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Reel Efektif Döviz Kurunun Türkiye'nin AB-27 ile İkili Ticareti Üzerine Etkisi: FADL Eşbütünleşme

Impact of The Real Effective Exchange Rate on Turkey's Bilateral Trade With 27 European Union Countries: FADL Cointegration

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Yılmaz TOKTAŞ

Dr. Öğr. Üyesi, Amasya Üniversitesi, Merzifon İktisadi ve İdari Bilimler Fakültesi

Assistant Professor, Amasya University, Merzifon Faculty of Economics and Administrative Sciences

toktasyilmaz@gmail.com

Orcid ID: 0000-0002-6996-7987

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Öz

Bretton Woods sistemi sonrası döviz kuru sistemlerinde meydana gelen değişimle birlikte döviz kuru politikalarının önemi artmıştır. Türkiye'de günümüze kadar farklı döviz kuru sistemleri uygulanmıştır. Türkiye'de meydana gelen ekonomik krizler öncesi ve sonrası Türk lirasının değerinde gerçekleşen önemli değişimler uygulanan kur sisteminin sorgulanmasına yol açmıştır. Günümüzde kurların piyasa koşulları içinde belirlenmesiyle birlikte döviz kurlarında oynaklık artış göstermiştir. Döviz kurlarında meydana gelen değişimler birçok makro ekonomik değişkenle birlikte ihracatı ve ithalatı da etkilemektedir. Döviz kurlarında meydana gelen değişimler ihracat ve ithalat üzerinde belirsizlik yaratmaktadır.

AB ülkeleri Türkiye'nin dış ticaret ilişkisi açısından hem ihracat hem de ithalatta önemli paya sahip olan ülke grubudur. AB ülkelerinde ortak para birimi olarak Euro ile birlikte farklı yerel paralar da kullanılmaktadır. Ekonomik birliklerin yarattığı etkilerden biri birlik dışında kalan ülkeyle olan dış ticarette, birlik içine doğru meydana gelen sapmadır. Birlik içindeki bazı ülkelerde parasal birliğin de sağlanmış olması Birlik dışında kalan Türkiye gibi ülkeler açısından döviz kurunda meydana gelen değişimlerin önemini de artırmaktadır.

Bu çalışmanın amacı Türkiye ve 27 AB ülkesi arasındaki ikili ticaret ve reel efektif döviz kuru arasındaki uzun dönemli ilişkiyi araştırmaktır. Çalışmada 1998-2020 dönemi için çeyreklik GSYİH, reel efektif döviz kuru, ihracat ve itahalat verileri, Fourier ADL eşbütünleşme testi kullanılarak araştırılmaktadır. Çalışmada serilerin durağanlığı için ADF ve FADF testleri kullanılmış ve tüm seriler I(I) olarak tespit edilmiştir. FADL eşbütünleşme testi sonuçlarına göre ihracat ve ithalatın bağımlı değişken olduğu her iki model için de eşbütünleşme ilişkisi tespit edilmiştir. Çalışma sonuçları, reel efektif döviz kurunun Türkiye'nin AB-27 ülkelerine olan ihracat ve ithalatı üzerinde istatistiki açıdan anlamlı bir etkisi bulunamamıştır.

Anahtar Kelimeler: İhracat, İthalat, Reel Efektif Döviz Kuru, Avrupa Birliği Fourier ADL Eşbütünleşme Analizi.

Impact of The Real Effective Exchange Rate on Turkey's Bilateral Trade With 27 European Union Countries: FADL Cointegration

Abstract

Exchange rate policies have become important after the change resulting from the Bretton Woods system. Until today, different exchange rate systems were implemented in Turkey. Drastic changes in the Turkish Lira's value before and after economic crises led to the questioning of the exchange rate system in Turkey. Fluctuations have increased due to the determination of exchange rates within market conditions. With several macro-economic variables, changes in exchange rates impacted exportation and importation as well, causing uncertainty for both.

EU countries have a significant share in Turkey's foreign trade regarding exports and imports. In the EU, local currencies are in use along with the EU's common currency, the Euro. A significant impact of economic unions is the inbound deviation within the union regarding trade with non-members. Monetary union among member states increases the importance of exchange rate fluctuations in non-member states such as Turkey.

