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Enflasyonun Borsa Endeksleri Üzerindeki Etkileri: BİST 100
Endeksinden Kanıt

**The Impact of Inflation on Stock Market Indices: Evidence from
BIST 100 Index**

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Enflasyonun Borsa Endeksleri Üzerindeki Etkileri: BİST 100 Endeksinden kanıt

Öz

Doğası gereği borsalar birçok faktörden etkilenebilir. Faktörler birbirinden farklıdır ve her birinin kendine özgü etkileri vardır. Bu durum, her olayda farklı tepkilere yol açacağı şeklinde açıklanabilir. Genellikle doğal nedenler, siyasi konular veya ekonomik nedenler olarak kabul edilmektedir. Makroekonomik değişkenlerden biri olan enflasyon, birçok araştırmacının ve politika yapıcının incelediği ve borsalar üzerindeki etkilerini belirlediği faktörlerden biridir. Enflasyon, borsa endekslerini ve piyasadaki yatırımcıları doğrudan etkileyebilir. Birçok yatırımcı enflasyonun yaşandığı dönemlerde karar vermede rasyonelliklerini kaybedebilir. Çünkü piyasada belirsizliğe neden olmaktadır. Enflasyon diğer bir ifadeyle satın alma gücündeki azalma olarak tanımlanabilir. Satın alma gücü azaldıkça yatırımcı kararlarında olumsuzluklar görülebilmektedir. Bu bağlamda çalışmanın amacı enflasyon oranının BİST-100 endeksine etkilerini incelemek ve söz konusu iki değişken arasında herhangi bir ilişki olup olmadığını araştırmaktır. Bu amaç ile BİST-100 endeksi ve Tüketici Fiyat Endeksi (TÜFE) esas olarak baz alınmıştır. Çalışmada VAR modeli ve Granger Nedensellik testleri kullanılmıştır. Veri seti olarak 2009 yılının Ocak ayından 2020 yılının Mart ayına kadar aylık veriler kullanılmıştır. Yapılan analiz sonucunda elde edilen bulgulara göre Enflasyon oranı ile BİST-100 arasında tek yönlü nedensellik ilişkisi tespit edilmiştir. Etki-tepki fonksiyonlarının anlamsız olduğu gözlemlenmiştir. Her iki veride meydana gelen değişimlerin çoğunluğunu kendi dinamikleri oluşturmaktadır.

Anahtar Kelimeler: BİST-100, Enflasyon oranı, VAR modeli, Granger Nedensellik testi, TÜFE Endeksi

The Impact of Inflation on Stock Market Indices: Evidence from BIST 100 Index

Abstract

Due to its nature the stock markets can be affected by many factors. The factors are different from each other and every single one of them has its own effects. Moreover, they are different from one situation to another, but generally they are considered to be natural reasons, political issues or economical reasons. Inflation as one of the macroeconomic variables is one of the factors that many researchers and policymakers have studied and determined its impacts on stock markets. Because it can directly impact the stock market indices and the investors in the market. Many investors may lose their rationality in decision making when inflation happens. Furthermore, it causes uncertainty in the market. In that context, this paper aims to investigate the impacts of inflation rate on stock market indices in



Turkey. For that purpose, we throwed light on the BIST-100 index as a representative for stock indices traded in ISE and CPI index is representing inflation rate in the same country. The study is depending on monthly published data by central bank of Turkey from which starts from January 2009 and ends with March 2020. The VAR model and Granger Causality test is applied to analyze the collected data. According to the results, it is found that there is only a one-way causality relationship between inflation and BIST-100. On the other hand, the results of impulse responses provided no meaning for relationship between the variables. Furthermore, according to variance decomposition both of the variables were contained dynamics with themselves.

