Month-on-month growth in CPI	-VAR -LTSVAR	Shocks related to the financial conditions index in South Africa affect economic growth.
Akdeniz and Çatık (2017)	- 1992:M1 ve 2015:M12. - Real effective exchange rate, overnight borrowing interest rate, total loans, BIST index, VIX et al. macroeconomic and financial variables	-VAR generalized impulse-response functions -Factor-augmented VAR models (FAVARs)	FCI obtained by the FAVAR method is a leading indicator of economic activities.
Sahoo (2017)	-2009: Q4-2016: Q4 -Short-term interest rate, exchange rate, housing price index, FDI total inflow, GDP growth, inflation	Weighted sum approach, Correlation Test, Granger Causality	One-way causality relationship between FCI and inflation, There is no causality between FCI and economic growth.
Kapetanios et al. (2018)	-2004:M1-2014:M6 -FTSE 100, CDS, REER, 3-month TBill, UK House Price Index, TED Spread, etc.	Multivariate Partial Least Squares (MPLS), SVAR, PCA	The FCI has an effective predictive power in the UK's economic growth.

Kaya and Barut (2020)	-2007:Q2-2018:Q4 -GDP, CDS, Industrial Production Index, Credit Volume, Deposit Volume, Consumer Confidence Index, Non-farm Employment.	-VAR, Maki cointegration test	A positive relationship was found between FCI and economic growth. The increase in economic activities and the improvements in the GDP and industrial production index increased the FCI.
Felek and Ceylan (2021)	- 2011:M1-2019:M6 - Variables include money supply, unemployment rate, government bond interest rate, current account balance/GDP, etc.	- PCA (to construct the FCI) - Structural VAR - Impulse Responses Analysis	- The financial stability index is affected positively and significantly against a shock to the 1-week repo and nominal exchange rates. - It is concluded that the interest channel and the exchange rate effectively ensure financial stability, while the credit channel is ineffective.
Sümer and Aydın (2022)	- 1999:M1-2020:M2 - GDP growth, overnight interest, stock, real effective exchange rates	- PCA (to construct the FCI) - Panel cointegration test (to analyze data)	Changes in the FCI, except for real effective exchange rates, overnight interest rates, and stocks, affect economic growth negatively in BRICS-T countries in the long run.

3. Methodology

This chapter of the study consists of two parts. The first is the data section, where the series is introduced. The second is the methodology part. The methodology section is also divided into two: The Principle Component Analysis (PCA) model, used to create FCI, will be explained with its equations, and the Toda-Yamamoto Causality model, used to test causality relationships, will be explained.

3.1. Data and Variables

We assembled a set of 14 indicators for 2010: Q1-2022: Q2 listed in Table 2 below. 13 variables are domestic, and others are global series. All the variables are selected as in quarterly frequency.

Table 2

Variables

Variables	Explanation	Source
Real GDP Growth	Change from a year ago, seasonally adjusted	FRED
Net Financial Account (NFA)	According to the IMF 6th Handbook	CRBT EVDS Database
VIX	CBOE Volatility Index	FRED
REER	Real Effective Exchange Rate, Percent Change from a year ago	CBRT EVDS Database
Interbank Rate (Overnight)	Less than 24 Hours: Call Money/Interbank Rate for Türkiye, Percent	FRED
CDS	Credit Default Swap (5-Years)	Bloomberg
EMBI+	Emerging Market Bond Index (J.P. Morgan)	World Bank Database
House Price Index (HPI)	Repeat-sales index	CBRT EVDS Database
Real Sector Confidence Index (RSCI)	Seasonally adjusted	CBRT EVDS Database
Policy Rate of Türkiye (TPR)	One-Week Repo Rate	CBRT EVDS Database
BIST 100	Borsa Istanbul Index (The Main Stock Exchange Index of Türkiye)	Bloomberg
Total Credit Volume (TCV)	National Currency	CBRT EVDS Database
M3	Broad Money Supply*, National Currency, Seasonally adjusted	CBRT EVDS Database
FCI	Financial Conditions Index	Calculated by authors

NFA is the variable created from the items in the Financial Account (Capital Account) under the Balance of Payments (Handbook 6th) title, prepared in IMF format, and taken as the opposite sign of the Financial Account, which shows Net Capital Inflows.