This study investigates the long-term relation between bilateral trade and real effective exchange rate in terms of Turkey's trade with 27 EU countries. Data regarding the 1998-2020 period's GDP, real effective exchange rate, imports and exports was investigated by Fourier ADL cointegration test. For series' stationarity, ADF and FADF tests were used; all series were determined as I (I). According to the results of the FADL cointegration test, a cointegration relation was determined for both models, where exports and imports were dependent variables. This study has found that real effective exchange rate does not have a statistically significant impact on Turkey's import and export with 27 EU countries.

Keywords: Export, Import, Real Effective Exchange Rate, European Union, Fourier Autoregressive Distributive Lag Cointegration Test.

Introduction

With the end of the Bretton Woods system, developed and other countries rejected the fixed exchange rate system and let their currencies fluctuate. With the rejection of the fixed exchange rate, the uncertainty in the exchange rates increased. The increase in globalization and technological progress and the constant renewal of international trade laws have increased the importance of exchange rates in countries' international trade. The effect of the uncertainty created by exchange rates on many macroeconomic

variables, particularly on exports and imports, has been examined through empirical and theoretical studies.

Different exchange rate systems have been timely used in Turkey; January 24, 1980, is a turning point in terms of exchange rate systems because a liberal foreign trade regime was adopted in Turkey on this day; this new practice required the liberalization of the foreign exchange regime. While the controlled free exchange rate system was implemented from 1989 to 1999, the Central Bank tried to keep the actual value of the Turkish lira constant in the period between 1995 and 1998 based on a particular currency basket. The fixed exchange rate system, wherein daily increases were determined, was applied from 2000 to 2001. This system was abandoned in a short time with the effect of the economic crisis. Since the second half of 2001, Turkey has been implementing a free-floating exchange rate system wherein the Central Bank of the Republic of Turkey's interventions are limited. In 1980–2001, when the exchange rates were used to obtain an advantage in foreign trade, the export-led growth model was applied partially and in real terms after 2001 (Barışık & Demircioğlu, 2006; Hepaktan, Çinar, & Dündar, 2011).

Changes in the real value of the local currency are the main determinants of movements in exports and imports, as well as competitiveness. Exchange rate affects the real economy and macroeconomic variables through the current account flows. (Yılmaz & Kaya, 2007).

According to Turkstat data, 27 European Union (EU-27) countries have an important share in Turkey's foreign trade. While Turkey's total exports to EU-27 countries were 11.70 billion dollars in 1998, they increased to 57.64 billion dollars in 2020, and the imports increased from 20.24 billion dollars to 60.61 billion dollars. Turkey's trade balance with the EU-27 countries had a deficit in 1998–2020, excluding 2019. As of 2020, the share of EU-27 countries in Turkey's total exports was approximately 18.5%, and its share in imports was 15.3%. EU-27 countries therefore have an important share in Turkey's foreign trade structure.

This study examines how the changes in the exchange rate affect Turkey's exports and imports to EU-27 countries, which are important foreign trade partners of Turkey. There are many ruptures in the economic and political field, depending on the global and local dynamics in Turkey. In this respect, the analysis results using the stationarity and cointegration approaches based on the Fourier functions used in the study will contribute to the extant literature. The use of the aggregate series in the study can be considered as a limitation of the study.

The remainder of the study is organized in the following manner. Section 2 examined the extant literature. The data and model used in the study were explained in Section 3. The methods used in the study were explained in

Section 4. The analysis findings were explained in Section 5, and the analysis results were interpreted in Section 6.

Literature Review

Several national and international studies in the literature have investigated the relationship between real exchange rates and exports and imports. In addition, these studies have mainly examined the effects of exchange rates on exports, imports, foreign trade balance, and prices. The national and international studies on this topic from the extant literature are summarized below.

Shirvani and Wilbratte (1997) examined the effect of exchange rate on the bilateral trade between the United States and G7 countries through a multivariate cointegration analysis. They concluded that the trade balance was not affected by the exchange rate changes in the concise term, but the foreign trade balance began to react against the exchange rate in 2 years.

