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UNDERPRICING OF IPOS (INITIAL PUBLIC OFFERING) IN BORSA ISTANBUL: THE EFFECT OF COVID-19 PANDEMIC PERIOD

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Alper Ataker[1], Oktay Tas[2]
[1]Istanbul Technical University, Department of Management Engineering, Istanbul, Turkiye.
alper.ataker@gmail.com, ORCID: 0009-0001-3049-203X
[2]Istanbul Technical University, Department of Management Engineering, Istanbul, Turkiye.
tas.okta@itu.edu.tr, ORCID: 0000-0002-7570-549X

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ABSTRACT

Purpose- The research investigates the impact of the COVID-19 pandemic on Initial Public Offering (IPO) mispricing in the Turkish IPO market from 2010 to 2022. The study aims to offer valuable insights into the behavior of IPOs during this period, aiding investors and issuers in understanding the effects of the pandemic on IPO pricing. The findings may empower stakeholders, including investors, regulators, and market participants, to make more informed decisions in times of market volatility and uncertainty.

Methodology- The study utilizes two methods, ordinary least squares (OLS) and quantile regression (QR), to analyze the impact of independent variables on IPO mispricing. OLS focuses on average effects, overlooking nuances in mispricing distribution. In contrast, QR allows the exploration of variable effects at different mispricing levels, accommodating the asymmetric distribution of returns. Employing QR helps identify specific impacts of variables on IPOs within distinct mispricing levels, addressing distribution heterogeneity observed in the sample. This robust approach enhances the study's ability to capture a more comprehensive understanding of the relationship between independent variables and IPO mispricing.

Findings- The study reveals a substantial increase in IPO mispricing during the COVID-19 period, attributed to factors like heightened asymmetric information, reduced IPO volume, and decreased demand. Notably, the impact extends beyond the pandemic period, indicating a lasting effect on IPO mispricing. Sector-specific effects are observed, with all sectors, except Consumer Non-Cyclicals, showing significance in first-day returns. However, for 1-year returns, only the Finance and Energy sectors exhibit significance, with the latter slightly exceeding the 10% limit.

Conclusion- The study provides robust evidence of increased IPO mispricing during the COVID-19 pandemic, highlighting the persistent impact of the crisis on financial markets, as well as sector-specific nuances influencing mispricing levels.

Keywords: IPOs, mispricing, pandemic, initial returns, long-term returns
JEL Codes: C21, C23, D81

1. INTRODUCTION

IPO (Initial Public Offering) mispricing has been a topic of interest in the finance and economics literature for several decades. Researchers have examined various factors that contribute to IPO mispricing, the consequences of mispricing, and potential explanations for the phenomenon. IPO mispricing refers to the deviation of the offer price from the actual market value of newly issued shares. It is typically measured as the difference between the offer price and the first-day closing price or the initial return of the stock. Underpricing is a common form of IPO mispricing, where the offer price is set below the stock's market value. This results in a significant initial return for investors who are allocated shares in the IPO. Overpricing, on the other hand, occurs when the offer price is set above the stock's market value, leading to negative initial returns.

Numerous factors have been identified as contributing to IPO mispricing. These include:

a **Information asymmetry:** Information disparities between issuers and investors can lead to mispricing. Investors may struggle to accurately assess the true value of the company due to limited information.

b **Market conditions:** The overall state of the stock market can impact IPO mispricing. During bullish market conditions, demand for IPO shares tends to be higher, leading to greater underpricing.

c **Book-building process:** The process of setting the offer price through book-building involves interactions between issuers, underwriters, and institutional investors. These negotiations can result in mispricing.

d **Investor sentiment:** Market sentiment and investor behavior play a role in IPO mispricing. Positive sentiment can drive up demand for IPO shares, contributing to underpricing.

e **Reputation signaling:** Companies with higher reputations and better-known underwriters may deliberately underprice their IPOs to signal quality and attract investors.

f IPO mispricing has implications for various market participants:

a. **Issuers:** Underpricing can result in missed capital-raising opportunities, whereas overpricing can lead to a lack of investor interest in future offerings.

b. **Investors:** Those who receive IPO allocations benefit from underpricing, while subsequent investors may experience negative returns if the initial price is inflated.

c. **Underwriters:** Mispricing affects underwriters' reputation and their ability to accurately price future offerings.

d. **Market efficiency:** IPO mispricing challenges the efficient market hypothesis, suggesting that markets are not always fully reflective of fundamental values.