The selected variables cover financial stability, monetary policy, economic activity, sovereign risk, and liquidity. All the variables are chosen according to FCI literature. First, REER (real effective Exchange rate) captures the magnitude of capital flows to and from Türkiye. The overnight Interbank Rate reflects the interest rate of financial markets. CDS (Credit Default Swap) and EMBI+ (JP Morgan Emerging Market Bond Index) indicate sovereign risk, and the House Price Index covers asset prices, collateral channels, the wealth and expectations of inflation, and other macroeconomic conditions. RSCI (Real Sector Confidence Index) shows real sector

representatives' general impressions and expectations regarding the economic outlook. TPR (Policy Rate of Türkiye) indicates the CBRT (Central Bank of the Republic of Türkiye) policy interest rate. BIST 100 (Borsa Istanbul Index, which is the main stock exchange index of Türkiye). Total Credit Volume in national currency shows the aggregate credit volume of all sectors. M3 is the broad money supply, which contains currency, deposits with an agreed maturity of up to two years, money market fund shares, repurchase agreements, deposits redeemable at notice of up to three months, and debt securities up to two years. FCI includes CDS, REER, OIR, HPI, TPR, BIST100, TCV, and M3. All these variables are standardized before using the Principal Component Analysis (PCA) to get FCI.

3.2. Empirical Methods and Analysis

This part of the study will explain the PCA model used in creating the Financial Conditions Index for Turkey and the Toda-Yamamoto Model for causality research.

3.2.1. PCA Method

The PCA method reduces observations to smaller sizes to detect the correlation between variables in models working with high-dimensional variables (Joliffe, 2002: 1).

The Principal Component Analysis (PCA) is a multivariate statistical analysis technique that converts a multivariate system consisting of a large number of variables that are related to each other into a system composed of fewer and unrelated new variables as linear functions of these variables and at the same time that can explain the total change of the previous system as much as possible.

The PCA Method is used in the study because it allows us to include it in the regression model by reducing the number of variables to one. It also provides for indexing the said variables since the financial conditions index is thought to consist of many variables.

The static measurement method of the FCI method used when calculating the financial conditions index is as follows (Brave and Butters, 2011: 24):

$$X_t = \Gamma F_t + \in_t \tag{1}$$

The definition of the expressions in the above equation is as follows:

F_t : 1xT latent factor, which captures time-varying and co-variation in the standardized NxT matrix,

X_t ve Γ : Nx1 loadings on the latent factor as constant financial indicators.

The value reached as a result of the Kaiser-Meyer-Olkin (KMO) test measures the degree of compliance of the data set with the principal components analysis, and the KMO statistic takes values ranging from 0 to 1 (Kaiser, 1974). This statistic measures whether it can be modeled with a factor analytical model. It is stated that the lower limit should be 0.50 for KMO, and the data set cannot be factored for KMO $\leq$ 0.50. KMO, unlike Bartlett, is a benchmark, not a test statistic. KMO is valid for the dataset formed by all variables (Field, 2018). The meaning of the KMO test values in which interval is given in the tables below.

Table 3

KMO Measure of Sampling Adequacy (Initial)

Variable	**KMO**
CDS	0.9010
REER	0.9103
OIR	0.6961
HPI	0.8605
RSCI	0.2480
TPR	0.6961
BIST-100	0.8820
TCV	0.7797
M3	0.7642
Overall	0.7952

Table 4

KMO Measure of Sampling Adequacy (Final)

Variable	**KMO**
CDS	0.9217
REER	0.8693
OIR	0.6969
HPI	0.8686
TPR	0.6969
BIST-100	0.8829
TCV	0.8037
M3	0.7976
Overall	0.8166

KMO Test measures sampling adequacy, which is necessary to apply the principal component analysis (PCA). According to KMO, it cannot be applied if the test statistics are more excellent individually or overall. The Real Sector Confidence Index's (RSCI) coefficient is under 0.5; therefore, it is omitted from the model. As seen in the tables, other variables and the overall score are over 0.5, which is the critical value of the KMO test.