Keywords: BIST-100 Index, Inflation rate, VAR model, Granger Causality test, CPI Index

Introduction

Literature Review

One of the most popular variables among all the macroeconomic variables is inflation that has been the title for many researches so far. Numbers of studies have examined the relationship between the inflation and stock indices. Yilmaz Kandir (2008) applied multiply regression model to exam the relationship between stock prices and variables in macroeconomic. He used twelve portfolio returns with seven macroeconomic variables. Results show that all the stock indices can be affected by the variables; meanwhile, inflation had impact on only three of the portfolios (Yilmaz Kandir, 2008, 36-42). Giving another example for ISE, Kapusuzoglu and Karacaer (2010) tested the impact of these variables on BIST-100 index, the collected data was analyzed by Johansen Cointegration test and Granger Causality to check the intervariable relationships and also both of the PP and ADF unit root tests were applied. They found that changes in inflation are not linked to the changes in stock indices and the relationship cannot be explained by other variables (Karacaer & Kapusuzoglu, 2010, 501-507). Another study by Erdem, Arslan and Erdem (2005) investigated that a strong unidirectional relationship exists between BIST 100 and inflation rate from Jan 1991 to Jan 2004, the study was based on the Exponential Generalized Autoregressive Conditional Heteroscedasticity (Erdem, Arslan, & Erdem, 2005, 987-994).

After testing the influence of thirteen variables on eleven stock portfolios in ISE by Applying APT from Feb 2001 to Sep 2005 based monthly data, Rjoub, Günsel and Türsoy (2008) could prove that there is no relation between the macroeconomic variables and stock returns, The CPI index was taken as a base for inflation rate (Türsoy , Günsel , & Rjoub, 2008, 50-57). Bai (2014) researched the data between years 2000-2010 to prove the relationship between the inflation rate and the Chines stock market, the CPI index was a



base for inflation. The results of the study proved that there is a weak relation between the two variables, but even this small impact can make a huge change in China stock exchange due to CSE is one of the world's largest markets (Bai, 2014, 268). Due to the world financial crisis financial markets have been affected during the last decades. In 2009 Thaker, Rohilina, Hassama, and Amin studied the relation between macroeconomic variables and stock market index in Malaysia, they examined data for two different times between 1987-1995 and the second series was based on 1999-2007 times. The effects of inflation, money supply and exchange rate were determined to the Kuala Lumpur Composite Index (KLCI) in the study. The results suggested that the variables have significant impact on KLCI as well as these variables have to be emphasized by Malaysian government to stabilize prices in stock market (Thaker, Rohilina, Hassama, & Amin, 2009, 23-26).

Devia (2019) applied VAR model to check whether the inflation rate and exchange rate change the direct of stock indices or not, he used data from 2004 to 2017 and the inflation rate was based on the CPI. The results of the study proved that the changes in inflation rate can negatively impact the stock prices in Indonesia (Devia, 2019, 35). Geetha, Chandran, Chong and Mohidin (2011) examined the impact of expected and unexpected inflation on stock markets in three countries, they could investigate that the stock prices of all countries can be affected by the taken types of inflation for long-term but for short term the relation was exist only for Malaysia and US not for China (Geetha, Mohidin, Chandran, & Chong, 2011, 13-14). Based on monthly data from 2000 to 2017 both of Sathyanarayana and Gargesa (2018) throws light on the effect of inflation to stock returns by using ADF statistics to analyze the data and investigate the relation. The CPI index have taken as basis for inflation for many countries, the results were negative for countries like, Canada, China, Belgium, Chile, Austria, France, India, Ireland. However, a positive coefficient was reported for Turkey, Japanese, Brazil, Spanish, Indonesia and Mexico (Sathyanarayana & Gargesa, 2018, 50-52).

By obtaining data from bank of Ghana, Kwofie and Ansah (2018) used ARDAL cointegration technique and ARDAL's error correction was applied to determine the effect between GSE and inflation. The data was collected from Jan 2000 to Dec 2013. The result of the study was a kind of different because a long-term connection was reported between the inflation rate and Ghana stock market (GSE), but diversely, no relation was reported for short term time between the variables (Kwofie & Ansah, 2018, 2-8). Eita (2012) had studied the macroeconomic determinants of stock prices in South Africa Namibia; the study shows that increase in inflation leads to decrease the stock prices in Namibia. Furthermore, results suggested that increasing in economic activities have a positive impact on stock price meanwhile stocks are not a barrier against inflation (Eita, 2012, 871-874). A research which studied by Otieno, Ngugi and Muriu (2018) was the first study to exam the connection between stock prices and inflation rate month-to-month and



year-to-year. The integrity of data was determined by ARFIMA model to determine whether the collected data from 1993 to 2015 are integrated, cointegrated or not. They result of the study shows that there is no impact of month to month inflation and year on year inflation on stock returns in Kenya. And also, FICEM model the results showed that year on year inflation rate positively affects the stock prices in the country (Otieno, Ngugi, & Muri, 2018, 78-80).

