

# How Inflation and its Uncertainty Affect Stock Returns: Insights from Borsa Istanbul

## Enflasyon ve Belirsizliği Hisse Senedi Getirilerini Nasıl Etkiliyor: Borsa İstanbul'dan Kanıtlar

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### ABSTRACT

This paper investigates the impact of inflation and inflation uncertainty on stock returns in Türkiye from January 2006 to April 2024. The study period was selected to reflect key structural changes in the Turkish economy, including the adoption of explicit inflation targeting and the process of financial deepening. Stock returns in Turkey are represented by the returns of the BIST100 index, which tracks the performance of the top 100 companies with the highest trading volume and market capitalisation. To capture the effects of inflation uncertainty, ARCH/GARCH models are employed. The Johansen cointegration analysis is used to estimate the long-term relations among the variables, while FMOLS, DOLS, and CCR methods are applied to estimate long-run coefficients. The findings point out that both inflation and inflation uncertainty positively influence stock returns in Turkey. In particular, a rise in inflation uncertainty has a stronger impact on boosting stock returns than a rise in inflation itself. These results suggest that stocks serve as a safe investment option in inflationary environments.

**JEL Codes:** C22, E31, E44

**Keywords:** Inflation, Inflation Uncertainty, Stock Return, Borsa Istanbul

### Öz

Bu çalışma Ocak 2006 – Nisan 2024 dönemi Türkiye'de enflasyon ve enflasyon belirsizliğinin hisse senedi getirilerine olan etkisini incelemektedir. Çalışma dönemi, açık enflasyon hedeflemesinin benimsenmesi ve finansal derinleşme süreci de dahil olmak üzere Türkiye ekonomisindeki önemli yapısal değişiklikleri yansıtacak şekilde seçilmiştir. Türkiye'deki hisse senedi getirileri, en yüksek piyasa değerine ve işlem hacmine sahip ilk 100 firmanın performansını gösteren BIST100 endeksi getirileri ile temsil edilmektedir. Enflasyon belirsizliğinin etkilerini yakalamak için ARCH&GARCH modelleri kullanılmıştır. Değişkenlerin arasındaki uzun dönemli ilişkiyi değerlendirmek için Johansen eş-bütünleşme testi kullanılırken, uzun dönem katsayılarını tahmin etmek için FMOLS, DOLS ve CCR yaklaşımları kullanılmıştır. Bulgular, Türkiye'de hem enflasyonun hem de belirsizliğinin hisse senedi getirileri üzerinde olumlu bir etkiye sahip olduğuna işaret etmektedir. Ayrıca, enflasyon belirsizliğindeki bir artış, hisse senedi getirilerini artırmada enflasyonun kendisinden daha güçlü bir etkiye sahiptir. Bu sonuçlar, hisse senetlerinin enflasyonist ortamlarda güvenli bir yatırım seçeneği olduğunu göstermektedir.

**JEL Kodları:** C22, E31, E44

**Anahtar Kelimeler:** Enflasyon, Enflasyon Belirsizliği, Hisse Senedi Getirisi, Borsa İstanbul

## Introduction

An economic structure that fails to achieve price stability—defined as a general level of prices that is low and stable enough not to affect the decision-making processes of economic units, such as investment, consumption and saving—imposes serious costs on the basic structures by adversely affecting macroeconomic factors (CBRT, 2013). Based on this point, studies suggesting that there will be a negative correlation between inflation and capital markets explain this situation with two main arguments. The first of these is that during periods of inflation, weakened expectations regarding future economic performance and the decline in purchasing power led to a narrowing of aggregate demand, which in turn decreases corporate profits. Secondly, the increase in the inflation risk premium causes a rise in discount rates, which in turn leads to a decline in the present value of stocks (Ammer, 1994; Hatipoğlu, 2021). This may lead to increased costs as inflation affects decision-making and investment processes involving labour, credit and external market factors, which may ultimately lead to postponement or abandonment of decisions. All these effects can lead to changes in the economic equilibrium by severely affecting the overall strategies, spending habits and financial position of economic agents (Aydin & Esen, 2017). Thus, this may put pressure on labour costs, narrow the profit margins for companies and adversely affect employment policies. At the same time, the increase in credit costs due to inflation may raise borrowing costs, which may adversely affect the financial position of both individuals and companies. Rising costs in foreign markets may affect the economy from a broader perspective by affecting the international trade balance (Düldül, 2021). One of the key factors that fuels inflation and causes it to progress unevenly is the uncertainty inherently created by inflation itself (Esen & Akin, 2023). This uncertainty can affect the economy through a number of channels. In the long term, rising interest rates and increasing uncertainty about the expected future values of economic variables may adversely affect markets. In periods of high inflation when uncertainty increases, investors attach more importance to preserving the purchasing power of their capital and seek investment instruments that can protect them against inflation (Bozkurt & Kaderli, 2024). Individuals and firms seeking to avoid uncertainty tend to reduce the risk of uncertainty by investing in financial assets (stocks, bonds, treasury bills, mutual funds, etc.) rather than allocating their savings to real assets (i.e., net additions to the "physical" capital stock). Moreover, the increasing

effect of inflation uncertainty on interest rates may also reduce investments in real assets as it increases investors' expected rates of return. Similarly, in this process, individuals may postpone or even abandon their investment decisions (Oltulular & Terzi, 2011).

