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Stock Market Overreaction: Turkish Stock Market

A Case Study of Overreaction for the Turkish Emerging Market under High Inflation Rates

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Abstract

In this research it is investigated if inflation could cause overreaction in the stock market and affect the behavior of investors. We use data from January 2020 till December 2021 on Turkey which has a history of high inflation rates in the last 50-years. We investigate the effect of two kinds of different shocks that took place: systematic and idiosyncratic. We use CAPM and event study on abnormal returns to evaluate the impact on overreaction. We found that there is not significant overreaction in the market under the high inflation rates.

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1 Introduction

In the last decades, many finance enthusiasts and academics have been debating on whether investors act rationally in general. In financial economics, acting rationally means that investors make their decisions to maximize profits based on clear thought, logic, reason, and based on all available information regarding the market (Fama, 1970).

However, being human means having different emotions and by their very nature, emotions make us feel – but they also make us act. Different studies have been conducted over time, aiming to find out if investor's decisions are influenced by different emotions, and if the market is affected by them. Being limited in answering this dilemma, there was a need for a new sub-area of financial economics. Behavioral finance is a subfield of behavioral economics which proposes that psychological influences and biases affect the financial behaviors of investors and financial practitioners. Moreover, influences and biases can be the source of explanation of all types of market anomalies. Specifically, market anomalies in the stock market, such as severe rises or falls in stock price (Hayes, 2021). In this paper, we will consider the impact of psychological influences under high inflation rates on the Turkish stock market during January 2020 till December 2021. This analysis explores market overreaction, investor behavior, and the effect on investment decisions in the chosen emerging market. Similar to our research, regarding high inflation rates and overreaction theory, there has previously been a study focused on the Turkish stock market during 1999-2003 by Vardar and Okan (2008), where they examined the short-term overreaction.

Overreaction is an extreme emotional response to new information. In finance and investing, it is an emotional response to security such as a stock or other investment, which is led either by greed or fear (Hayes, 2021). Investors overreacting to news influence the security to become either overbought or oversold until it returns to its intrinsic value (Hayes, 2021). The overreaction theory came to life as a result of different assumptions from De Bondt and Thaler in 1985. Their study was mainly based on the idea that investors mostly prefer to invest in stocks that have a history of poor performance, rather than stocks with great performance. Later on, De Bondt and Thaler (1987) found further evidence in order to fully support their main theory. However, there are other researchers who do not agree with this theory. Chan (1988), Ball and Kothari (1989), and Maheshwari and Dhankar (2014) provide different arguments and points of view that go against the stock market overreaction theory. Different from De Bondt and Thalers' point of view, Chan

(1988), Ball and Kothari (1989) believed that investors didn't always prefer the poor performance stocks since the risk level couldn't always remain constant during different time intervals.

1.1 Research problem

The issue of stock market overreaction, although not a new discussion topic, has evolved due to different external factors affecting it. These new factors make this study area lively and interesting to research. A better understanding of the stock market overreaction theory can be beneficial to private investors, however, also for investment companies in the formulation of their future investment strategies. Moreover, there are some other benefits such as, helping in observing the market's stability, predicting expected earnings through the historical overreaction performance, as well as measuring the mentality and experience of the current investors of the chosen stock market. As mentioned earlier, the stock market overreaction theory has evolved in different ways thanks to different factors affecting it, but what makes this topic interesting is to find out how investors tend to react to some news in a market consisting of high inflation. Having long episodes of inflation in Turkey, reaching a record of 36,08 % in our chosen years (Balci & Koc, 2022), we believe that investors' forecasts are prone to error which consequently leads to overreaction. We use event study which allows us to answer our main research question which is relevant for future investment decision-making and better financial resource management under a market with a high inflation rate:

(1) Has the high inflation rate caused an overreaction occurrence in the Turkish Stock Market during the 2020-2021 time period?

1.2 Purpose

There has been a considerable amount of studies regarding the concept of stock market overreaction theory and its relationship with different stock prices variations. However, to our knowledge, there have been only a few studies focused on this phenomenon in our chosen country, Turkey. What makes this country unique regarding our research question is that Turkey has been suffering from high inflation rates for more than 50 years and still do.