In March 2020, the World Health Organization declared the COVID-19 outbreak a pandemic, which led to a global economic downturn and heightened uncertainty in financial markets worldwide, including the IPO market. Researchers have examined the effects of the pandemic on IPO underpricing, exploring how market conditions, investor sentiment, and other factors have influenced the mispricing phenomenon.

Understanding the impact of the pandemic on IPO underpricing can provide insights into changes in market dynamics, investor behavior, and the overall functioning of the IPO market during times of crisis.

The long-term implications of the pandemic on IPO underpricing are still unfolding. The extent to which the changes observed during the pandemic will persist in the post-pandemic period remains uncertain. Further research is needed to evaluate the lasting effects and potential adjustments in IPO pricing dynamics as markets recover and stabilize.

This research paper specifically examines the impact of the pandemic on IPO activity, with a focus on the increase in information uncertainty. To measure this effect, we use underpricing and post-IPO stock return volatility as proxies.

2. LITERATURE REVIEW

Researchers have proposed several theories to explain IPO mispricing, including:

a. **Information-based explanations:** Information asymmetry, uncertainty, and the presence of informed traders contribute to mispricing.
b. **Behavioral finance theories:** Investor sentiment, herding behavior, and overreaction to news can drive mispricing.
c. **Signaling models:** Underpricing as a deliberate strategy to signal quality and attract investors.
d. **Institutional factors:** Regulatory requirements, underwriter reputation, and the role of investment banks in setting IPO prices.

2.1. Literature Review: IPO Underpricing

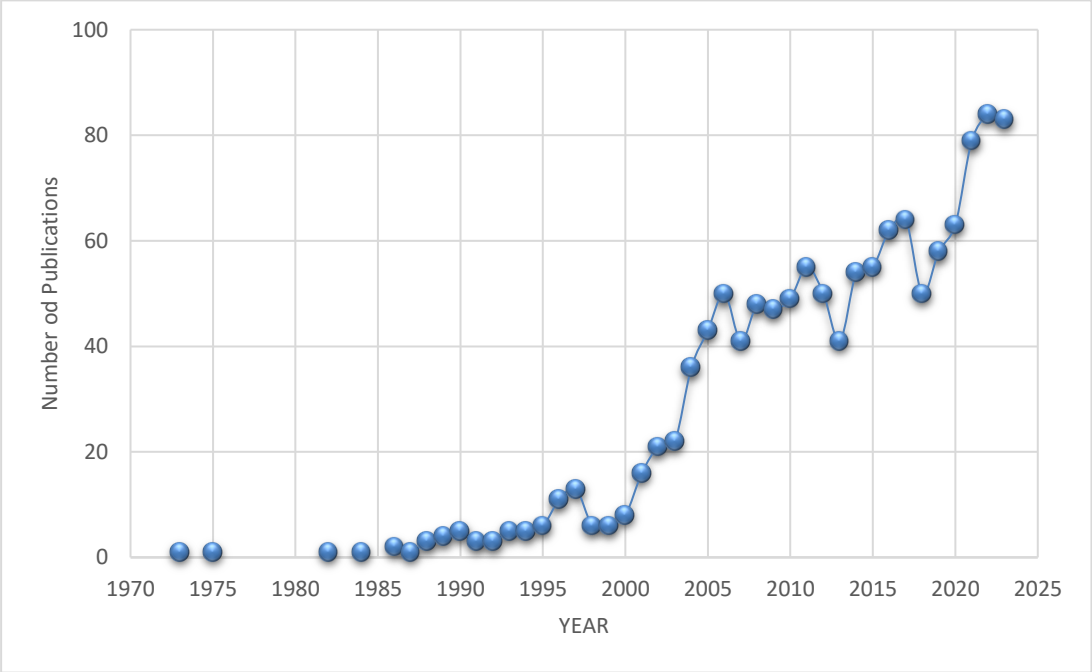
The phenomenon known as IPO underpricing is widely recognized as empirical evidence of high first-day returns for IPO firms. Since the Securities and Exchange Commission conducted a study in 1971, it has been evident that IPO stocks are initially priced lower than their subsequent sale price in the secondary market. This trend of IPO mispricing has persisted over time, as demonstrated by the frequency of studies analyzing the mispricing of IPOs in Figure 1.

In 1973, Dennis Logue (Logue, 1973) published the first academic paper on the subject of IPO mispricing. Titled "On the Pricing of Unseasoned Equity Issues: 1965-1969," the study examined 250 IPOs released between 1965 and 1969. Upon conducting a text search of the article, it is found that the terms "underpricing" and "overpricing" are mentioned six times and once, respectively. Notably, Logue referred to the IPOs as the "first public offering of common stock" instead of using the term "initial public offering."