Reviewing at the literature, it is seen that the inflation—stock returns nexus has been researched for a long time and the debates in this area are ongoing. Stocks are traditionally recognised to serve as a strategic hedge against inflation (Choudhry & Pimentel, 2010; Ely & Robinson, 1997; Luintel & Paudyal, 2006). This is because stocks are backed by real assets of companies, and these companies tend to maintain their profit margins by raising their prices during periods of inflation. This allows stock returns to remain nominally above inflation. One of the foundational studies on the link among nominal interest rates and expected inflation is Fisher's (1930) hypothesis. It says that interest rates reflect future inflation rates. It is suggested that this hypothesis also applies to the stock return-inflation relationship. Thus, it is argued that the expected nominal interest rates on financial assets respond one-for-one with expected inflation, in other words, a rise in expected inflation rate will eventually lead to an equal rise in interest rates (Choudhry, 2001; Lee, 2010). In contrast with the conventional wisdom and the Fisher hypothesis, a considerable body of empirical evidence in the literature indicates that that inflation—stock returns nexus is a negatively correlated (Fama & Schwert, 1977; Fama, 1981).

The Turkish economy has been characterised by high and fluctuating inflation in recent years. These macroeconomic imbalances have significant effects on financial markets and stock returns may be affected directly or indirectly by these effects. It is insightful for investment managers and policy makers to understand effects of inflation and inflation volatility on stock returns in Turkey. High and volatile inflation rates in Turkey are critical in shaping investors' expectations and market dynamics. During periods of high inflation, companies, especially in sectors with high growth potential, can raise their prices to protect their profits and this may have a positive impact on stock returns. Moreover, a rise in nominal stock returns due to inflation may be perceived positively depending on investors' assessment of real returns.

At this point, the impact of inflation uncertainty is more complex. High volatility may undermine investor confidence by increasing economic uncertainty and risk perception, which may lead investors to be more cautious

and favour less risky assets. However, volatility may also present investors with opportunities for high returns. High inflation volatility observed in Turkey in recent years has led to increased volatility in equity markets. Such fluctuations can create strategic opportunities for investors and investments made at the optimal time may provide high returns potentially. Especially in emerging markets such as Borsa Istanbul, impacts of inflation volatility on stock returns may be more pronounced. The opportunities and risks created by inflation volatility in emerging markets affect investors' strategies and shape market dynamics. In this context, during periods of high inflation volatility, investors may take advantage of opportunities arising from these fluctuations to generate higher returns.

Rising inflation rates may cause savers to face serious difficulties in preserving the real value of their assets and can lead to an erode in real value of their assets. In Turkey, rising inflation reduces the purchasing power of individuals' savings and undermines economic confidence. In light of the aforementioned circumstances, this process may force investors to turn to alternative investment instruments to protect their assets and increase their value. Increasing interest rates because of contractionary monetary policies may lead investors who are unable to channel their savings into large and relatively illiquid investments such as real estate to more liquid investment instruments such as the stock market and foreign exchange. In Turkey, during this process, investors may turn to high-yielding corporate stocks that have the potential to protect and even increase the value of their savings. As these companies may manage their costs and increase their prices in an inflationary environment, they can increase their profits and pass these profits on to their investors. Increasing inflation and inflation uncertainty do not always have negative consequences. On the contrary, with the right investment decisions and strategies, it is possible to profit from this situation. In Turkey, sectors and companies that generally perform well during inflationary periods may be identified and investors can gain advantage by investing in these areas. In particular, energy, food and export-oriented sectors may be more resilient during inflationary periods and provide profitability to investors. During periods of high inflation in the Turkish economy, individual investors and portfolio managers can diversify their portfolios by developing strategies to cope with inflation. In Turkey, instruments such as foreign exchange, gold and equities can stand out as hedging instruments against inflation, and these instruments provide significant returns to investors when managed properly.

This paper aims to understand the long-term effects of inflation and its uncertainty on stock returns in Türkiye. The analysis covers the period between January 2006 – April 2024, during which Turkey adopted explicit inflation targeting. Inflation uncertainty is estimated using ARCH/GARCH models and the Johansen cointegration test is employed to determine long-term relationships among the variables. In addition, Fully-Modified Least Squares (FMOLS), Dynamic Least Squares (DOLS) and Canonical Cointegrated Regression (CCR) methods are used to analyse the long-term coefficients. The main research questions addressed in this study are as follows: How do inflation and inflation uncertainty affect stock returns in Turkey? Does inflation or its uncertainty (volatility) have a stronger impact on stock market performance in Turkey? Which of these factors are market participants more sensitive to? Turkey's experience with high and volatile inflation rates and structural reforms such as explicit inflation targeting make this study an ideal context to examine the long-term impact of macroeconomic uncertainty on financial markets.