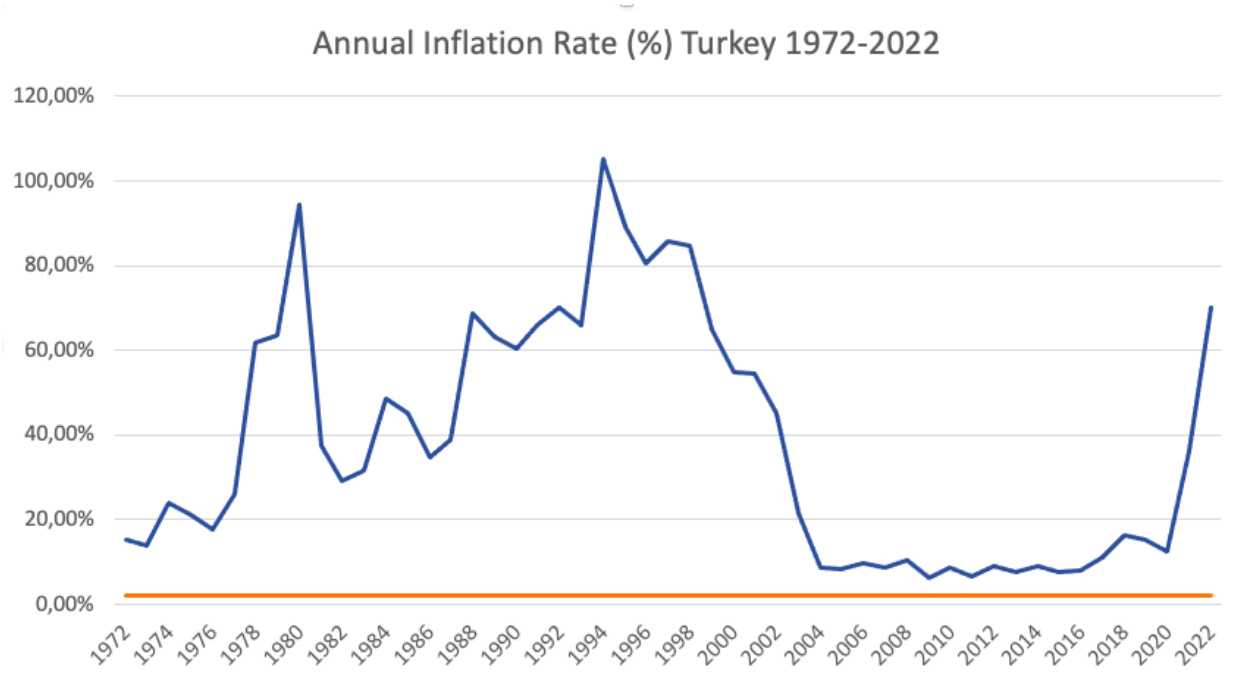

Figure 1: Annual Inflation Rate (%) Turkey 1972-2022

From Figure 1, we can observe the annual inflation rate for Turkey, during a 50-year time period from 1972 - 2022. The figure shows consistent fluctuations of high levels. Each year the inflation rate changes, where at one point the inflation reached 105,20%. In comparison, according to the Federal Reserve System, an acceptable inflation rate is 1,5-2% which is represented by the red line in Figure 1 (FRB, 2011).

In addition, most of the research papers within this field focus more on countries with larger stock markets instead, such as, USA which accounts for 56% of world stocks, Japan which consists of 7.4%, followed by China with 5,4%. The New York Stock Exchange (NYSE) and the NASDAQ are the largest stock exchange operators worldwide. Turkey ranks low on the list, consisting less than 1% of total world stock. However, due to natural high inflation setting in this paper, we will focus on the Turkish BIST-100 index. This stock market consists of 100 stocks selected among the stocks of companies that trade on the Stars Market (Statista Research Department, 2022).

Our purpose is to investigate if the continuous high levels of inflation have different effects on investors and their behavior and mentality, causing overreaction in the market of a developing country like Turkey. We examine this research question during the occurrence of two different

types of shocks for the chosen years. Firstly, overreaction was tested in the case of a systemic shock, meaning a kind of shock or event affecting the whole country in a general way. This systemic shock was caused by a decision made by Erdogan, the Turkish president, to fire the Central Bank Chef on 22nd of March 2021 (Turac, 2021). This news made the whole market fall rapidly causing sudden changes in investors behaviors. Secondly, overreaction was tested in the case of idiosyncratic shocks for the chosen companies in the BIST-100 index. An idiosyncratic shock is an individual shock or event for each firm that is not affected by a macroeconomic or microeconomic event. We expand and contribute to the previous studied literature that is examined in section 3.2, previous empirical studies by examining the overreaction effects using two different kinds of shocks, systemic and idiosyncratic. The delimitation in our paper is that we use a sample of 100 biggest companies, thus introducing some bias; we use CAPM, capital asset pricing model, to expand the required returns on stocks; and we choose the time period that overlaps with the corona pandemic in order to have another external factor that affect the market and stock prices during the time period that is investigated. Future research can include more companies, use other models such as Fama French 3-factor model, to predict stock returns and explore longer periods. The difference between our used model and this model, is that Fama French 3-Factor model, expand on the CAPM (Capital Asset Pricing Model) by adding value risk factors and size risk to the market risk factor in CAPM. This model is supposed to be more efficient just by adding these extra two factors and it is simply the result of an econometric regression of historical stock prices (Hayes, 2021).

This study is organized as follows: Section 2 gives background information on stock price overreaction theory, investment behaviour, and the Turkish Stock Market. Section 3 consists of theoretical framework containing theories and methods that can be helpful in this study. Also, the literature review is mentioned. Section 4 contains our research's hypothesis. In section 5, we describe the method and the empirical model of choice. Section 6 consists of our results from the chosen statistical software and the result from the regression model. Lastly, section 7 involves the paper's conclusion.

2 Background

Throughout the years Turkey has had high growth rates up until 2017, the growth increased the status of the country and Turkey reached upper-middle income status. However, with a stable growth rate and increasing economic status the country hit a difficult stage when the productivity growth decreased which made Turkey seek support by taking credit booms to support growth that resulted in private sector debt. The World Bank describes the result of this situation with high inflation rates and high unemployment rates. Furthermore, Turkey experienced an exchange rate crisis in the year 2018 which contributed to a decrease in growth performance throughout 2019. With a start of recovery for the economy in early 2020, the whole world was hit by COVID-19, which affected the economy of Turkey, and served as an extra influence to the market, Turkey was one of few countries that had a positive growth performance in 2020. The hit influenced the country into taking severe preventive measures. However, the government and the president did not put the economy in a stand-still position. President Erdogan wanted the economy to be intact since they tried to limit the cost and debt of the COVID-19 crisis. Another factor for the economy to keep going, was that they tried to recover from the economic crisis in 2018, external debts and the devaluation of the currency (Turac, 2021). According to the World Bank, Turkey also suffered a record high inflation, a peak of 31,08% during 2021, while a normal inflation rate should be around 2% or a bit below according to the beliefs of policymakers. The World Bank states that the country's currency, lira, reached a peak of 18 to the US dollars on December 21, 2020, while a stable lira during 2015, was 2,7 lira to the dollar (World Bank, 2022).

In December 2020 the GDP in Turkey reached 720.10 billion USD, with a growth rate of 1.8%. Compared to the ideal growth rate of 2-3%, which indicates that Turkey could achieve stable economic development and had a hard time avoiding negative effects on the country, such as an increase in unemployment (World Bank, 2022).

When investigating the Turkish market and economy there are a lot of factors that are into play for the economy to grow with one specific part being investments. Throughout this paper the focus on investment is based on the BIST-100 (XU100) index. The BIST-100 index is a free-floating capitalization-weighted index which consists of the Borsa Istanbul Stars Market Segment

companies. It tracks the performance of 100 companies within the Istanbul market (World Bank, 2022).