Table 5

Principal Components/Correlation

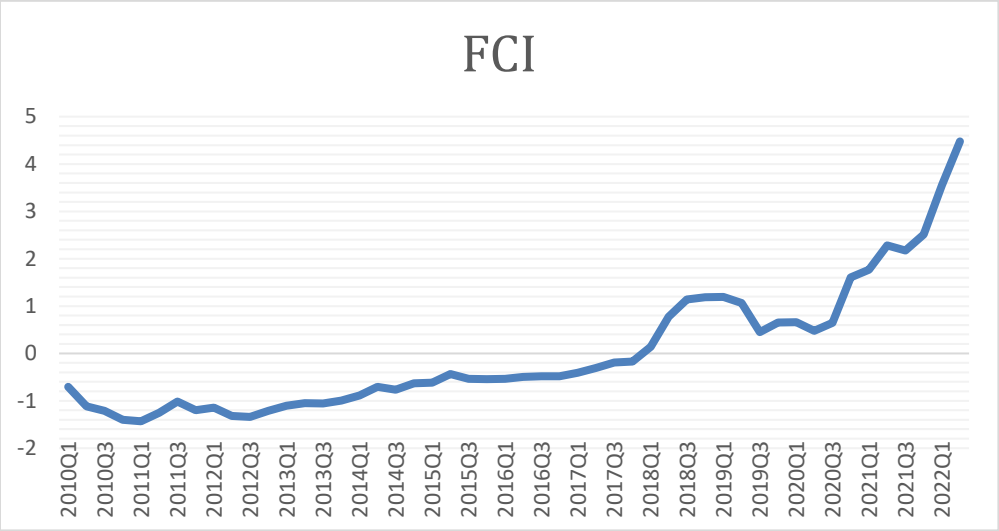
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.7314*	4.48129	0.7164	0.7164
Comp2	1.25012*	.486665	0.1563	0.8727
Comp3	.763451	.595823	0.0954	0.9681
Comp4	.167628	.114818	0.0210	0.9891
Comp5	.05281	.0242607	0.0066	0.9957
Comp6	.0285492	.0225075	0.0036	0.9992
Comp7	.00604169	.00604169	0.0008	1.0000
Comp8	0	.	0.0000	1.0000

Table 6

Principal Components (Eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Unexplained
CDS	0.3825	0.1534	-0.0048	0.8817	0.0740	0.2116	0.0500	0
REER	-0.2115	0.1952	0.9543	0.0626	-0.0436	0.0115	0.0242	0
OIR	0.2999	-0.6031	0.1960	-0.0264	0.0804	-0.0128	-0.0254	0
HPI	0.3844	0.3061	0.0633	-0.1382	0.6117	-0.5855	0.1356	0
TPR	0.2999	-0.6031	0.1960	-0.0264	0.0803	-0.0127	-0.0250	0
BIST100	0.3894	0.2548	0.0658	-0.4058	0.2538	0.7362	-0.0897	0
TCV	0.4085	0.1186	0.0349	-0.1698	-0.5767	-0.0730	0.6716	0
M3	0.4035	0.1959	0.0543	-0.0687	-0.4565	-0.2543	-0.7198	0

According to the results in the PCA model table, the Eigenvalues of Component 1 and Component 2 are above 1.00; therefore, these are suitable for the reunion. Finally, Component 1 and 2 are multiplied by their weights and summed up as seen in the equation (Comp1*0.7164)+(Comp2*0.1563). As a result of this process, the FCI was/has been obtained. The calculated FCI index is in Graph 1 below.



Graph 1. FCI

Upward movements in the index indicate that the general financial conditions are more harmonious, while downward movements suggest that the general financial conditions are tighter (Gumata et al., 2012).

Between 2010 and 2012, the FCI had slight fluctuations due to the variability of internal and external conditions. Financial conditions took a favorable position in 2012 due to the CBRT's gradual loosening of its liquidity policy and the increase in the global risk appetite (Kara et al., 2015). The index turned positive in early 2018 as monetary and credit conditions eased. However, in the face of the exchange rate shock, in the 2nd quarter of the same year, it was observed that there was a break in the FCI with the sudden policy change of CBRT and its transition to a tight monetary policy. After a relatively horizontal movement for a while, it went down in 2019. The period between 2019: Q3 and 2020: Q3, the effects of the Covid-19 global pandemic have been seen. In this period, it can be said that the index followed a relatively flat course. From 2020: Q3, FCI has accelerated sharply upwards. The reason for this is estimated to be the fact that the stocks in BIST 100 have become cheaper compared to their counterparts in other markets due to the expansionary stance of CBRT in monetary policy, the gradual continuation of interest rate cuts, the abundance of liquidity created in the domestic market and the rise in the exchange rate.