### Literature Review

A comprehensive review of empirical literature reveals a lack of consensus on effect of inflation and its volatility on stock returns. Although there is a substantial amount of literature examining relations among inflation rates and stock market indices, different findings have been reported. In this context, while some studies (Akyol, 2020; Boamah, 2017; Coşkun & Özer, 2024; Horasan, 2008; Karamustafa & Karakaya, 2004; Sayilgan & Süslü, 2011; Zügül & Şahin, 2009) argue that inflation has positive effects on stock returns and that stocks are an effective hedge against inflation, while other studies (Elmahgop & Sayed, 2020; Geske & Roll, 1983; Kusumaningtyas et al., 2021; Liu & Serletis, 2021, etc.) suggest that stock returns do not provide a hedge against inflation, that is, inflation has either a negative or no impact on stock returns.

Among these studies, Liu & Serletis (2021) investigate the relations among inflation, uncertainty and stock returns in G7 and EM7 economies during the period October 1982 - July 2020. The study uses VARMA, GARCH and BEKK models. The study finds that impact of inflation and its uncertainty on stock returns differ among economies. In general, it is concluded that inflation has complex and time-varying effects on stock returns, but in most cases, it has a negative impact.

Geske & Roll (1983) investigated effect of fiscal and monetary policy on stock returns and inflation nexus in the

USA during the period 1947:Q1-1980:Q1. The findings reveal that monetary policy has a considerable effect on stock returns and inflation and that tightening monetary policy has a negative effect on stock markets in case of a rise in inflation.

Yener & Tekin (2018) analysed relations among stock markets and economic growth in BRICS, G7 countries, and Turkey, covering the period 1998: Q1-2016: Q4. Based on co-integration and causality tests, they explored both short- and long-term dynamics among stock indices and GDP. Their findings indicate a generally unidirectional relationship, where stock indices drive GDP, with the two series moving together in the long-term. This indicates that a rise in stock price contributes to economic growth. Additionally, the study highlights that while stock prices positively impact growth, inflation can weaken this effect.

Jareno and Navarro (2010) analysed whether firms listed on Spanish stock exchange during period 1993-2005 reflected inflationary shocks in their prices. Using empirical methods such as the Dividend Discount Model (DDM) and Stone's two-factor model, they found that this ability varies significantly across different sectors. Firms that are better at reflecting inflation in their prices tend to have stock returns that are less affected by changes in inflation and nominal interest rates. In short, when companies can pass inflation onto their prices, adverse impact of inflation on their share prices is reduced.

Sönmez & Noyan (2022) analysed the relations among stock returns, inflation, and economic growth in Turkey, utilising data sets over period 2008 - 2022, focusing on the BIST 30 and BIST 100 indices, the CPI and GDP. The study applied wavelet coherence analysis and found that stock returns are not affected by inflation, making them a reliable hedge against inflation. Additionally, the research identified a positive link between economic growth and stock returns, though this relationship, which was strong until 2015, weakened after that period. The findings reveal that stock returns are closely linked to economic growth but are not affected by inflation.

Eyüboğlu & Eyüboğlu (2018) examined inflation and stock returns relations for the period January 2006-November 2016, focusing on 15 sectoral indices of Borsa Istanbul. The bounds test revealed that stock returns in all sectors were related to the CPI in both short- and long-term. Specifically, CPI increases negatively affected the returns of 11 sectors. Using ARDL models and the bounds test, the study concluded that inflation significantly impacts stock returns, with this effect being present in

both short- and long-term.

Ayaydın & Dağlı (2012) employed panel data analysis to assess effect of inflation on stock returns in 22 emerging economies, including Turkey, based on data for the period 1994 to 2009. The study applied both fixed effects and random effects models. The findings show that in lower middle-income markets, higher inflation rates tend to exert a positive impact on stock returns. Overall, study highlights a generally positive relations among inflation and stock returns across sample markets.

Mukherjee & Naka (1995) examined the dynamic relations among various macroeconomic variables and Tokyo Stock Exchange All Share Index for the period January 1971 - December 1990. Based on cointegration tests and vector error-correction method, they reported positive relationships among stock market index and exchange rate, industrial production, and money supply. Conversely, stock market had a negative relationship with inflation and government bond interest rates, while showing a positive relationship with loan interest rates.

Karamustafa & Karakaya (2004) analysed effect of inflation on performance of the Istanbul Stock Exchange (ISE) for period January 1995 – June 2003. They used various indicators such as trading volume, market capitalisation, number of contracts, listed companies, and index value to assess market performance, based on the CPI as the measure of inflation. Based on Johansen-Juselius co-integration and error-correction model, they revealed evidence of a partially negative long term relations among inflation and stocks. In short term, inflation was positively linked to trading volume but had no significant effect on trading quantity.

Sayılgan & Süslü (2011) analysed impacts of inflation on stock returns in Turkey and other developing countries over the period 1999-2006. Findings indicate that inflation has a positive effect on stock returns.