3 Literature review

3.1 Theoretical Framework

3.1.1 Efficient Market Hypothesis

According to previous studies on overreaction market theory, there are a couple of implications and dilemmas regarding other popular and ultimate theories. Different from De Bondt and Thalers' point of view, Chan (1988) argued that the stocks with a series of negative abnormal returns will experience an increase in their equity betas and thus increased expected returns. The results of the study were consistent with the risk change explanation as large changes in betas from the rank period to the test period were observed. The loser's beta increases after a period of abnormal loss and the winner's beta decreases after a period of abnormal gain. Further, after accounting for the changes in betas of losers and winner portfolios from rank period to test period, the contrarian strategy earns only small, non-economical significant abnormal returns as stated in Maheshwari and Dhankar (2014) study. According to Chan (1988), the overreaction theory was no longer valid. Such debates about the overreaction theory being invalid and the Efficient Market Hypothesis having more weight instead, have been going on for decades.

But what does it mean for markets to be efficient? The Efficient Market Hypothesis states that prices in the stock market are the best indicators of all the information needed for investments. The Efficient Markets Hypothesis (EMH) argues that markets are efficient, leaving no room to make excess profits by investing since everything is already fairly and accurately priced (Downey, 2021). Sewell (2021) argues that this theory has been mentioned and discovered since the 16th century, but it wasn't popular until mentioned by Fama in 1965. He stated that the shares are almost all the time priced correctly, and that new information spreads quickly within all big players and investors. Fama (1970) argued that the market should be divided into three different levels of efficiency. Also, that the classification should be made according to the information obtained from the stock's share price. The first level of efficiency is the Weak Form, it suggests that today's stock price reflects all the information and data necessary from the past prices. There does not exist any kind of special financial analysis techniques that could help investors make better-investing decisions to generate profit. The second form of this theory is called the Semi-Strong Form of the Efficient Market Hypothesis. This form insists that since the stock's price is calculated using all

the public information, investors could not be correctly assisted by any kind of technical or financial analysis in their decision-making process to gain higher returns in the market. Some investors believe that the only way to boost their returns at a level more than average in the market is by knowing the private information that every company stores. Lastly, the final form of the Efficient Market Theory is the Strong Form. This form states that both kinds of information, public and all information not publicly known are reflected in current stock prices. There is no type of information that can give an investor an advantage in the market. Advocates for this degree of the theory suggest that investors cannot make returns on investments that exceed normal market returns, regardless of information retrieved or research conducted (Maverick, 2022).

Even though Fama (1970 and 1991) has convinced most academics and investors about the efficiency of this theory, there are plenty of other studies and research papers that do not agree and found evidence on Efficient Market Hypothesis inconsistency. For example, Ariel (1987) mentioned another theory called the January effect. Banz (1981) and Reinganum (1983) proved that the size of companies and actual stock have an impact on stock returns. Also, lastly, French (1980), Gibbons and Hess (1981), Keim and Stambaugh (1984), and Rogalski (1984) showed evidence that weekdays and weekends have a different kind of return when it comes to the stock market. All these studies mentioned, informs us that there exist anomalies that the Efficient Market Theory cannot explain and that may even flatly contradict the theory (Maverick, 2022).

3.1.2 Overreaction Theory

While mentioning some of these anomalies, the overreaction theory of the stock market cannot be left behind. If the overreaction theory is valid, what causes it? During our research, it was found out that the answer to this question might rely on two main factors; the psychology of investors during the decision-making process and the way that the new information is obtained. As mentioned earlier, investors tend to overreact, as a cause from greed or fear to new information, aiming to make more profits, or to avoid losses. The overreaction theory, mentioned in the background, was studied by De Bondt and Thaler (1985) where they investigate how market behavior and investors decisions affect the stock price. Furthermore, if the behavioral segment in economics can explain if overreaction has occurred. When studying overreaction, it is important to know the significance of behavioral economics. Richard Thaler, together with De Bondt are the first economists who applied their findings from behavioral economics to formulate the

overreaction theory. De Bondt and Thaler (1985) formulated their hypothesis, by stating that a movement in the share price would cause a corrective movement on the opposite side. This implies that all the stocks which performed poorly in the past are expected to have a better performance in the upcoming period and vice versa. This hypothesis is followed up by another one, by the two economists which argued that a bigger movement in the share price would result in a bigger corrective movement on the opposite side. Already mentioned in the background, De Bondt and Thaler conducted research on the New York Exchange (NYSE). They found proof that investors overreact to new information and ignore present information and previous historical events. This indicates that they show non-logical and irritating behavior in the stock market and in their decisions. Furthermore, the overreaction theory states that if there is an overvaluation or an undervaluation to a stock price then it should in the next coming days reverse itself back to the intrinsic value.

3.1.3 CAPM Capital Asset Pricing Model

In order to model the expected returns of the asset (stock) we use the Capital Asset Pricing Model (CAPM), developed by William Sharpe, Jack Treynor, John Linter and Jan Mossin in the early 1960s. During the time period it was developed, the study of uncertainty in correlation with theoretical frameworks of decision making was a new research topic. The first study of the CAPM was carefully examined when investigating stocks and their returns. André F. Perold mentioned that Fisher and Lorie were surprised that the research and measurement of rates of returns of stocks had not been researched and examined earlier. Their study is based on calculating the returns on the New York Stock Exchange, their returns are reported as average stock market returns during 1962. Their conclusion, in their investigation, is that the rate of returns on common stock were higher than safer alternatives (Perold, 2004).

Capital Asset Pricing Model (CAPM), that define the relation between risk and return was first developed independently by Sharpe (1964) and Lintner (1965). The total risk of a security is the sum of diversifiable/idiosyncratic risk (Variation in a stock's return due to firm-specific news) and systematic/undiversifiable risk (due to market-wide news that affects all stock). In the CAPM model, the market portfolio is used as the benchmark for systematic risk. In our case market portfolio is approximated by the Turkish market index.

CAPM postulates that return on security equals the risk-free rate plus the beta times the market risk premium at period *t* is:

$$R_{i,t} = Rf_t + \beta_i(Rm_t - Rf_t)$$

where $R_{i,t}$ is the return on security *i*, Rf_t is the return on risk-free asset, Rm_t is the market return, β of a security is the responsiveness (sensitivity) of the security return to the the market index return, market risk premium $E[Rm]-Rf$ is the expected excess return of the market portfolio, which mirrors general risk appetite of the investors and represents the market price of risk.