Baharumshah (2001) sought to determine the main economic indicators affecting the bilateral trade of Malaysia and Thailand with the U.S. and Japan in the 1980-1996 period, using the Johansen cointegration test method. The empirical results of the study showed that the real effective exchange rate is an important indicator in the trade balance equation, and that decreases in the local currency value improves the trade balances of Malaysia and Thailand in the long run.

Yılmaz and Kaya (2007) investigated the relationship between real exchange rates and exports and imports in Turkey using the vector auto-regression model for the 1990–2004 period. As a result of the Granger causality test, it was determined that changes in the real exchange rate did not significantly affect the foreign trade balance.

Tekin and Yazgan (2009) studied the exchange rates' effect on the internationally traded products within Turkey's production sector. The findings suggested that, although the change in exchange rates in Turkey affects the exports, but not the imports. This aspect indicates that the export manufacturing sector in Turkey has acquired a competitive advantage by projecting the change in exchange rates onto its prices.

Aktaş (2010) examined the relationship between exports, imports, and real exchange rates for the 1989–2008 period in Turkey through Johansen cointegration analysis, and a cointegration relationship was found according to the test result. The results of variance decomposition and impulse–response functions showed that changes in the real exchange rate did not significantly affect the foreign trade balance, and that the real exchange rate could not be used effectively in maintaining the foreign trade balance.

In a study by Yıldırım and Kesikoğlu (2012), which empirically investigated the causality relationship between the imports, the exports, and the real exchange rate in Turkey for the 2003-2011 period, the leveraged bootstrap

technique recommended by Hacker and Hatemi-J (2006) was applied and corrected by the Modified Wald test. Consequently, no causal relationship was found between the imports, the exports and the real exchange rate.

Cheung and Sengupta (2013) studied the impacts of the real effective exchange rate on the export share of the Indian nonfinancial sector firms in the 2000-2010 period. As a result of the empirical analysis, they observed currency appreciation and exchange rate volatility to have adverse effects on the market share of the Indian firms.

Sweidan (2013), using the ARDL bound test in his studies on Jordan for the 1976–2009 period, concluded that the exchange rate affects exports and imports in the short run.

Genç and Artar (2014) examined the impact of exchange rates on exports and imports in emerging countries for the 1985-2012 period, using panel data analysis techniques. The study's empirical findings suggested that there was a cointegration relationship between the long-term effective exchange rates and the exports and imports of developing countries.

In Nyeadi, Atiga, and Atogenzoya's (2014) study, as a result of the regression analysis of the exchange rate movements on the export growth of Ghana for the 1999–2012 period, a significant effect of the exchange rate was determined.

Li, Ma, and Xu (2015) used firm-level data to analyze the impact of exchange rate on exports in China for the 2000-2007 period. According to the empirical results of the study, increases in local currency had a negative effect on firms' export potential and diversification of exports.

Bahmani-Oskooee and Harvey (2017) studied the effect of the real exchange rate on the trade flows between Singapore and its leading trading partner, Malaysia, for the 1979–2013 period, using the ARDL bound test. After disaggregating the trade flows by commodities, they concluded that exchange rate volatility has significant short-term effects in 70 out of 156 exporting sectors and 73 out of 155 importing sectors. However, the short-term effects persist in the long-term only in 46 exporting and 36 importing sectors.

Şendilmen (2017) investigated the impact of real effective exchange rate volatility on the trade between the U.S. and Turkey, using the ARDL approach. They found that, the real effective exchange rate volatility is only in one industry a significant explanatory variable in the long run. Turkey's exports to the United States of America mostly depend on the real effective exchange rate, imports of Turkey from the U.S..

Gül (2018) investigated the effect of real exchange rate changes on Turkey's exports and imports, using the nonlinear ARDL bound test in reference to monthly data for the 2004–2016 period. The study highlighted that Turkey's exports, specifically to countries that accounted for almost half of all Turkish exports, were significantly affected by real exchange rate changes.

Bozdan, Özenci, and Benli (2018) studied the effect of the exchange rate on exports and imports with reference to monthly data for the 2010–2017 period in Turkey, using the ARDL bound and Granger causality tests. A cointegration relationship was observed between the variables; however, according to the results of the Granger causality test, no causality relationship was found between the variables.