Yıldırım & Alhajrabee (2020) analysed impact of inflation and interest rates on the BIST Financial Index in Turkey from January 2013 to March 2020. The study confirmed a one-way Granger causality from stock returns to inflation. This evidence indicates that while inflation does not significantly affect stock returns, stock returns may be used to estimate inflation.

Horasan (2008) analysed effect of inflation on stock returns in Turkey for period 1990-2007. Using time series analysis with data set from the ISE 100 index and producer



price index (PPI), study revealed a statistically significant positive correlation among inflation and stock returns, suggesting that rising inflation positively influences stock returns.

Yurttañıkılmaz (2012) investigated effect of inflation and exchange rate changes on stock performance in Turkey for period 1994:1-2010:12. In this study, time series analysis and causality tests are conducted using data from the CPI, exchange rate and ISE 100 index. The findings demonstrate that inflation has a significant and positive impact on ISE index in Turkey.

Boamah (2017) analysed relations among stock returns and inflation for G7 and BRICS economies. Covering the period 1991-2014, this study employs cointegration and vector error correction techniques to test Fisher effect, which suggests that nominal interest rates correlate with expected inflation. The study's findings reveal that there is a positive long-term relation among stock returns and inflation for both groups of countries.

Züğü̇l & Şahin (2009) examined effect of inflation and major macroeconomic variables on ISE 100 index in Turkey for period January 2004 – December 2008. As a result of the analyses using CPI, exchange rate, M1 money supply and deposit interest rate data, a positive correlation among inflation and the ISE 100 index was found.

### Model and Dataset

This study uses monthly Consumer Price Index (CPI) data and BIST 100 Index returns for the period January 2006 - April 2024 to examine link among inflation and stock returns in Turkey and the effects of inflation volatility on this relationship. The data are obtained from the CBRT' Electronic Data Distribution System (EVDS) at monthly frequency.

**Table 1: Data source and definitions used in the analysis**

Variables	Symbol	Unit of measurement	Data source
Consumer price index	CPI	Annual % change (2003=100)	CBRT (2024)
BIST 100 Index Return	BIST100RTR	According to closing prices (27-12-1996=9.76)	CBRT (2024)

In this study, inflation uncertainty is measured using ARCH/GARCH models, and the resulting inflation volatility variable is incorporated into the analysis of its effects on stock returns. These approaches allow for a more comprehensive examination of the dynamic impacts of

inflation on the stock market. The model employed to test the relations among inflation, inflation uncertainty, and stock returns is designed in equation (1).

$$BIST100RTR_t = \beta_0 + \beta_1 CPI_t + \beta_2 CPI\_VLT_t + \varepsilon_t \quad (1)$$

The variables in equation (1) and their explanations are as follows: CPI represents the Consumer Price Index based on the year 2003. BIST100RTR stands for Borsa Istanbul 100 Index Returns. CPI\_VLT is the inflation uncertainty (volatility) calculated by the authors using CPI data with ARCH/GARCH models. In addition, 'ε' denotes the error term. The descriptive statistics for variables used in the study are shown in Table 2.

**Table 2: The descriptive statistics**

	BIST100RTR	CPI	CPI_VLT
Sample Period	2006M01 - 2024M04	2006M01 - 2024M04	2006M01 - 2024M04
Number of Observations	220	220	220
Mean	7.201359	2.502345	0.167946
Median	7.063000	2.284500	0.025854
Maximum	9.860000	4.449000	1.495753
Minimum	5.728000	1.383000	0.008491
Std. Deviation	0.889843k	0.711485	0.334992
Skewness	1.154666	1.418393	2.439734
Kurtosis	4.192221	4.137229	7.666100
Jarque-Bera	61.91536***	85.62260***	417.8322***

As seen in Table 2, skewness, kurtosis and normality tests, which provide information about the distribution of the data related to the series, were considered. According to results of analyses, both the BIST 100 index return series, and the inflation variable show a skewness value greater than 0, indicating a right-skewed distribution. Kurtosis is a measure of the combined size of the two tails of the distribution, i.e., its sharpness or kurtosis. Kurtosis measures the amount of probability in the tails and hence the degree of steepness of a distribution. The kurtosis value of a normally distributed data set is generally considered to be equal to 3. When the calculated kurtosis value is greater than 3, it is understood that the data set shows pointed rather than normal distribution. When the kurtosis value is less than 3, it is stated that distribution is flatter than normal and has open tails (Choi & Lee, 2021). At this point, based on kurtosis analysis results of both the BIST 100 index return series and inflation variable, it is understood that this value is greater than 3 and the series shows a skewed distribution. Jarque-Bera probability values, another normal distribution indicator, have critical values less than 0.05 for both series. This leads to reject of the null hypothesis  $H_0$ , which states that series are normally distributed, and therefore series do not conform

to a normal distribution.

### Empirical Results

#### ARCH-GARCH analysis to estimate the uncertainty variable

In this study, which analyses effect of inflation and inflation uncertainty on stock returns, before starting forecasting process, time series properties of each variable should be examined and it should be decided whether series are stationary or not, and if stationary, at which level all of them are stationary. In this study, the stationarity levels of the series are tested using the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests and the results are presented in Table 3.