The risk-free rate represents the interest that an investor is expected to have from an absolute risk-free investment in a stock.

3.2. Previously Empirical Studies

This paper is following previous studies of overreaction in the stock market, with a focus on the Turkish Stock Market and their BIST-100 index. Overreaction has been researched in many stock markets and indexes throughout the world, with the purpose of analyzing investments decisions and stock market predictions. Main focus of this paper is to examine the shock on stock price using event study. Mentioned previously in this paper, overreaction is a subject that has been studied in previous empirical studies. De Bondt and Thaler (1985) main objective with their research is to see if overreaction is predictive in their market analysis, also if it gives more information than an ordinary P/E ratio. They theoretically explain and empirically confirm the stock market price overreaction effect in their case study during the years of 1926-1982.

Using large data, they divide the period of time into different periods: 12, 24, 36 or 60 months. Furthermore, they divide the portfolio into two different sectors, one including the winners of the portfolio and one containing the losers. In their study they examine every period thoroughly to check if previous loser portfolios had become winners in the upcoming period and vice versa. They classified these portfolios by comparing every stock within an index and then choose the stocks with the most deviations from this index. The research that De Bondt and Thaler carry out results in a discovery that the chosen portfolio with winning shares prices shows a negative deviation from 1926 through 1982. Moreover, the portfolio with losing shares prices shows a positive deviation return instead. The exact percentage changes for these deviations were a positive 24.6%

return on loser portfolios, and a negative average return of 5% on previous winner portfolios. The evaluation period consisted of 36 months during the chosen period. Both the economists drew the conclusion that the investors overreact to new information and ignore the present information. Consequently, they show non-logical and irrational behavior in the stock market. The stock's share prices diverged as a consequence of pessimism in the case of investors obtaining bad news and optimism in case of good news. De Bondt and Thaler stated that this was the ultimate proof of rejecting the hypothesis regarding Efficient Markets.

Moving forward, overreaction in the Turkish exchange market has been studied before, throughout the years of 1999-2003. During this 4-year period Vardar and Okan (2008) gathered the daily closing price of 190 stocks. Vardar and Okan focus are to investigate the short-term overreaction effect in the market. They calculate the theory through raw return of all stock each day to later on calculate the abnormal profit. Their findings conclude that the stocks pre and post crisis period of the Turkish market were more volatile for the years 1999-2003. Furthermore, overreaction is more noticeable in the pre-years of a crisis compared to the post years. They emphasize that the losers of the stock market do not overreact in the same way as the winners before and after a crisis. Vardar and Okan state that even if there is overreaction in the stock market, investors can avoid risks of overreaction if they become more conservative toward news (Vardar, G., & Okan, B. 2008).

Another study on the overreaction hypothesis in the stock market is performed by Farag (2015). He examined the Egyptian stock market with price limitations during the years of 1996-2010, collecting the daily closing stock price for the EGX30 index. Using event study, he confirms the effect of investor overreaction in conditions with price limitation. He also discusses that in markets where overreaction is evident, investors can earn an abnormal return by exploiting the overreaction anomaly. For emerging markets, the studying of market imperfections can be used as an early warning system to the regulator in these markets which they can benefit from (Farag, 2015).

Ma, Tang and Hasan investigated the overreaction effect on the Nasdaq Stocks from 1996 until December 1997. Even though this study was carried out more than 20 years ago, we use event study and CAPM in the exploration of overreaction as in their study. Through listing winners and losers of the portfolio they select the highest percent change in both directions for the New York Stock Exchange and Nasdaq National Market System. The sample they generated contained 1012 observations based on daily stock trading days, where they observed the return and calculated the

abnormal return (AR) for the winners and losers of the portfolio. After an abnormal return is calculated, the authors using regression explore the relationship between level of post-event price reversal and the abnormal return.

4 Hypothesizes

4.1 *Hypothesis 1*

Based on the literature review in section 3, we propose our hypothesis which test's results are presented in the results parts, in section 6. The stock market overreaction theory states that in case of new information or news, investors tend to overbuy or oversell stocks, due to different psychological factors, such as greed or fear. Another statement of this theory is that, in case of stock market overreaction, the prices will usually reverse themselves, despite the changes in itself. Based on this theory, in the event that there is a new announcement, investors' behavior will directly cause instability of the market and over affect the stock prices. Furthermore, our hypothesis includes the presence of high inflation rates and its effects on the investor behaviors towards the market.

Hence, either way, bad news or good news, pessimism or optimism, the stock prices are expected to diverge. Additionally, in such a case, we expect to see at the following period after (t+1), (t+2) days, that the stock price will return to its intrinsic value or close enough to it. Therefore, based on this theory, our hypothesis is as follows:

H_0: There is no relationship between overreaction occurrence and high inflation rates in case of a systemic shock

H_1: There is a relationship between overreaction occurrence and high inflation rates in case of a systemic shock

4.2 *Hypothesis 2*

Our second hypothesis is based on the same foundation as the first one, with the only difference in the type of shock experience. In this case we observe the market during an idiosyncratic shock, which means that event dates differ for each company included. The idiosyncratic shock is based on the largest increase or decrease for each firm in the chosen portfolio being part of a high inflation market. Similar to the first situation, where an exogenous shock is considered instead, we expect overreaction as a result of investor's behavior affected by high inflation rates. For that reason, our second hypothesis is as follows:

H_0: There is no relationship between overreaction occurrence and high inflation rates in case of an idiosyncratic shock

H_1: There is a relationship between overreaction occurrence and high inflation rates in case of an idiosyncratic shock

5 Methodology and Data

The data throughout this paper is obtained from Borsa Istanbul, Turkey's main stock exchange during March 2022. This research examines if there is any occurrence of overreaction on BIST-100 (XU100). The Borsa İstanbul-100 index consists of 100 different Turkish companies. For the empirical analysis, daily closing prices of all 100 companies' stocks, traded in the best performing index in the Turkish stock market, are examined thoroughly for the chosen 2-year period, ranging from 1st January 2020 until 31st December 2021. The aim of this analysis is to observe the existence of the overreaction theory in the market and find out if continues high levels of inflation have different effects on investor behavior and mentality, causing overreaction in the market of a developing country like Turkey.