3.2.2. Toda-Yamamoto Causality

The traditional Granger (1969) causality test analyzes the causality relationship between variables, provided the series is stationary and there is no cointegration. In Toda-Yamamoto's

(1995, pp.225-250) causality test, the fact that the series is stationary at the same level or cointegrated does not affect the validity of the test. As in the Granger causality test, an advantage of this test is that it prevents data loss when the series is made stationary by taking the difference.

To apply this test, the lag length (p) must be determined by establishing a Vector Autoregressive (VAR) model. Then, the highest degree of integration, d_{max}, is added to the lag length p. Knowing these two values allows the model to be predicted correctly, preventing data loss and enabling more successful results at the level.

For the Toda-Yamamoto causality test, unit root tests should be performed to determine the maximum stationarity (d_{max}). The table below shows the results of the Augmented Dickey-Fuller unit root test and Phillips-Perron unit root test.

In the study, ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) unit root tests were performed to determine whether the series was stationary or not. When the results of both tests were taken together, I (1) was chosen.

Table 7

ADF Test and Phillips-Perron Test Results

	ADF Test Statistics		**Phillips-Perron Test Statistics**	
Variables	**I(0) Constant**	**I(1) Constant**	**I(0) Constant**	**I(1) Constant**
FCI	3.42 (1.00)	-4.04* (0.0027)	2.97 (1.00)	-4.04* (0.0027)
GDP Growth	-4.47 (0.0007)	-10.51* (0.0000)	-4.55 (0.6)	-10.20* (0.0000)
NFA	-3.80 (0.53)	-5.13* (0.0000)	-3.80 (0.53)	-5.13* (0.0000)

Not. *It represents stationary according to %5 significance level. Values in brackets are probability values.

As can be seen in Table 7, the FCI Index, GDP, and NFA variables become stationary at the first difference at the 5% significance level. According to unit root tests, all variables are stationary at I(1). After determining that the series is stationary at the first difference, cointegration

tests will be carried out between FCI and GDP and FCI and NFA. Relevant empirical results are presented in the next section.

4. Empirical Findings

The causality test developed by Granger (1969) and has been used frequently since entered the literature as the concept of "Granger Causality". In this study, Granger tests causality by using predictability as a criterion. More generally, if variable X is the Granger cause of variable Y, changes in variable X must precede changes in variable Y. In other words, if the prediction of Y improves significantly when the past or delayed values of X are added to the variable Y, then it can be said that X is the Granger cause of Y (Gujarati and Porter, 2018: 654).

The Granger causality test could not be applied primarily due to the pre-tests, so various approaches were developed. It is an essential advantage that the Toda-Yamamoto test, one of these approaches, can apply a causality test regardless of whether the series is stationary and cointegrated (Tarı et al., 2019:444).

Toda-Yamamoto causality analysis, developed to investigate Granger causality, is an approach that prevents the loss of information caused by taking the difference since it is applied to the level values of the series.

This method proposed by Toda-Yamamoto (1995) is an extended version of the VAR method developed by Sims (1980). In the Toda-Yamamoto extended Granger analysis, the extended Wald test (MWALD) shows the x^2 distribution and is applied to the constrained parameters of the VAR model with lag length k. Toda-Yamamoto extended Granger analysis is a two-stage method: In the first stage of the VAR model, which gives susceptible results to the lag length, the optimal lag length (k) and the maximum integration levels (d_{max}) of the variables in the model are determined by unit root tests with information criteria such as AIC and SIC. After determining the maximum degree of integration (d_{max}) and optimal lag length (k) of the variables, the lag is estimated at the level of the enhanced VAR model with $k + d_{max}$.