Al-Shami and Ibrahim (2013) used VAR and arbitrage pricing theory to test the closeness between some macroeconomic variables and Kuwait Stock Market. The data was collected from Jan 2001 to Dec 2010 monthly based data. They proved the relation based on one-month time in a positive manner for inflation rate while the relation was not positive for two-month time (Al-Shami & Ibrahim, 2013, 57-66). Al-Khazali (2003) tested changes in inflation rate and stock prices over 21 capital markets. He could investigate that there is a negative relation between the inflation and macroeconomic variables, expect Malesia the negative relationship exists between all the taken countries. Moreover, GARCH model and the OLS models were used to determine both of the long-run and short-run relationships (Al-Khazali, 2003). Error correction model was used by Cochran and Defina (2006) to determine the effects of inflation rate on real stock prices. According to the results inflation has shown as a negative manner to the stock prices especially S&P 500 index in US stock market (Cochran & Defina , 2006, 263-274). Fama (1982) presented the outcomes of change in inflation, money-demand theory and money quantity theory was explained by Fama to understand the term of inflation and many researchers could use the study as evidence to their findings (Fama E. F., 1982, 201-231). The real activities in economic have direct relation with inflation in up or down, and of course this up and down in inflation can affect prices in the market. Fama (1981) believe that the changes in inflation rate can positively impact the stock prices and returns. He stated that, most of the decisions in investing is returning to the forecast in economy, and also inflation can be expected before happens, that is why the stock returns are being affected by inflation (Fama E. F., 1981, 545-565).

Chen (2009) used variables such as inflation rate, unemployment rate and money supply to determine the changes in them and their affect to the stock market indices like S&P 500. He could prove the fact that the changes in the variables whether in increase or decrease can change the direction of stock indices according to the conditions (Chen, 2009, 220). Belen and Gumrah (2016) analyzed both of the expected inflation and real inflation then examined their impact on the stock Istanbul Stock Index (BIST-100 Index) They could investigate the relation between the announcements of inflation and stock returns in BIST-100. By using CPI index as a measure for inflation they could find that there is no explanation in the relation between the types of inflation namely, expected, real and unexpected inflation over the ISE



national 100 index from Jan 2000 to Feb 2016 (Belen & Gümrah, 2016, 430-433). Schwert and Fama (1977) researched the impact of different types of inflation on stock returns, T bills and some other stocks in US stock market. They find that every kind of inflation can negatively impact the stock markets in their level of return. They also investigated that inflation was a hedge against the stock returns during 1953-1971 (William & Eugene, 1977, 115-146).

Kalyanaraman and Al Tuwajri (2014) studied the connection between five macroeconomic variables and stock prices by giving Saudi Arabia's stock market as evidence. They collected data from Jan 1994 to Jun 2013 and analyzed them via Johansen Cointegration test and Vector error correction model. According to Johansen cointegration test all the variables have long-run relationship with stock prices in Saudi Arabia and all the macroeconomic variables had impact on stock price in that nation during the study time. Meanwhile, short run causality was found only between oil price and stock prices. Furthermore, the changes S&P 500 index could not make changes in Saudi stock prices (Kalyanaraman & Al Tuwajri, 2014, 81-90). In India, stock prices are the topic of researches for many years, some researchers like Upadyaya, Nag and Mixon (2018) investigated that changes in macroeconomic such as interest rates, inflation rate, exchange rate etc. can directly change the stock prices by move up or move down (Upadhyaya, Nag, & Mixon, 2018, 35-44). The evidence for that can be Boudoukh and Richardsons' study in (1993) while they explained both of the positive and negative relation between stock prices and inflation rate (Boudoukh & Richardson, 1993, 1350). Macroeconomic variables are the main reason to changes in stock prices, in other words, the increase or decrease in inflations are related to the changes in stock prices even returns (Muradoglu, Taskin, & Bigan, 2000).