We use event study as an empirical analysis tool that examines the impact of an event on the value of a security, such as company stock. Event studies can reveal important information about how a security is likely to react to a given event; this is a key point when it comes to studying the way people react to news or events. This method employs linear regression, using time as the dependent variable and then is looking for variables that explain the duration of an event, or the time until an event occurs (Hayes, 2022).

Firstly, in order to investigate the overreaction theory in the market, the first step was to calculate the return of stocks on each day *t* ($r_{i,t}$) as the difference between todays and previous day's closing price (P) as follows:

$$\boldsymbol{r_{i,t}} = \frac{\boldsymbol{P_{i,t}} - (\boldsymbol{P_{i,t-1}})}{(\boldsymbol{P_{i,t-1}})}$$

After the daily percentage return of each stock is calculated, we proceed to find the annual percent return for every company that is part of the index. Hence, 15 winners and 15 losers of the index are identified, being judged on the 15 best-performing companies (for the winner portfolio) and the 15 worst performing companies (for the loser portfolio) during the chosen period of time. The companies that have missing price data, are excluded from the process of finding the winners and losers of the index as can be seen in table 1.

Portfolio of Winner and Losers BIST-100 Index

Winners	Winner percent change in stock closing price from 1st Jan 2020 – 31st Dec 2021	Losers	Loser percent change in stock closing price from 1st Jan 2020 – 31st Dec 2021
RTA	854,31%	*Global Yatirim*	- 45,90%
SASA Polyester	803,42%	*Adese Gayrimenkul*	- 40,48%
Gubretas	738,97%	*Vakif Bankasi*	- 33,69%
Hektas	555,07%	*Turkiye Halk Bk*	- 26,43%
Borusan Yatirim	522,62%	*Ulker Biskuvi*	- 24,61%
Sarkuysan	516,82%	*Is Finansal Kiralama*	- 23,08%
Aksa Enerji Uretim	409,69%	*Akbank TAS*	- 11,98%
Doğuş Otomotiv	358,16%	*IDC*	- 11,74%
Is Yatirim Menkul Degerler	345,60%	*Sekerbank*	- 10,62%
Aksa Akrilik	338,36%	*Pegasus*	- 1,22%
ERBOSAN	331,10%	*Garanti Bank*	0,00%
Turk Traktor	300,00%	*Tekfen Holding*	3,16%
Kartonsan	253,59%	*Zorlu Enerji*	9,93%
Ford Otosan	240,39%	*Turkiye Is Bankasi C*	10,28%
Kardemir D	236,50%	*TAV Havalimanlar*	11,76%

Table 1: Portfolio of Winner and Losers Bist-100 Index

Event study is performed using two stages: estimation of CAPM and regression of subsequent cumulative abnormal returns.

CAPM is estimated using linear regression using security risk premium $R_{i,t} - Rf_t$ on LHS and market risk premium $E[Rm] - Rf$ on RHS:

$$R_{i,t} - Rf_t = \alpha_i + \beta_i(Rm_t - Rf_t) + e_{i,t}$$

where $R_{i,t} - Rf_t$ is the security risk premium, α_i is the constant or intercept term of the regression for security i, $e_{i,t}$ is error (or residual) term. In the efficient market one would expect $\alpha_i = 0$. As the proxy for the risk-free rate was used, the annual average of the high and low price for the 10-year bond yield was taken. Furthermore, after calculating the average we divided it with 250 which is based on the actual active trading days to get the daily percentage risk-free rate

Then using estimated parameters from estimated CAPM$(\widehat{\alpha_\iota}, \widehat{\beta_\iota})$ and observed excess returns for security and market, we can get predicted security return $\widehat{R_{\iota,t}}$ at time t:

$$\widehat{R_{\iota,t}} = Rf_t + \widehat{\alpha_\iota} + \widehat{\beta_\iota}(Rm_t - Rf_t)$$

We can get abnormal return for security *i* at time *t* as the difference between realized and predicted return, using:

$$AR_{i,t} = R_{i,t} - \widehat{R_{\iota,t}}$$

Cumulative abnormal return before the shock $CARB_i$ is the sum of abnormal returns for periods *t* and $t - 1$:

$$CARB_i = \sum_{t-1}^{t} AR_{i,t}$$

Cumulative abnormal return after the shock $CARA_i$ is the sum of abnormal returns for periods *t* and $t + 2$:

$$CARA_i = \sum_{t+1}^{t+2} AR_{i,t}$$

We use linear regression to estimate response of the after-shock abnormal cumulative return $CARA_i$ to before-shock abnormal cumulative return $CARB_i$ for security *i*:

$$CARA_i = a_0 + a_1 CARB_i + u_i$$

where a_0 is the average level of return when there is no correction in returns, a_1 is the reaction coefficient, that captures the responsiveness of the post-shock return to before-shock return and u_i is residual. If there is overreaction, reaction coefficient would be negative, since it would correct for previous reaction.

While observing the data, it is decided to go deeper with the research and investigate overreaction theory in the chosen index during 3 different important event situations. In the first situation, it is the same date for every company, 22nd of March 2021. This date came to attention after seeing a significant percentage drop for every company on the chosen winner and loser's portfolio. As mentioned earlier, on the 22nd of March 2021 President Erdogan fired the head of the central bank causing a shock for the whole market. Naci Agbal, had been in the duty for 4 months and aimed to tame inflation by implementing policies. However, the Turkish lira depreciated by 7% towards

the US dollar. Agbal policies raised the central bank's benchmark interest rates reaching a peak of 19% aiming to slow down the present economy and reduce inflation. Through the policies he succeeded in recovering the lira from the record lowest value (Ewing & Nelson, 2021). Even though, having achieved progression, the president didn't agree with his monetary policies despite a high inflation in the country. The news of the removal of Agbal, made investors believe that the president would go back to the old ways of managing the high inflation levels such as cutting interest rates. Due to these policies taken and showing no result in years, the investors have dumped the lira and lost faith in the system. Therefore, we believe that the reason that investors might overreact is not just the fact that a normal central bank chef is fired, but rather the idea and loss of hope in the country's economic situation.