The search yielded a second article, namely Ibbotson's (Ibbotson, 1975) study named "Price Performance of Common Stock New Issues." In this study, the author analyzed a sample of 120 IPOs released between 1960 and 1969. Ibbotson's findings revealed an average initial positive return of 11.4%. Throughout the article, he used the term "underpricing" to refer to mispricing, which was mentioned seven times.

After Ibbotson's work, numerous studies have confirmed the significant initial day returns for IPO stocks. These studies have put forth various explanations for underpricing, including information asymmetry among investors (Rock, 1986), the reputation of underwriters (Beatty et al., 1986) signaling by qualitative firms (Grinblatt and Hwang, 1989; Welch, 1989), and other factors. Several firm-level characteristics have also been identified as potential contributors to IPO underpricing, such as the pre-issuance uncertainty of the issuing firms (Beatty et al., 1986), uncertainty surrounding future growth opportunities, and firm age (Ritter, 1984; Loughran and Ritter, 2004), higher P/E ratios (Chen et al., 2004; Engelen, 2003), and the proportion of insider shareholding (Habib and Ljungqvist, 2001). These explanations are rooted in competitive theories like information asymmetry, signaling, market timing, agency theory, and others.

Figure 1: Frequency of Publications by years Related to "IPO Mispricing/Underpricing"



Source: Scopus Data; Filter: "IPO" & "Mispricing" and "IPO" & "Underpricing", As of 13/06/2023

Previous studies have revealed significant disparities in IPO mispricing, particularly when comparing the mean and median levels of mispricing. To illustrate, in Australia, Lee, Taylor, and Walter (1996) found a mean mispricing of 16.41% and a median mispricing of 10%. In China, Wang (2005) reported a mean mispricing of 271.90% and a median mispricing of 123.90%. In Canada, Kooli and Suret (2001) observed a mean mispricing of 20.57% and a median mispricing of 5%. Malaysia had a mean mispricing of 95.20% and a median mispricing of 76.50% according to Ahmad-Zaluki, Campbell, and Goodacre (2007). South Korea, as reported by Lin, Pukthuanthong, and Walker (2013), had a mean mispricing of 55.83% and a median mispricing of 36.19%. Taiwan, according to Lee and Kuo (2010), experienced a mean mispricing of 28.42% and a median mispricing of 17.89%. In the United States, Miller and Reilly (1987) found a mean mispricing of 9.87% and a median mispricing of 2.78%, whereas Chang et al. (2014) reported a mean mispricing of 13.36% and a median mispricing of 6.27% (Table 1).

Recent studies have primarily focused on the impact of sentimental data on prices when examining the mispricing/underpricing of IPOs. Ikeda (2022) found that IPO performance worsens as the average level of optimism and the divergence of investors' opinions increase. Another study revealed that media-connected firms receive more frequent and positive media coverage compared to their unconnected counterparts, resulting in reduced IPO underpricing. However, these media-connected firms experience poorer post-IPO market performance. Despite their better pre-IPO accounting performance, these firms engage in more earnings management with the support of their connected media (Chao et al., 2023). It has also been observed that companies with fluent names tend to be more profitable (Green and Jame, 2013), yet some investors seem to overlook this information. Consequently, stocks with fluent names generate higher abnormal returns relative to stocks with non-fluent names (Montone et al., 2023).

When an investment banker shares a social connection with a mutual fund manager, the manager is significantly more likely to (1) participate in the IPO, (2) submit bid prices above the average, and (3) achieve lower IPO returns. The influence of social relationships between investment bankers and fund managers is more prominent when the issuer has low accounting quality or when the underwriter is a small bank. Additional evidence suggests that these social connections between investment

bankers and fund managers reduce IPO underpricing. In summary, the findings suggest that social interactions enable individual investment bankers to effectively exchange value-relevant information with IPO investors (Wu, 2023).