The CPI is the measurement for calculating inflation rate in Turkey; in (2018) Eyuboglus determined the relationship between the stock prices in Istanbul Stock Exchange 15 index and the changes in inflation rate between 2006 and 2016. The Bound test was used to determine the integrity of data, although the data is not stationary but the results show that there is both long-term and short-term relationship between inflation and stock indices in Turkey (Eyüboğlu & Eyüboğlu, 2018, 89-93). Sevinc (2014) studied the impacts of some macroeconomic variables on stock indices in Turkey, BIST-100 index and inflation rate were among the macroeconomic variables to determine the relationship. They could investigate that the variables in macroeconomic can directly impact the stock indices during 2003 and 2013 (Sevinç, 2014, 288-291). As a support to Sevin's results Koyuncu in (2018) found that there is a general relationship between variables of macroeconomic and stock prices. To prove that, he examined data from 1988 to 2016. The results of the study tell that the changes in inflation can directly change the stock index performance and their prices (Koyuncu, 2018, 618-622).



Data and Methodology

This paper aims to study the relationship between inflation and stock indices in Turkey and determines the impacts of inflation on the stock market in the mentioned country. The official Consumer Price Index CPI represents inflation rate and BIST-100 index represents stock indices in Istanbul Stock Exchange. At the same time, the data of BIST-100 national index and inflation rate has been taken from Jan 2009 to March 2020 in central bank of Turkey. The first phase of data analysis is describing the features data by using descriptive statistics and summarized the gathered data. The stationarity of series is checked by Augmented Dickey-Fuller test (ADF) unit root tests (Dickey & Fuller, 1979) and Granger Causality (GC) test (Granger, 1987) is applied to test if there is any relationship between the exemplified variables. The last section of the methodology part will be Vector Autoregressive (VAR) model to study the last section of series.

Findings and Results

As we mentioned in the above section, the study is depending on monthly collected data from January 2009 to March 2020. And the data for both of inflation and ISE 100 national index has collected from the central bank of Turkey. In this study Consumer Price Index (CPI) representing inflation rate during the time period of the research. The first step of our analyzing process is to look at the descriptive statistics data as shown in the table below:

Table 1. Descriptive Statistics

	Mean	Std.Dev	Skewnes	Kurtosis	Jarque_bera
BIST-100	0.009256	0.068629	-0.025632	2.687574	0.559662
CPI	0.007685	0.009378	1.495120	9.879783	314.1906*

*1% **5% ***10%

The descriptive statistics is ruling in analyzing the samples, trends and summaries of time series data in a meaningful way. As can be seen here in the table above the BIST-100 mean scores 0.009256 with a standard deviation at 0.068629. Furthermore, the skewness of BIST-100 is owned a negative skewness with -0.025632 with a low value of kurtosis at 2.687574. The last part of BIST-100 index is the integrity of data while the index is normally disintegrated. The table above provides mean for CPI index with 0.007685 and standard deviation with 0.009378. The skewness of CPI shows an opposite manner compare to BIST-100 index with a positive skewness 1.495120. Moreover, the CPI index owns a sharp kurtosis with 9.879783 and the jarque_bera of CPI is not normally distributed compared to 1%.



Table 2. ADF Unit Root Test

ADF Unit Root Test	Intercept	Trend& Intercept
BIST-100	<0.01	<0.01
CPI	<0.01	<0.01

According to the outcomes of ADF unit root test, the time series data is stationary in both of BIST-100 index and CPI index based on both of intercept and trend intercept tests at level. Hence, these results are useful and ready to run the VAR model easily.

The second manner that can be helpful to run the VAR model in an easiest way would be VAR residual heteroskedasticity tests by applying white heteroskedasticity no cross terms over the time series data. The table below shows the result of heteroskedasticity test with more than 10% based on lag length 4.

Table 3. Heteroskedasticity Test

Heteroskedasticity test result	
Prob.	0.1167

The table above evident that there is an exist restriction between time series data at lag length four as well as the probability of that is more than ten percent which means that we have the second step of VAR model. In other words, there is a heteroskedasticity in the computed model. This test is one of the common types of assumptions in time series data to check if heteroskedasticity exist in the data or not.