For our second research, it was decided to choose the event date where each companies' stock price during the 2-year chosen time reaches the biggest difference from the previous day's closing price, regardless of if it is a peak or a minimum value change. For the last research, it was decided to choose the event date according to the winner and loser portfolios. For winners, every firm's highest value reached in the daily percentage return was chosen, and for the losers it was chosen every firm's lowest value reached in the daily percentage return as an event date. The difference between these 3 observations, is that the first observation is based on one only general event date, while the two other observations are based on different event dates for each different firm. However, all these 3 cases were investigated during the COVID-19 pandemic. Since the index consists of different firms, operating in different sectors of the market, they can be influenced at different dates.

6 Results

The overreaction effect in this paper is studied using the stocks from the Turkish BIST-100 stock market index from the 1st January of 2020 until the 31st December of 2021. The results presented in Table 2 are obtained by running linear regression on the cumulative abnormal return (CAR) during the shock period, for all 15 winners and 15 losers in each of the 3 cases**.**

Estimated results from first stage CAPM regression for each security are shown in the Appendix. As expected, estimated t-stats for alpha coefficients are lower than 2 in absolute values, while most of the t-statistics for beta are bigger than 2 in absolute value, indicating significance. Our results are in line with CAPM that in the efficient market alpha=0 and security return should price and dependent on beta coefficient only.

Before we run the regression, we plot the distribution of CARA (y-axis) and CARB (x-axis) to see if there is a relationship and pattern in the distribution of returns. We can in all three figures see a negative relationship between CARA and CARB, however, it seems more significant in Figure 2.

	Case 1		Case 2		Case 3	
Event Date	Same Event Date 22 March 2021		Different Event Date, Largest Increase or Decrease		Different Event Dates, Largest Increase or Decrease based on Winner or Loser Portfolios	
	Alpha α	Beta β	Alpha α	Beta β	Alpha α	Beta β
Coefficient	0,0277	-0,222	0,0177	-0,0167	0,0234	-0,0578
Standard Error	0,0151	0,2887	0,0147	0,1085	0,0164	0,1248
t-statistic	1,8308	-0,7681	1,2284	- 0,1538	1,4269	-0,4635
p-value	0,0778	0,4488	0,2295	0,8788	0,1646	0,6466

Table 2: Regression Results

Average Cumulative Abnormal Return (%)

	Case 1		Case 2		Case 3	
	Winner	Loser	Winner	Loser	Winner	Loser
Event Period						
(t-1, t)	-4,41%	-2,73%	5,28%	-4,29%	12,87%	-5,98%
(t+1, t+2)	6,38%	1,12%	-0,06%	3,62%	0,25%	4,37%

Table 3: Average cumulative Abnormal Return (%)