Table 1: Mispricing Across Time and Markets

Country	Study	Year	Period	Mean(%)	Median(%)
US	Miller & Reilly	1987	1982-1983	9,87	2,78
Hong Kong	McGuinness	1992	1980-1990	17,60	
US	Michaely & Shaw	1994	1984-1988	7,27	
Australia	Lee et al.	1996	1976-1989	16,41	10,00
Germany	Ljungqvist	1997	1970-1993	9,20	
Japan	Hamaoi Packer, Ritter	2000	1989-1995	15,70	
Malaysia	Jelic, Saadouni & Briston	2001	1980-1995	99,25	79,04
Canada	Kooli & Suret	2001	1991-1998	20,57	5,00
Belgium	Engelen	2003	1996-1999	14,32	
China	Wang	2005	1994-1999	271,90	123,90
UK	Hill & Wilson	2006	1991-1998	11,41	
Malaysia	Ahad-Zaluki et al.	2007	1990-2000	95,20	76,50
China	Guo & Brooks	2008	1984-2005	378,40	119,37
Turkiye	Kucukkocaoglu	2008	1993-2005	7,01	7,67
France	Chahine and Filatotchev	2008	1997-2000	22,70	9,80
Taiwan	Lee & Kua	2010	1997-2007	28,42	17,98
China	Lee, Hsieh & Yen	2010	1993-2005	144,42	108,16
Brazil	Boulton, Smart & Zutter	2010	2000-2004	13,70	13,90
China	Gao	2010	2006-2008	157,00	
India	Hopp & Dreher	2013	1988-2005	96,74	
Singapore	Hopp & Dreher	2013	1988-2005	22,43	
South Korea	Lin et al.	2013	1991-2011	55,83	36,19
New Zealand	Lin et al.	2013	1991-2011	17,95	31,51
Indonesia	Husnan, Hanafi & Muhandar	2014	1995-2012	23,06	15,42
Greece	Autore et al.	2014	1998-2008	58,30	
Taiwan	Chang, Chen, Kao & Wu	2014	2006-2010	50,60	34,00
US	Chang et al.	2014	2006-2010	13,36	6,27
Australia	Bird & Ajmal	2016	1995-2013	25,51	8,62

Furthermore, research indicates a significant relationship between board members and underpricing. A board with a strong reputation and extensive experience tends to help companies reduce uncertainty and decrease IPO underpricing in China (Wang et al., 2023). Additionally, firms without venture capital support exhibit a 2.4% lower IPO underpricing effect compared to firms with venture capital support.

2.2. Literature Review: IPO Underpricing during COVID-19

Existing studies on equity, debt, and derivative markets demonstrate that the severity of the COVID-19 outbreak, coupled with government policy measures, resulted in higher levels of volatility and uncertainty (Baig et al., 2021; Baig et al., 2022; Zaremba et al., 2021). Several studies have analyzed the impact of COVID-19 on IPO underpricing. Findings suggest mixed effects, with some studies reporting an increase in underpricing, while others find a decrease or no significant change. The variations in results may be attributed to differences in sample periods, regional markets, and the severity of the pandemic's impact. However, there is a consensus that the pandemic and the government initiatives that preceded it have had a negative impact on the quality and effectiveness of markets and institutions, due to the increased uncertainty it has caused. Based on previous market observations and IPO theories, it is anticipated higher levels of underpricing and volatility for IPOs that were issued during the pandemic. This is because increased uncertainty is typically associated with higher levels of IPO underpricing, and it is natural to expect greater underpricing during times of economic distress (Beatty & Ritter, 1986).

Government intervention and stimulus measures implemented in response to the pandemic could have influenced IPO underpricing. These measures aimed to stabilize financial markets and support economic recovery. The provision of liquidity and favorable market conditions resulting from government actions may have positively impacted IPO underpricing.

The COVID-19 pandemic compelled governments to swiftly adapt and take action to protect both the health and the economy of their respective countries. However, there were notable variations in how different countries handled the crisis, resulting

in divergent outcomes. Therefore, our paper focuses on analyzing the IPO changes in Turkiye, to identify the underlying factors behind these changes. It is apparent that informational shocks and government responses related to the pandemic have had a significant impact on the IPO markets, and our research aims to shed light on these effects.

Table 2: First-Day Returns: 1992-2016

Country	# of IPO	First-Day Returns (%)
Australia	1138	0,18
Brazil	88	0,06
Canada	193	0,21
China	1533	0,57
Denmark	26	0,02
France	95	0,04
Germany	35	0,02
Greece	28	0,16
India	363	0,29
Indonesia	103	0,34
Italy	63	0,18
Japan	1913	0,6
Mexico	28	0,03
Poland	64	0,35
Russia	31	0,56
Saudi Arabia	102	2,13
South Africa	29	0,17
South Korea	689	0,37
Sweden	57	0,06
Turkiye	24	0,06
United Kingdom	404	0,27
USA	3206	0,24
Average		*0,38*
Median		*0,14*
Max		*16,8*
Min		*-0,89*
Developed Countries	7191	
Average		*0,32*
Median		*0,1*
Max		*13,5*
Min		*-0,89*
Developing Countries	3021	
Average		*0,51*
Median		*0,32*
Max		*16,8*
Min		*-0,88*