Another phase in our analyzation process is examining the data by applying autocorrelation LM test as shown in the table below:

Table 4. Autocorrelation LM Test

Prob.
0.9378
0.5813
0.3027
0.4780



The Impact of Inflation on Stock Market Indices: Evidence from BIST 100 Index

0.2104

0.3196

0.8517

0.3256

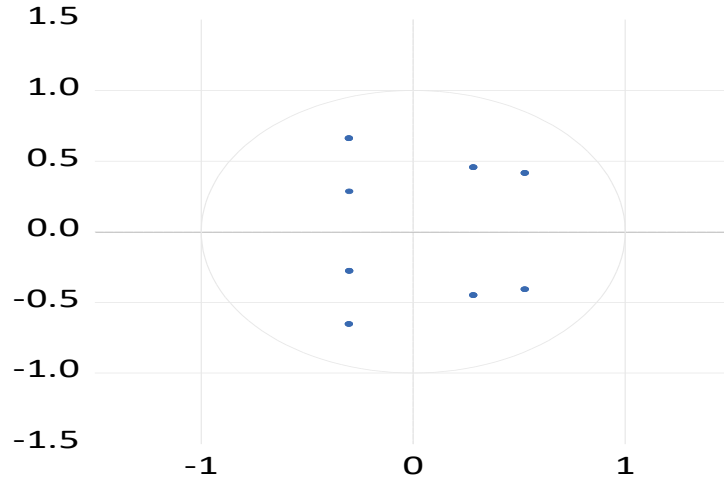
0.8028

0.4123

The table above provides an autocorrelation from all the values above and all of them are greater than 10%. Therefore, the time series data are constrained.

Another useful test to run VAR model is AR roots graph which has shown in the figure below. As can be seen all the roots are inside the circle and it means that the data is stationary. In other words, the results of AR characteristic polynomial prove that the data is stationary and it provides a better analysis in the study.

Inverse Roots of AR Characteristic Polynomial



Graph 1. AR roots graph

After providing the necessary conditions in time series data and determining the unit root test with their analyzation, we are examining the data by applying Granger Causality test over the time series data.

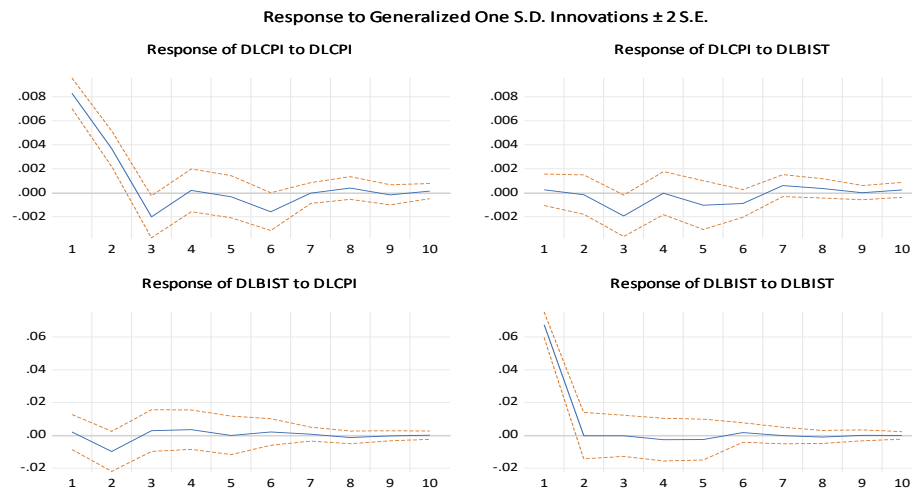


Table 5. Granger Causality Test

Granger Causality	
CPI $\neq$ BIST	0.4985
BIST $\Rightarrow$ CPI	0.0221

The table above demonstrated the fact that there is no causality from CPI index to BIST-100 index and diversely the causality from BIST-100 index is exists over the CPI index. In other words, the changes in BIST-100 as a dependent variable can impact CPI index but changes CPI as a dependent variable cannot influence the BIST-100 index. Hence, there is only a one-way causality relationship between the existing variables.

The impulse response is applied to check the relationship between the two variables. The impulse responses introduced by Sims (1980) to investigate the changes in stock markets in a shock happens. This shock is not only reflecting the market itself but affects all the provided endogenous variables belong to the situation. The figures below provide more information:



Graph 2. Impulse Response

The figures above provide four different responses between the variables and variables their selves. The first figure shows a positive impact with itself. It means that, any shock in CPI index can positively impact the same index for 3 months. Meanwhile, the second and third figure does not provide any meaning. In other words, no mean exists between the changes in BIST-100 index and CPI index. However, the last figure provides a positive impact of BIST-100 index on itself. Any shock in BIST-100 can positively influence the BIST-100 index itself for two months.