Nguyen and Do (2020) examined the impact of foreign direct investment, imports and real exchange rate shocks on exports, using time series methods for the 1994-2016 period in Vietnam. According to the Johansen cointegration test result, a cointegration relationship was determined between variables. In the long run, the exchange rate volatility had an impact on the external trade.

Chang, Rajput, Bhutto, and Abro (2020) investigated the effects of changes in exchange rate volatility series, which they classified on a scale ranging from extremely large to extremely small changes, on the U.S. imports from Brazil, India, Mexico and South Africa for the 1986-2018 period. In this study a new methodology called MTNARDL was used. The empirical results of the study showed that, regarding imports, the effects of extremely large changes in the exchange rate volatility were different from the effects of extremely small changes in the exchange rate volatility.

Alev (2020) examined the impact of real effective exchange rate and exchange rate volatility on Turkey's imports and exports, using the ARDL approaches for the 2010-2019 period. The empirical results of the study suggested a negative impact of real effective exchange rate on Turkey's exports and imports.

Güler (2021) investigated the impact of real effective exchange rate on exports and macroeconomic indicators, using the ARDL method for the 2013-2020 period in Turkey. The study's empirical results showed that positive and negative real exchange rate shocks increased exports.

Data and Model

Quarterly data covering 1998Q1–2020Q4 were used in the study. The export and import data used in the study were obtained from the Turkish Statistical Institute database and were seasonally adjusted. The real effective exchange rate was obtained from the Bank for International Settlements (BIS) database. In addition, the logarithms of all variables used in the study were considered and included in the model. While creating export and import models, the model in Bahmani-Oskooee and Goswami's (2004) study was used, and the following models were derived:

$$LNEXP_t = \alpha_1 + \beta_1 LNREER_t + \beta_2 LNGDP\_EU_t + \varepsilon_t \quad (1)$$

$$LNIMP_t = \alpha_1 + \beta_1 LNREER_t + \beta_2 LNGDP\_TR_t + \varepsilon_t \quad (2)$$

$LNEXP_t$ export, $LNIMP_t$ import, $LNGDP\_EU_t$ gross domestic product (GDP) of EU-27 countries, $LNGDP\_TR_t$ GDP of Turkey, $LNREER_t$ real effective exchange rate and, ε_t error term.

Econometric Methodology

Fourier Augmented Dickey Fuller (FADF) Unit Root Test

In the study, the FADF unit root test was used by Christopoulos, Leon-Ledesma, and Finance (2010), which considers soft changes and significant structural breaks and does not need to specify the number, form, or duration of the structural breaks. This unit root test uses trigonometric variables to capture significant changes in the variable's deterministic terms, considering the following model:

$$y_t = \delta_0 + \delta_1 sin\left(\frac{2\pi kt}{T}\right) + \delta_2 cos\left(\frac{2\pi kt}{T}\right) + v_t \quad (3)$$

where k is the number of frequencies of the Fourier function, t is a trend term, T is the sample size, the frequency number considers an integer value between 1 and 5.

The FADF test, which is used for linear and nonlinear series, states that the H_0 hypothesis series contains a unit root.

$$H_0: v_t = \mu_t, \mu_t = \mu_{t-1} = h_t$$

Here, ht is assumed to be a stationary process with a mean of zero.

A three-step procedure calculates the test statistics proposed by Christopoulos Leon-Ledesma, and Finance (2010). The first step involves obtaining the appropriate frequency value as (k^*). The nonlinear deterministic component is estimated in Model 1 using the ordinary least squares (OLS) method for k values between 1 and 5, and the k value that minimizes the residual sum of squares is selected. Then, the OLS residuals of the model are calculated.

$$\hat{v}_t = y_t - \hat{\delta}_0 + \hat{\delta}_1 sin\left(\frac{2\pi k^* t}{T}\right) + \hat{\delta}_2 cos\left(\frac{2\pi k^* t}{T}\right) \quad (4)$$

The unit root test is applied to the OLS residuals obtained from the first step in the second step. Three different models, linear and nonlinear, have been proposed for the unit root test.

$$\Delta v_t = \alpha_1 v_{t-1} + \sum_{j=1}^{p} \beta_j \Delta v_{t-j} + u_t \quad (5)$$

$$\Delta v_t = \rho v_{t-1} + (1 - \exp(-\theta \Delta v_{t-i}^2)) + \sum_{j=1}^{p} \alpha_j \Delta v_{t-j} + u_t \quad (6)$$

$$\Delta v_t = \lambda v_{t-1}^3 + \sum_{j=1}^{p} \beta_j \Delta v_{t-j} + u_t \quad (7)$$