6.1 Case 1: Same Event Date

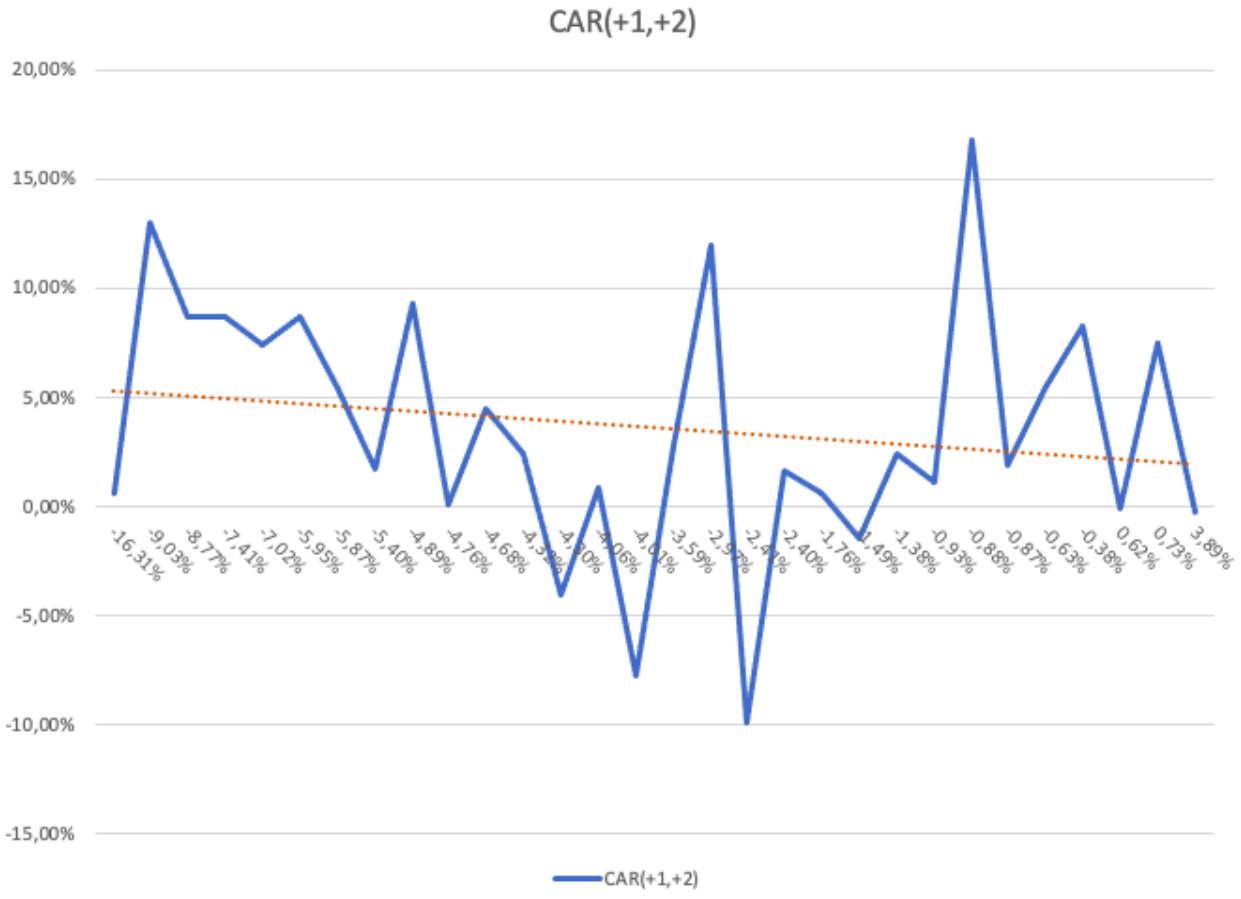

Figure 2: Distribution of CARA & CARB Case 1

Our first analysis of the overreaction effect is using the same event date, 22 March 2021, as the date where a systematic shock event occurred. As can be seen from the Figure 1, there is a negative relationship between before-shock and after-shock cumulative abnormal returns. Still, there are big deviations from the linear fit, which might indicate low significance of the negative relationship. The intuition is checked using linear regressions.

Firstly, in the case 1, CARB (cumulative abnormal return before shock) as seen in Table 3 is -4.41% and 6.38% for the CARA (cumulative abnormal return after shock) for winners. Moreover, looking at losers, the CARB is -2,73% and CARA is 1,12%. Furthermore, when analyzing the results in Table 2, we see that the p-value of the dependent variable (X) is larger than 0.05 (0.4488 > 0.05). This suggests that there is no significant overreaction in this case. However, there is still some indication of overreaction because the coefficient of beta is negative. As shown in Table 2, the intercept (alpha) is positive (0.0277), which implies that the portfolio of winners and losers, with an exogenous shock, performs better than what the CAPM predicts. Furthermore, Table 2 also shows the p-value of alpha (0.0778), which is significant for the 10% confidence interval. There is a 10% chance that we make an error in rejecting the null hypothesis when in fact, it is true. For case 1, we reject the null hypothesis that there is no relationship between overreaction occurrence and high inflation rates in case of a systematic shock.

6.2 Case 2: Different Event Date

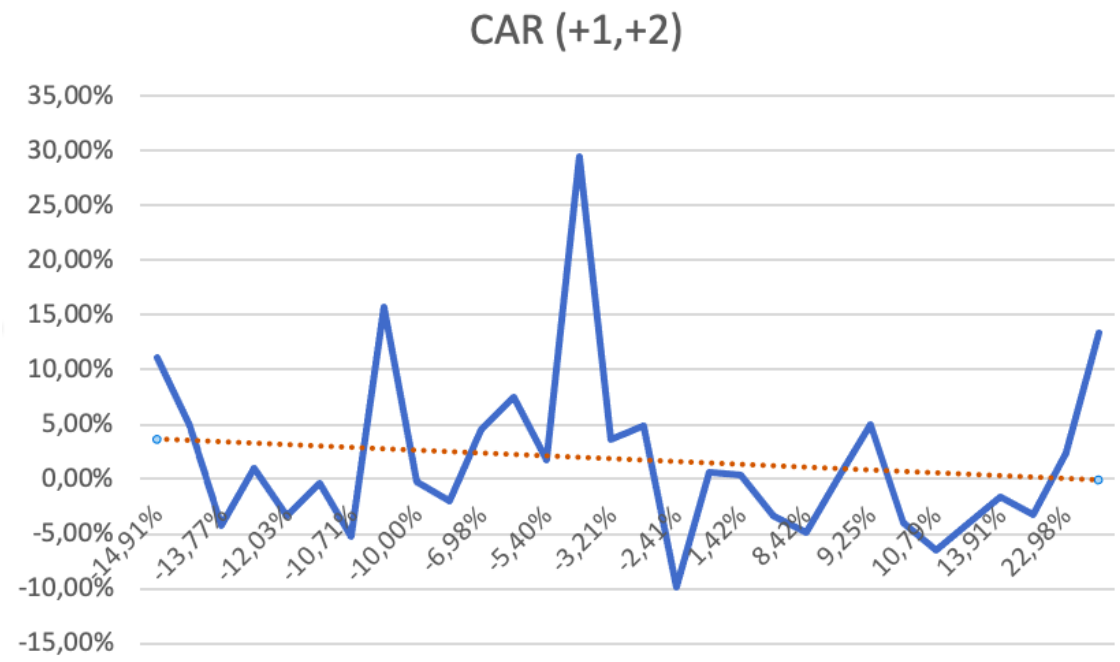

Figure 3: Distribution of CARA & CARB Case 2

In the second case, instead of analyzing the same event day for all firms we investigated different event dates. Same as in the first case, as can be seen from the Figure 3, there exists a negative connection between before-shock and after-shock cumulative abnormal returns. Still, there are big deviations from the linear fit, which could be signaling low significance of the negative relationship. The intuition is examined using linear regressions. These breakeven dates were the dates on which each of the firms had the highest positive or negative real return during the observation 2-year period, regardless of if they were winners or losers. The average cumulative abnormal return (CARB) for the winners on the event days turned out to be 5.28%, and the average cumulative abnormal return (CARA) for the two day-post events is -0.06%. Losers had CARB of -4.29% and the two-day post announcement CARA of 3.62%. Table 2 shows that when accounting for different shock dates, there is a change in alpha and beta. The dependent variable is still negative. Regression coefficient for alpha is 0,2295 and for beta -0,8788. Since alpha is still positive it indicates that the portfolios are performing better than what CAPM predicts. Since alpha is significant, it also tells us that there is a higher chance we wrongly reject the null hypothesis.

The coefficient for overreaction, (beta in this research) has a larger p-value than what the significant level for accepting the null hypothesis should be. It means that we in this case reject the null hypothesis stating, *there is no relationship between overreaction occurrence and high inflation rate in case of an idiosyncratic shock*. This rejection is based on the p-value being larger than our acceptance level.