The Impact of Inflation on Stock Market Indices: Evidence from BIST 100 Index

The last phase of the data analyzation is checking the time series data by variance decomposition. This section helps us to determine how much of the variability in independent variable is lagged by its own variance and how much is lagged by dependent variable variances. As can be seen the two tables below the percentage of each variance is tabled with their number for each variable.

Table 6. Variance Decomposition

Bist100	
BIST-100 Dynamics	CPI Dynamics
100.0000	0.000000
97.93810	2.061898
97.76199	2.238010
97.50934	2.490660
97.51291	2.487094
97.43416	2.565838
97.42390	2.576095
97.39168	2.608322
97.38963	2.610367
97.38954	2.610461

The table above shows the BIST-100 index as an independent variable with its dependent variables and their numbers. The variability of BIST-100 index includes 97.7% of its own dynamics and only lagged by 2.3% of CPI index dynamics.

Table 7. Variance Decomposition

CPI	
BIST-100 Dynamics	CPI Dynamics
0.088858	99.91114
0.107344	99.89266
4.256525	95.74347
4.255816	95.74418
5.385048	94.61495



6.048769	93.95123
6.395279	93.60472
6.512290	93.48771
6.509924	93.49008
6.560369	93.43963

However, in the table above CPI index is ruling as an independent variable. Here, the variance of CPI includes 95.3% variance of its own dynamics. Meanwhile, it is lagged only 4.7% of BIST-100 index dynamics.

Conclusion

As a macroeconomic variable, inflation has a significant role in economics. High inflation rates can negatively impact the business activities all around the world. The huge economic countries such as US, China and other countries in Europe are working hard to balance their inflation rates with inflation all its types. Turkey is one of those countries that suffered high inflation during the last few decades. The history of Turkish economy has recorded many up and down in difference stages. Inflation as a real danger to business could cause many changes in the region. And many investors lose their rationality in making decision while inflation rises. Despite all the up and down that Turkish economy has seen, Istanbul Stock Exchange were growing up day by day as a central market of financial markets for many countries in the area. Some researchers proved that high inflation can impact business activities in financial markets partially stock prices and returns.

This study aims to determine the impacts of inflation on stock market indices by taking Turkey as evidence. For that purpose, BIST-100 index has taken as a representative for stock indices and CPI index representing inflation rate. The time series data has taken from central bank of Turkey based on monthly data which starts from January 2009 and ends with March 2020. The analyzing process of data is depending on VAR model that uses in analyzing econometric data. Therefore, the data described by descriptive statistics and then ADF unit root test was applied to determine the stationary of data. The data was quite suitable to be run by VAR model. And then Granger Causality test was applied to examine data. According to the results of GC test there was only a one-way causality from BIST-100 to CPI. Nevertheless, impulse response was applied to show the impacts of each variable to another. The results of two important figures show no meaning between CPI and BIST-100. Finally, variance decomposition was applied to determine the impacts of dependent variables on independent variables. The outcomes show that both of the variables are contain variance with their dynamics. These outcomes can be evidenced by some studies mentioned in literature review. For instance, the study of (Belen & Gümrah, 2016) investigated that there is no relationship between the two variables. As well as the same title was researched by (Karacaer & Kapusuzoglu, 2010), the



results of their study obtained no link between the two variables. In other words, the changes in BIST-100 index are not linked to the changes in CPI index. Meanwhile, some other studies provide difference results regarding the impacts of inflation on stock market returns. In 2009 the impact inflation rate on KLCI index was determined by (Thaker, Rohilina, Hassama, & Amin, 2009), they proved that the changes in inflation rate hardly affects the indices traded on Miliesian stock market. In addition to that (William & Eugene, 1977) proved that every type of inflation negatively impacts the stock indices. Different comments can be given to other studies mentioned in literature section. These various results may return to the time period of the studies or the methodology that the researchers employed to analyze the collected data during study times. The results of our study can be evidenced by many of these literatures.

History has inspected the impacts of high inflation on economics in different ways. As we mentioned in the literature part it causes the purchasing power of currency and the value of currency moving down when inflation happens, falling in real wages, reducing the value of savings and the most important one which discourages investments. Hence, many researchers tried to exam the relations between stock markets and inflation rate. They investigated various results regarding to the time and conditions of the research time. Therefore, the outcomes of the study can be useful for those investors who have lost their rationality in decision making due to the fluctuations in inflation rate in Turkey.

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