**Table 3:** *The results of the unit root test*

Variables	ADF Unit Root Tests			
	Level		1st Difference	
	Constant	Constant & Trend	Constant	Constant & Trend
CPI	-0.8437	-2.2245	-10.7456***	-10.7892***
BIST100RTR	2.3109	0.0428	-13.8565***	-14.2534***
CPI_VLT	-1.2445	-2.2076	-6.8566***	-6.9195***

  

Variables	PP Unit Root Tests			
	Level		1st Difference	
	Constant	Constant & Trend	Constant	Constant & Trend
CPI	-0.3977	-1.7419	-10.6067***	-10.5741***
BIST100RTR	2.2925	-0.0292	-13.8565***	-14.2574***
CPI_VLT	-0.8448	-1.8012	-13.5598***	-13.5978***

\*\*\*, \*\* and \* indicate statistically significant at 1%, 5% and 10% level, respectively.

In the literature, inflation uncertainty is measured using different methods. The main methods include the standard deviation of the inflation rate, the moving standard deviation, the moving average of the absolute change, and the variance of the expected inflation. In addition, ARIMA models and ARCH/GARCH models are frequently used for analysing inflation uncertainty. In this study, the Autoregressive Conditional Heteroskedasticity (ARCH) model introduced by Engle (1982) and the Generalized ARCH (GARCH) model developed by Bollerslev (1986) are adopted (Artan, 2006; Oltulular & Terzi, 2006). ARCH type models are widely recognized in the literature for estimating time-varying conditional variance and are particularly effective when ARCH effects are present in the error terms of economic time series (Yıldız et al., 2020). GARCH models, on the other hand, provide an advantage over ARCH models because they eliminate the autocorrelation problem by including lagged values in the model (Doğru, 2013). In addition, these models offer ease of application in the stationarization of series with non-constant variance without requiring additional operations such as exponential transformation (Gökçe, 1999; Erdal et al., 2008).

The results shown in Table 3 indicate that both variables contain unit root at level but become stationary when first difference is taken. From this point of view, firstly, the model to be used in the test of inflation

uncertainty is the ARIMA model, where the letter 'I' denotes the degree of integration. If the variable for which the uncertainty series is calculated is found to be I(1), it is necessary to take the first difference to make the series stationary (Uğurlu, 2014). Therefore, first differences of the series are taken and used in the analyses.

Following the stationarity analyses, ARCH-LM (ARCH Lagrange Multiple) test is carried out to detect the ARCH effect in the inflation series. Before testing the presence of ARCH effect in the series where uncertainty will be handled, ARIMA models should be constructed and tested for significance. Since it is determined that the inflation series is not stationary at the level and becomes stationary when the first-degree difference is taken, the value of 'i' in the ARIMA model is set as 1. In ARCH-LM test, autoregressive and moving average (ARMA) processes were employed to determine the mean equation of each series and the inflation series were analysed up to twelve (12) lags. The most appropriate model was determined based on Akaike information criterion (AIC) and Schwarz information criterion (SIC). The results obtained in these analyses demonstrate that the ARMA (0,1) model, which is selected in the testing of ARIMA models, represents the most appropriate model.

**Table 4: ARMA model estimation results**

	SIC	AIC
Number of estimated ARMA models	25	25
Number of non-converged estimates	0	0
Selected ARMA model	(0,1)	(3,3)
Information criteria value	-1.410151394	-1.489139418

In the ARCH-LM test, autoregressive and moving average processes (ARMA) were used to determine the average equation for each series. In this context, the inflation series were analysed up to the twelfth (12) lag and the best model was determined according to AIC and SIC. The results of the analyses show that the ARMA (0,1) model is most appropriate model in tests of ARIMA models.

**Table 5: Results for ARMA (0,1) Model**

	Coefficient	Std. Error	t-stat.	p-value
C	0.010048	0.010258	0.97961	0.0000
MA(1)	0.300697	0.048056	6.25716	0.0000
SIGMASQ	0.013270	0.000759	17.4728	0.0000

After this point, ARCH - LM test is employed to check existence of an ARCH (Autoregressive Conditional Heteroskedasticity) impact in average equations. This test is used to determine whether there is an ARCH effect in the average equations of inflation series. This test, which is important for analysing the dynamic structure of the inflation series and detecting the heteroskedasticity that may be present in the series, is performed to reveal the time-varying variance structure of the series and possible volatility. ARCH-LM test analyses whether variance of inflation series is constant and whether changes in the variance should be considered in empirical modelling.

**Table 6: ARCH — LM test results for ARMA (0,1)**

F-stat.	Prob. F (1,216)	Obs*R <sup>2</sup>	Prob. $\chi^2$ (1)
4.357474	0.0380	4.310856	0.0379

Table 6 presents the estimate results of ARCH LM test in detail. According to results of ARCH LM test conducted to determine the volatility, i.e. uncertainty, in inflation series, the  $H_0$  is rejected and it is revealed that there is an ARCH effect, that is, it is clearly stated that the inflation series contains volatility. These results point out that the inflation series varies over time and this variability is caused by unforeseen shocks or economic fluctuations. For this reason, it is emphasised that ARCH models should be used to better understand and model the dynamic structure of the inflation series.