Here, $\theta > 0$ and u_t white noise is the error term. If the null hypothesis expressing the existence of a unit root is rejected in the second step, the trigonometric terms are analyzed by using the F test for Model 1 in the third step. At this stage, the null hypothesis H_0: $\delta 1 = \delta 2 = 0$ is tested against the alternative hypothesis H_1: $\delta 1 = \delta 2 \neq 0$. If the null hypothesis is rejected, it can be concluded that the variable is stationary around a deterministic function with a break. The significance of trigonometric terms is tested with the critical values in Becker, Enders, and Lee's (2'0') 't'd'' 'h''m'i''a'v''t'g''o' ''i' ''s' '' 'h'' 't''o's'de's'stru'tural breaks and nonlinear structures together.

Fourier Autoregressive Distributive Lag (FADL) Cointegration Test

In their work, Banerjee, Arčabić, and Lee (2017) studied the Autoregressive Distribution Lag (ADL), including the Fourier analysis explanation: They proposed a new cointegration test based on the ADL model. In addition, in this study, the deterministic components of Fourier functions are placed instead of the constant terms. The Fourier ADL test is a cointegration test that models the break of unknown numbers and forms without knowing the break dates beforehand. The model to be used for the test is given below:

$$\Delta y_{1t} = d(t) + \delta_1 y_{1,t-1} + \gamma' y_{2,t-1} + \varphi' \Delta y_{2t} + \epsilon_t \ (8)$$

In the above equation, y_{1t} is the dependent variable. γ, ϕ, and y_{2t} are the explanatory variables, and lag in Δy_{1t} and Δy_{2t} allows to check for possible correlations in the error term. Lagged values of the variables are added to the right side of Equation (8). AIC and BIC information criteria are used for the appropriate delay length.

Using the Fourier approach, the deterministic component d(t) is defined in the following manner.

$$\mathrm{d(t)} = \gamma_0 + \sum_{k=1}^{q} \gamma_{1,k} \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{q} \gamma_{2,k} \cos\left(\frac{2\pi kt}{T}\right), \ q \leq T/2 \ (9)$$

The null hypothesis of no cointegration is tested against the alternative of the presence of cointegration. The hypotheses are set up in the following manner:

$H_0: \delta = 0$ against $H_1: \delta < 0$

The t-statistic was used for basic hypothesis testing $H_0: \delta = 0$, and critical values are tabulated by Banerjee et al. (2017). The test statistic for FADL is calculated below:

$$t_{ADL}^{F} = \frac{\hat{\delta}_1}{se(\hat{\delta}_1)}$$

In the above equation, $\hat{\delta}_1$ is the least squares estimator of δ_1. $se(\hat{\delta}_1)$ is the standard error of the least squares estimation of $\hat{\delta}_1$.

Empirical Results

Stationarity Analysis

The standard ADF stability test results of the variables are shown in Table 1.

Table 1: Augmented Dickey Fuller Results

	Level				First Difference			
	Constant		Constant and Trend		Constant		Constant and Trend	
Variable	t-stat	Prob.	t-stat	Prob.	t-stat	Prob.	t-stat	Prob.
LNEXP	−1.56	0.50	−2.31	0.43	−10.70***	0.0	−10.78***	0.0
LNGDP_EU	−1.81	0.37	−2.33	0.41	−11.02***	0.0	−11.22***	0.0
LNGDP_TR	−1.33	0.61	−1.23	0.90	−8.58***	0.0	−8.63***	0.0
LNREER	−0.99	0.75	−1.23	0.90	−8.09***	0.0	−8.51***	0.0

Note: ***, **, and * values indicate that the series are stationary at 1%, 5%, and 10% significance levels, respectively.

The results of the ADF test indicate that all the variables used in the study were found to be stationary at the first difference.

The standard FADF stability test results of the variables are shown in Table 1.