Toda and Yamamoto's (1995) analysis is made with the VAR model established by adding the lag length and the maximum integration level. The relevant VAR model is as follows (Tarı et al., 2019:445-446 and Kasabalı, 2004:749):

$$Y_{t=}\mu + A_{1l}Y_{t-1}+\ldots+A_{1k}Y_{t-k} + \sum_{l=k+1}^{k+d_{max}} A_{il}\, Y_{t-l} + u_t \qquad t=1,2,\ldots, T \tag{2}$$

After estimating the above equation, the hypotheses used for the causality test are as follows:

$$\begin{aligned} H_{0:} &: A_{il} = 0 \\ H_1 &: A_{il} = 0 \end{aligned} \tag{3}$$

The formula of the Wald test statistic used in the test of the hypothesis in the relevant model is as follows (Tarı, 2019:446):

$$W = T\{(S_1 \otimes S')vec\varphi\}'[(S_1 \otimes S')\sum\nolimits_u^{\wedge}(S_1 \otimes S')']'(S_1 \otimes S')vec\varphi \tag{4}$$

The definition of the expressions in the above equation is as follows:

T: Number of observations,

$S_1 = (1,0,0,0,....,0)'$,

$S = I_k \otimes (1,0,0,0,....,0)'$,

I_k = unit matrix in k row,

$\otimes$ = Kronecker multiplier.

To decide on the existence of Granger causality, the MWALD test is applied to the constraints of the k-lagged VAR model in the second step.

There are two causality tests in this work. The first one is between FCI and real GDP growth. The second one is between FCI and NFA.

4.1. FCI – Real GDP Growth Model

According to Toda-Yamamoto analyses, the VAR model should be established first. Then, the appropriate delay length must be determined.

Table 8

Lag Length for FCI-Real GDP Growth Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-521.9773	NA	8.19e+08	26.19886	26.28331	26.22940
1	-453.4283	126.8156	32482926	22.97141	23.22475	23.06301
2	-451.9281	2.625427	36883594	23.09640	23.51862	23.24906

3	-440.9405	18.12945	26128867	22.74703	23.33813	22.96075
4	-429.4593	17.79595	18126302	22.37296	23.13296	22.64775
5	-427.2405	3.217147	20081949	22.46203	23.39091	22.79788
6	-415.5067	15.84063	13915202	22.07534	23.17311	22.47226
7	-412.3437	3.953725	14922013	22.11719	23.38385	22.57517
8	-400.9433	13.11051	10708254	21.74717	23.18271	22.26621
9	-390.1667	11.31540*	8029339.*	21.40834	23.01277*	21.98845*
10	-385.3068	4.616939	8223083.	21.36534*	23.13866	22.00652

The lag order selected 9 according to LR, FPE, SC, and HQ criteria for FCI and GDP growth. As calculated, k=9 comes from the VAR lag order, and d_{max} =1 comes from the unit root test, which equals 10. In total, the lag for the model is 10.

4.2. FCI and NFA Model

Table 10 shows the VAR Lag order of the FCI-NFA Model.

Table 9

Lag Length for FCI-NFA Model

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-560.3880	NA	1.43e+08	24.45165	24.53116	24.48144
1	-480.3865	149.5681*	5240128.*	21.14724*	21.38576*	21.23659*
2	-477.4840	5.174128	5503666.	21.19495	21.59249	21.34387
3	-476.4547	1.745342	6281542.	21.32412	21.88066	21.53260
4	-472.3015	6.681120	6274004.	21.31746	22.03301	21.58551

The lag order selected 1 according to LR, FPE, AIC, SC, and HQ criteria for FCI and NFA. As calculated, k=1 comes from the VAR lag order, and d_{max} =1 comes from the unit root test, which equals 2. In total, the lag for the model is 2.

Table 10

FCI-Real GDP Growth and FCI-NFA Toda-Yamamoto Test Results

Aspect of Causality	**x^2 Test Statistics**	**Probability Value**	**Decision**
ΔGDP => FCI	255.4904	0.0000	There is a causal relationship from Real GDP Growth to FCI.
FCI => ΔGDP	47.39754	0.0000	There is a causal relationship from FCI to Real GDP Growth.
NFA ≠> FCI	3.011659	0.2218	There is no causal relationship from NFA to FCI.

FCI => NFA	6.923644	0.0314	There is a causal relationship from FCI to NFA.

The analysis shows a mutual causality relationship between FCI and Real GDP Growth, as shown in Table 10. According to this, Real GDP Growth is the cause of FCI, and FCI is the cause of Real GDP Growth. This result indicates that FCI has a significant impact on Türkiye's economic growth and also shows that Türkiye's economic growth has a significant impact on the financial conditions of Türkiye. Therefore, it can be interpreted as Real GDP Growth and FCI having a mutually reinforcing relationship.