The fourth step is concerned with selection of appropriate ARCH and GARCH models in presence of ARCH effect in mean equations. At this stage, various ARCH and GARCH models are analysed and the most appropriate model for the analysis of inflation uncertainties is determined. Considering the analyses and model comparisons, it was concluded that GARCH (1,1) model is the best model to reveal inflation uncertainties. This finding indicates that GARCH (1,1) model can best capture dynamic nature of inflation uncertainties and time-dependent variability of the variance. Therefore, it is recommended that the GARCH (1,1) model be used in forecasting inflation uncertainties and policy making.

**Table 7: GARCH (1,1) model results for inflation series**

	F-stat.	Std. Error	z- stat.	p – value
C	0.006917	0.006745	1.025420	0.3052
MA(1)	0.297777	0.047859	6.222031	0.0000
Variance Equation				
RESID(-1)^2	0.034326	0.005553	6.181729	0.0000
GARCH(-1)	0.965674	0.005553	173.9079	0.0000

The results of GARCH (1,1) model for inflation series are reported in Table 7. At this stage, the model's appropriateness and performance are assessed. Then, ARCH-LM test is employed to re-detect potential ARCH effect in the model. The results of the test are showed in Table 8 to determine whether model contains endogenous heteroskedasticity. This process is important to reinforce the validity and reliability of the model.

**Table 8: ARCH - LM test results for GARCH (1,1)**

F-stat.	Prob. F(1,216)	Obs*R <sup>2</sup>	Prob. $\chi^2$ (1)
0.595769	0.4410	0.599631	0.4387

Based on estimation results of ARCH LM test in Table 8, the  $H_0$  cannot be rejected. This indicates that there is no ARCH effect in series and volatility of series is eliminated. This finding suggests that the GARCH (1,1) model is most appropriate model to model current volatility.

Following the selection of GARCH (1,1) model, monthly conditional variance values of the inflation series were calculated. The obtained conditional variance series is used as the uncertainty variable in the model. To construct this uncertainty variable, the annual average of the monthly conditional variance values is calculated for the period January 2006 - April 2024.

### Cointegration analysis to estimate the model

At this stage of the research, whether there is a long-run relation among the variables is investigated within

framework of Johansen (1991, 1995) cointegration approach. To determine the appropriate lag length among the variables, the vector autoregressive (VAR) model is first estimated. As a result, the optimal lag length for Johansen co-integration test is determined as 2 based on FPE (Final prediction error), AIC and HQ (Hannan-Quinn information criterion). After deciding on appropriate lag length, Johansen co-integration analysis is carried out to detect

the existence and number of co-integration links. The results of co-integration test based on two tests such as Trace and Maximum Eigenvalue statistics are presented in Table 9.

**Table 9: Results of Johansen cointegration and diagnostic tests**

Johansen cointegration tests						System diagnostics	
H <sub>0</sub>	H <sub>1</sub>	λtrace	%5 c.v.	λmax	%5 c.v	Serial correlation	Heteroskedasticity
r = 0	r ≥ 1	26.5170*	24.2759	18.0530*	17.7973	2.935767	42.80885
r ≤ 1	r ≥ 2	8.46403	12.3209	5.98432	11.2248		
r ≤ 2	r ≥ 3	2.47971	4.12990	2.47971	4.12990		
						(0.9668)	(0.2021)

\* indicates that the  $H_0$  is statistically rejected at 5% significance level. "r" shows the number of cointegration relationships. The numbers in parentheses represent p-values.

The results of the cointegration analysis in Table 9 indicate that both the maximum eigenvalue and trace test statistics reject the  $H_0$  hypothesis that there is no cointegration among inflation, its uncertainty and the BIST100 index return at the 5% significance level, and therefore there is a cointegration relation among the variables by both tests. As seen in Table 10, the trace statistic is 26.5170, which is above the critical value of 24.2759. Therefore, the null hypothesis ( $r=0$ ) is rejected at 5% significance level. Likewise, for the max. eigenvalue test, the  $H_0$  of no cointegration ( $\lambda_{\text{max}} = 18.0530 > 17.7973$ ) is rejected at 5% significance level. These results provide evidence that the CPI, CPI\_VLT and BIST100RTR series have a cointegration relationship. In other words, it is observed that there is a long-run relations among inflation, its

uncertainty and BIST100 Index returns. To assess the overall model fit, a series of diagnostic tests including serial correlation and heteroskedasticity tests are applied. According to the results of these tests, the probability values are above 5%. This indicates that there are no autocorrelation and changing variance problems in the model. As indicated in Table 9, there is no indication of significant violations in the diagnostic tests.