Table 2: Fourier Augmented Dickey Fuller Results

Variables	$\hat{k}$	FADF	$f(\hat{k})$	Optimal Lag
LNEXP	1	−1.30291	42.93172	0
LNGDP_EU	1	−1.46008	51.68763	0
LNGDP_TR	1	−1.86958	154.57221	0
LNIMP	1	−1.83567	101.42123	1
LNREER	1	−3.19302	113.0742	0

Table 2. shows the FADF unit root test results applied to the series. The column $\hat{k}$ in the abovementioned table is frequency, and value $f(\hat{k})$ is the F statistic calculated for the significance of trigonometric terms; it expresses the unit root test statistic value in FADF. The FADF unit root test results determined that all variables contain unit root at a level.

Table 3: Fourier Autoregressive Distributive Lag (FADL) Cointegration Test Results

Dependent Variable	Independent Variables		$\hat{k}$	FADL Cointegration Test Statistics
LNEXP	LNREER	LNGDP_EU	2	−4.32045*
LNIMP	LNREER	LNGDP_TR	1	−5.09268**

Note: ** and * values indicate significance at 5% and 10% levels, respectively.

In the model where export is the dependent variable, the frequency value is 2. As the test statistic is greater than the 10% critical value in absolute value, the null hypothesis, which says there is no cointegration relationship between the variables, was rejected. In the model where the import is the dependent variable, the frequency value was 1. As the test statistic was more significant than the 5% critical value in absolute value, the null, which says there is no cointegration relationship between the variables, was rejected. According to the test statistics calculated for both models, the cointegration relationship was found at a 10% significance level. Therefore, the existence of a long-term relationship between the variables for both models has been determined.

Table 4: Long-run Coefficient Estimates

Models	LNEXP = f(LNREER, LNGDP_EU)		LNIMP = f(LNREER, LNGDP_TR)	
Variables	Coefficients	Significance	Coefficients	Significance
Constant	−25.260***	0.000	13.644***	0.000
Trend	−0.005***	0.000	0.004**	0.046
LNREER	−0.021	0.653	0.229	0.116
LNGDP	3.276***	0.000	0.706***	0.000

Note: ***, **, and * indicate the significance of the coefficients at the 1%, 5%, and 10% levels, respectively.

According to the results in Table 4, the real influential exchange rate variable was not statistically significant in the model, where both the exports and imports are dependent variables. The GDP variable was statistically significant and positive in both models. In addition, the coefficient of GDP variable of EU-27 countries in the export model was calculated as more significant than that of the coefficient of Turkey's GDP in the import model.

Conclusion

This study has investigated the relationship between real exchange rate and exports and imports with reference to quarterly data covering the 1998Q1–2020Q4 period, by using the FADL cointegration analysis. First, the stationarity analyses of the series were performed with the ADF unit root and FADF tests. As a result, it has been determined that the variables–

namely, real exchange rate, Turkey's GDP and EU-27 GDP, export and import– are stationary at the first difference. The FADL cointegration test was applied to determine whether there was a long-term relationship between the variables. It has been concluded that there was a cointegration relationship between real exchange rates and exports and imports. After the cointegration relationship was determined, the calculation of the long-term coefficients began. The real exchange rate variable was not found statistically significant for both export and import models. This finding supports the findings of earlier studies by Aktaş (2010), Bozdan et al. (2018), Yıldırım and Kesikoğlu (2012), and Yılmaz and Kaya (2007) which concluded that exchange rate did not significantly affect foreign trade.

The findings of the study have shown the theory, which suggests the real effective exchange rate decreases imports and increases exports to be invalid for the period investigated in the present study. This means that the exchange rate cannot be used as the main policy tool to increase exports and maintain the trade balance. Therefore, it does not seem possible to affect foreign trade by changing real exchange rates in Turkey. Due to Turkish exports' high dependency on imports, the real effective exchange rate's impact on foreign trade may be ineffective. The government should focus on structural economic reforms to decrease the country's risk and increase trade volume.

It should be noted that the impact of the real effective exchange rate was examined by using aggregate trade data in this study. Consequently, no statistically significant effect of the real exchange rate on Turkey's exports and imports to EU-27 countries was found in the long run. Since the data used in the study are aggregated data, it reveals the necessity of sector-based analyses in order to come up with a more detailed commentary on the effect of the real effective exchange rate on bilateral trade.

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