Another causality test was conducted for the FCI and NFA models. Results of the analyses show that while FCI was the cause of NFA, NFA was not the cause of FCI. Therefore, there is unidirectional causality from FCI to NFA. Accordingly, net capital inflow to Türkiye is the cause of the financial conditions of Türkiye. However, FCI is not a reason for net capital inflows into Türkiye.

5. Conclusions

This study aims first to create a financial conditions index that can reflect the outlook of financial markets and then to test the causal relationships between this index and real economic growth and net capital inflow. In parallel with these objectives, financial and macroeconomic variables were selected, as in the rest of the studies in the literature, while calculating the FCI. In the study covering 2010: Q1-2022: Q2, FCI was obtained using The Principal Component Analysis (PCA) method. It has been determined that the calculated FCI is important for Türkiye in terms of understanding the financial fluctuations.

The FCI was formed from financial and macroeconomic variables to reflect financial conditions better, and its relationship with economic activity was examined. The relationship between real economic growth and the net capital inflow reflecting economic activity and FCI was investigated with the Toda-Yamamoto test, a Granger causality model. According to the results, a reciprocal causality was found between real GDP growth and FCI. Accordingly, real GDP growth is the cause of FCI, and FCI is the cause of real GDP growth. Appropriately, the study shows parallelism with the following studies that found causality between FCI and real GDP growth: Gauthier, Graham, Liu (2004), Swiston (2008), Gumata, Klein, & Ndou (2012), Ho & Lu (2013),

Charleroy & Stemmer (2014), Balcılar et al. (2016), Akdeniz and Catik (2017), Kapetanios et al. (2018) and Kaya and Barut (2020). However, this study differs from the following studies in the literature, which find that there is no causality between real GDP growth and FCI: Davis et al. (2016), Sahoo (2017), and Sümer & Aydın (2022).

Many studies have stated that the weights of the components in the FCI indices change over time. Since the PCA method is a dynamic model, it is assumed that the index created better reflects the outlook of financial markets. Variables in FCI, such as CDS, REER, OIR, TPR, and BIST 100, give important signals about the country for foreign investors. For this reason, the Toda-Yamamoto causality test was also conducted between the FCI and the net capital inflow to look for an answer to the question marks that there might be a relationship between the index and the net capital inflow to Türkiye. As a result of the test, it was revealed that while FCI was the cause of net capital inflow, net capital inflow was not the cause of FCI. Therefore, there is unidirectional causality from FCI to net capital inflow. Correspondingly, net capital inflow to Türkiye is the cause of the financial conditions of Türkiye. This analysis, which we have determined has not yet been done in the literature, is essential in terms of shedding light on the researchers and decision-makers who will work in this field, both because it is the first with the findings it has reached.

In line with the results mentioned above, it should be noted that economic policy recommendations are vitally crucial for the development of FCI, sustainable economic growth, and the continuity of capital flows. Accordingly, the government and economic policymakers have essential duties to sustain economic growth, financial conditions, and capital flows. First, maintaining political stability in a country, reducing regional risks, having a solid democracy, ensuring the superiority and independence of the law system, and carrying out structural reforms are extremely important in terms of investments and financial conditions. On the economic side, macroeconomic and macroprudential policies should be implemented to support the financial conditions index. In particular, policymakers should attach importance to the stability of CDS, REER, OIR, TPR, and BIST100 variables, which have a high weight in FCI because FCI is the cause of capital flows. To improve the investment environment in the country, country risk must be at a minimum level, inflation and exchange rates must be as stable and predictable as possible, and monetary policies must be carried out in coordination with an independent, reliable, and well-planned economic program. Taking steps that will add depth to the stock market and increase

investment volume is essential. Reducing the stock market index volatility and establishing stability in the capital markets may be recommended.

In future studies, it is possible to calculate the FCI by updating it at certain intervals and to compare the indices obtained in these intervals. In addition, new FCIs can be estimated with different indicators or changing weights, as the indicators used in calculating FCI and their weights, which are assumed to reflect the outlook of financial markets, may change over time.

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