Based on results revealing the co-integration relationship among the variables, long-run coefficient estimators, which include FMOLS, DOLS, and CCR methods are utilised. The results of the long-run coefficient estimators are presented in Table 10.

**Table 10: Estimation results of long-run cointegration coefficients**

Variables	DOLS		FMOLS		CCR	
	Coefficient	t- stat.	Coefficient	t- stat.	Coefficient	t- stat.
C	4.12670 * (0.0918)	11.1742	4.0531* (0.2688)	15.0740	4.0535* (0.2671)	11.5262
CPI	1.02596* (0.0918)	3.08285	1.0514* (0.0904)	11.6268	1.0522* (0.0912)	11.5262
CPI_VLT	42.1933* (13.6864)	15.1879	43.177* (13.6920)	3.15347	43.036* (13.5793)	3.1692

Standard errors in parentheses. Statistical significance levels are \*  $p < 0.01$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.1$ , respectively.

An analysis of coefficients in Table 10 indicates that variables are significant at 1% level. In long-run, a 1% increase in Inflation (CPI) increases BIST100 Index Returns (BIST100RTR) by 1.02596%. According to the FMOLS method, a 1% increase in the CPI in the long run increases BIST100RTR by 1.0514%. According to the CCR method, it is observed that a 1% increase in CPI increases BIST100RTR by 1.0522%. In all long-term cointegration parameters,

inflation uncertainty appears to affect stock returns more positively than inflation itself. These results prove that inflation and inflation uncertainty in Turkey positively affect Borsa Istanbul 100 Index Returns in the long-term.

## Conclusion

In this study, ARCH-GARCH models are applied to estimate volatility of inflation using data set covering the



period January 2006 - April 2024. To analyse existence of long-term cointegration relations among the variables, Johansen cointegration analyses were employed. Furthermore, to estimate long-term coefficients, DOLS, FMOLS and CCR models were used. It is expected that the implementation of these methods contributes to the understanding of comprehension link among inflation and stock returns.

This paper analyses effect of inflation rates and its uncertainty on BIST100 Index returns in the period after 2006 when Turkey adopted the explicit inflation targeting strategy. Using the DOLS, FMOLS and CCR methods, the findings consistently indicate that rises in inflation positively influence BIST100 Index returns in long-term. Additionally, the results reveal that inflation volatility also has a positive effect, with volatility having a more pronounced impact on stock returns than inflation itself. Therefore, this suggests that stocks are a safe haven in an inflationary environment. Investors tend to react swiftly to inflation expectations and economic uncertainties, often turning to stocks during periods of high inflation to protect their capital from losing value, which can cause sudden increases in the BIST100 Index. On the other hand, as inflationary pressures decrease and the economy recovers, it should not be ignored that increased investor confidence serves to boost interest in the stock market.

A different perspective on inflation and the increase in inflation uncertainty is that savers and investors may face difficulties in protecting the value of their assets. In such economic conditions, investors may generally allocate their assets to short-term investment instruments such as the stock market, which are more liquid, instead of long-term property investments. In this process, investors may aim to provide protection against inflation and inflation volatility by transferring their assets to portfolio management companies or mutual funds that they believe will manage their financial resources more effectively than themselves. The results of this paper are consistent with the research in the literature and reveal that there are long-term and positive relations among inflation and stock returns. Studies conducted by Adusei (2014), Ayaydın & Dağlı (2012), Boamah (2017), Sayilgan & Süslü (2011), Tekin & Yener (2018), Yurttañıkırmaz (2012) and Zügöl & Şahin (2009) support these results. In this context, the study's findings are expected to provide significant contributions to both academic literature and practical applications. From an academic perspective, it fills gap in the literature on impact of inflation and its uncertainty on stock markets in Türkiye and offers a robust foundation for future studies. In particular, those results emphasise the

stronger impact of inflation uncertainty on stock returns, raising new questions for further research on this relationship. In practical terms, the findings are valuable for financial market participants, portfolio managers, investors and policymakers. Portfolio managers can use these insights to develop strategies to effectively diversify and manage their stock portfolios during periods of inflation and uncertainty. Investors can consider stocks as a strategic investment tool in inflationary processes, while policymakers can use these findings to better understand market dynamics and develop more effective policies to reduce economic uncertainty. Future studies could expand on these findings by analysing different indices or conducting sector-based analyses to test the generalizability of the results and to examine the relationships between inflation uncertainty and other economic variables in more detail.