6.3 Case 3: Different Event Date

The last case (3) explored if overreaction has occurred based on different event dates for all firms. However, similar to the second case we take the date where it showed the highest increase or decrease in return. Different from the second case, however, is that the max and min of our research was correlated with the portfolio the firm was located in. This implies that for winners, we only took the highest difference that was positive, while for losers the highest difference that was negative. Our findings for this specific case turned out to be for the winners of the portfolio, the average CARB is 12.87% and CARA 0.25%. For the losers, CARB is -5.98% and CARA is 4.37%. In our results the average CAR difference is significantly small which means that for the overreaction theory it's not significant. Furthermore, p-value for intercept according to Table 2 is 0.1646 and for dependent variable 0.6466. Since our p-value of dependent variable is larger than 0.05, we reject the null hypothesis that there *is no relationship between overreaction occurrence and high inflation rate in case of an idiosyncratic shock.* However, this does not mean that our alternative hypothesis is true. The dependent variable is negative, which means that there is some negative overreaction, however, it is not significant ($0.6466 > 0.05$).

The results from all three observations conducted in this study contradicts our expectations and do not show any significant overreaction based on high inflation during 2020-2021. This research, similar to previous study of Vardar and Okan (2008) deals with high inflation rates due to different crises and market imperfections. However, different from their study our research focuses on whole market overreaction based on different shocks rather than winner and loser portfolio overreaction. They found overreaction in winner portfolios and insignificant overreaction in loser portfolios during the event study of 1999-2003. The high inflation rate can be seen in Figure 1, where inflation reaches a peak of 75% during these three years. We believe that Turkey's long history of high inflation, can be a reason for not finding significant overreaction in the market, as our study indicates. This could develop due to investors' adaptability and risk aversion from

investors being used to the high inflation news in Turkey. Another difference between our studies is, during this 20-year time difference, investors have lower levels of optimism and instead base their investments decisions on logic, reason and market history. This makes us believe that the Market Efficiency Hypothesis by Fama stated in 1970, is valid in our research.

7 Conclusion

In this research paper we examine the overreaction theory in a market which has been influenced by high inflation rates for more than 50 years. We focused on a 2-year (2020-2021) case study where different factors, such as inflation rate and COVID-19 influence the Turkish Stock Market. For our research purposes, we investigate the BIST-100 (XU100) index in order to evaluate if overreaction has occurred. We use CAPM model to predict asset returns, which deviations we cumulate and regress in the event study. The aim of this study is to see if a country like Turkey, with high inflation rates and market difficulties, has an occurrence of overreaction that is influenced by the behavior of investors during the chosen time period. We test overaction to two kinds of shocks: systematic and idiosyncratic, which makes our study unique. However, based on our results, we cannot state that there is a relationship between overreaction and high inflation based on different shocks. Our evidence cannot support a significant overreaction in the market. However, we do have indications that there is some weak overreaction. Furthermore, we also show some evidence that the reversal effect is showing in our data. While looking at the average CAR for all cases during the announcement period we can see in the two-day post announcement, CARA, a reversal effect in cumulative abnormal returns. This suggests that the price of stock is returning to its intrinsic value after the shock occurrence.

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Appendix

Appendix 1

Case 1 Regression

Regressions Statistics Case 1	
Multipel-R	0,143651767
R square	0,02063583
Adjusted R square	-0,014341462
Standrad Error	0,058683306
Observationer	30

ANOVA

	Df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,002031725	0,002031725	0,58997793	0,448857521
Residual	28	0,09642445	0,00344373		
Totalt	29	0,098456175			

	Coefficients	*Standard Error*	*t-statistic*	*p-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,027724491	0,015143434	1,830792895	0,07779408	-0,003295427	0,05874441	-0,003295427	0,05874441
X-variabel 1	-0,221750137	0,288699489	-0,768100207	0,44885752	-0,813124232	0,36962396	-0,813124232	0,36962396

Appendix 2

Case 2 Regression

Regressions Statistics Case 2	
Multipel-R	0,029060429
R-square	0,000844509
Adjusted R-square	-0,034839616
Standard Error	0,079765655
Observationer	30

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,000150578	0,000150578	0,023666225	0,878840661
Residual	28	0,17815167	0,00636256		
Totalt	29	0,178302248			

	Coefficient	*Standard Error*	*t-statistic*	*p-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,017902248	0,01457296	1,228456524	0,229501505	-0,011949107	0,047753603	-0,0119491	0,047753603
X-variabel 1	-0,016716984	0,10866594	-0,153838308	0,878840661	-0,239309071	0,205875103	-0,2393091	0,205875103

Appendix 3

Case 3 Regression

Regression Statistics Case 3	
Multipel-R	0,087258288
R square	0,007614009
Adjusted R s	-0,027828348
Standard Err	0,086493034
Observatione	30

ANOVA

	Df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,001607138	0,001607138	0,214827948	0,646592213
Residual	28	0,209469256	0,007481045		
Totalt	29	0,211076394			

	Coefficient	*Standard Error*	*t-square*	*p-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,023372869	0,016379579	1,426951734	0,164650907	-0,010179178	0,056924916	-0,010179178	0,0569249
X-variabel 1	-0,057826067	0,124760833	-0,46349536	0,646592213	-0,313387047	0,197734913	-0,313387047	0,1977349

RSQ	**T-value, Alpha**	**T-Value, Beta**
0,01	2,44	-1,55
0,12	2,45	6,54
0,11	3,02	6,17
0,11	2,2	6,11
0,13	2,4	6,84
0,15	2,41	7,46
0,15	1,74	7,33
0,23	1,72	9,41
0,01	2,04	1,35
0,09	1,45	5,43
0,18	1,38	8,26
0,12	2,91	6,52
0,06	2,07	4,53
0,11	1,96	6
0,25	1,74	10,09
0,26	0,21	10,23
0,21	0,19	8,94
0,35	-1,37	12,69
0,28	-1,04	10,89
0,24	-0,35	9,74
0,28	-0,46	10,84
0,33	-1,53	12,2
0,01	0,11	1,63
0,28	-0,05	10,77
0,2	-0,19	8,63
0,31	-1,13	11,72
0,35	-1,15	12,68
0,27	0,46	10,7
0,31	-0,94	11,67
0,24	-0,84	9,86