**Hakem Değerlendirmesi:** Dış bağımsız.

**Yazar Katkıları:** Fikir- ÖE, EA; Tasarım- ÖE, EA; Denetleme- ÖE, DÇY, EA; Kaynaklar- ÖE, EA; Veri Toplanması ve/veya İşlemesi- ÖE, EA; Analiz ve/ veya Yorum- ÖE, DÇY, EA; Literatür Taraması-EA; Yazıyı Yazan-EA; Eleştirel İnceleme-ÖE, DÇY

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## Geniřletilmiř zet

**Ama:** Gnmz ekonomilerinde sıklıkla karřılařılan yksek enflasyonun, beraberinde getirdiėi belirsizlik aracılıėıyla bireylerin ve firmaların yatırım, tktim ve tasarruf kararlarını olumsuz etkilediėi bilinmektedir. zellikle enflasyonun ngrlemeyen dalgalanmalar yaratması, ekonomik birimlerin planlama ve karar verme srelerinde ciddi maliyetlere ve risk artıřına yol amaktadır. Literatrde hlen hisse senetlerinin enflasyona karřı etkili bir korunma (hedge) aracı olup olmadıėı tartıřılmaktadır. Bu alıřma, Trkiye’de enflasyon ve enflasyon belirsizliėinin Borsa İstanbul’da iřlem gren hisse senetleri getirilerini (BIST 100 Endeksi zelinde) uzun dnemde nasıl etkilediėini analiz etmeyi amalamaktadır.

**Yntem:** alıřmada 2006:01 – 2024:04 dnemine ait aylık veriler kullanılmıřtır. Enflasyon deėiřkeni olarak TFE (Tktici Fiyat Endeksi), hisse senedi getirisi olarak da BIST 100 Endeksi getirisi dikkate alınmıřtır. Enflasyon belirsizliėini lmek amacıyla ARCH/GARCH modelleri uygulanmıř ve bylece enflasyon volatilitesi (CPI\_VLT) tahmin edilerek analizlere dahil edilmiřtir. Deėiřkenler arasındaki uzun dnemli iliřkiyi incelemek zere Johansen eřbtnleřme testi yapılmıř; uzun dnem katsayı tahminleri iin ise FMOLS, DOLS ve CCR yntemleri kullanılmıřtır. Bu sayede, enflasyon ve enflasyon belirsizliėi ile hisse senedi getirileri arasındaki dinamik etkileřim daha kapsamlı biimde deėerlendirilebilmiřtir.

**Bulgular:** Eřbtnleřme analizine gre, enflasyon (CPI), enflasyon belirsizliėi (CPI\_VLT) ve BIST 100 Endeksi getirileri (BIST100RTR) arasında uzun dnemli bir iliřki bulunmaktadır. Uzun Dnem Katsayı Tahminleri olan DOLS, FMOLS ve CCR yntemlerinden elde edilen sonular hem enflasyonun hem de enflasyon belirsizliėinin BIST 100 getirilerini pozitif ve istatistik olarak anlamlı bir řekilde etkilediėini gstermektedir. Bu bulgular, Trkiye’de enflasyonun uzun dnemde Borsa İstanbul 100 Endeksi getirilerini olumlu ynde etkilediėini kanıtlamaktadır. Ayrıca, enflasyon belirsizliėindeki (volatilite) artıřların da BIST100 Endeksi getirilerini pozitif etkilediėi tespit edilmiřtir. zellikle enflasyon belirsizliėinin artıřı, enflasyon artıřından daha fazla getiri saėladıėı grlmektedir. Bu durum, hisse senetlerinin enflasyonist ortamlarda gvenli bir liman olarak hizmet ettiėine iřaret etmektedir. Bu noktadan hareketle, yatırımcıların enflasyon beklentileri ve ekonomik belirsizliklere hızlı tepki vererek, tasarruflarının deėer kaybetmesini nlemek iin daha fazla risk alarak hisse senetlerine ynelebildiklerini gstermektedir. Bu da BIST100 Endeksi’nde ani ykseliřlere yol aabilir. Ancak, enflasyon oranlarının dřmesi ve ekonomik istikrarın saėlanması yatırımcı gvenini pekiřtirerek hisse senedi piyasasına olan ilgiyi canlı tutabileceėi de gz ardı edilmemelidir.

**Sonu:** alıřma, Trkiye’de 2006:01 – 2024:04 dneminde enflasyon ve enflasyon belirsizliėinin hisse senedi getirileri zerinde uzun dnemde pozitif bir iliřki yarattıėını ortaya koymuřtur. zellikle belirsizlik (volatilite) artıřının, yatırımcıların enflasyona karřı korunma arayıřını glendirdiėi ve borsaya ynelik talebi artırdıėı anlařılmaktadır. Bu durum, enflasyonist ortamlarda hisse senetlerinin grece daha cazip bir yatırım aracı olarak ne ıkabileceėini gstermektedir. Dolayısıyla, politika yapıcılar ve yatırımcılar aısından, enflasyon dinamiklerinin ve volatilitenin izlenmesi hem uzun vadeli stratejik kararlar hem de risk ynetimi aısından kritik nem tařımaktadır. Literatrde benzer ynde sonular sunan alıřmalar (rneėin, Adusei, 2014; Ayaydın & Daėlı, 2012; Boamah, 2017; Sayılın & Ssl, 2011; Tekin & Yener, 2018; Yurttaıkırmaz, 2012; Zėl & řahin, 2009) ile birlikte deėerlendirildiėinde, bu bulguların Trkiye rneėinde enflasyon-hisse senedi getirileri iliřkisinin pozitif ynde seyrettiėini teyit ettiėi sylenebilir.