Source: Jamaani, F. & Abdullahi Dahir A. (2021)

2.3. Literature Review: Underpricing in the Turkish IPO Market

The first study conducted on the IPO market in Turkiye emerged in the year 2000 (Kiymaz, 2000). In his research, he took 163 firms listed and traded on the Istanbul Stock Exchange between 1990 and 1996. This research again focused on initial (first trade date) return and the results show that the Turkish IPOs are underpriced on the initial trading day by an average of 13.1%. In his research, he also made a sub-sector analysis for IPO underpricing.

Then in 2006, M. Banu Durukan (Durukan, 2006) showed that the relationship between ownership structure and underpricing is weak and Mehmet Orhan (Orhan, M, 2006) investigated underpricing on the Istanbul Stock Exchange for 18 sectors for the period 1996–2005. His analysis showed that half of the sectors provided a negative first-day return.

Other research regarding Turkish IPO Market Underpricing is also mainly concentrated on "Initial Returns" and "Ownership" and commitment period. Finally, in 2023, there is research (Ilbasmış, M., 2023) related to the effect of uncertainty on IPO underpricing, short-term performance after IPO, and hot-and-cold-IPO market cycles. Empirical results show that short-term market-adjusted abnormal returns of IPO firms during the pandemic are much larger than those before the pandemic.

3. THEORETICAL FRAMEWORK

3.1. Underpricing as a Proxy for Information Uncertainty

Underpricing is a common phenomenon in IPOs, often associated with information asymmetry between issuers and investors. In times of uncertainty, such as during the pandemic, information asymmetry is likely to be exacerbated. Thus, underpricing can be utilized as a proxy for induced information uncertainty caused by COVID-19.

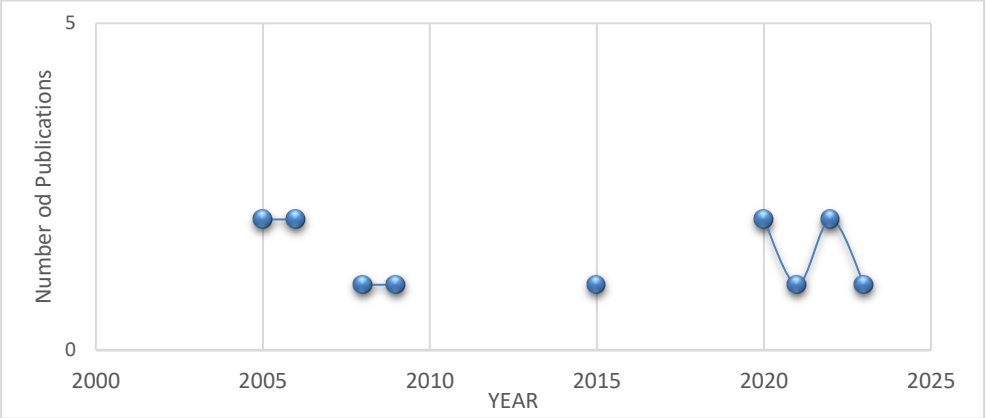
3.2. Volatility as a Proxy for Information Uncertainty

Volatility measures the fluctuations in stock prices and reflects the uncertainty in the market. Increased volatility during the pandemic can indicate higher information uncertainty, as investors struggle to assess the impact of COVID-19 on firms' prospects. Thus, volatility can serve as a proxy for induced information uncertainty caused by the pandemic.

4. MOTIVATION & OBJECTIVES

The primary objective of this study is to determine whether the COVID-19 pandemic has had a significant impact on IPO mispricing in the Turkish IPO market in the longer run, which means up to 1 year. As is seen in the Literature Review, most of the research was made by the comparison of first-day returns as the definition of "IPO mispricing" and there were a limited number of research had been done for the Turkish IPO market (Figure 2).

Figure 2: Frequency of Publications by years Related to IPO Mispricing/Underpricing in "Turkish Market"



Source: Scopus Data; Filter: "IPO" & "Mispricing" and "IPO" & "Underpricing", as of 17/05/2023

This will be achieved through the following specific objectives:

a. To analyze the IPOs that were listed on the Borsa Istanbul between January 2010 and December 2022.

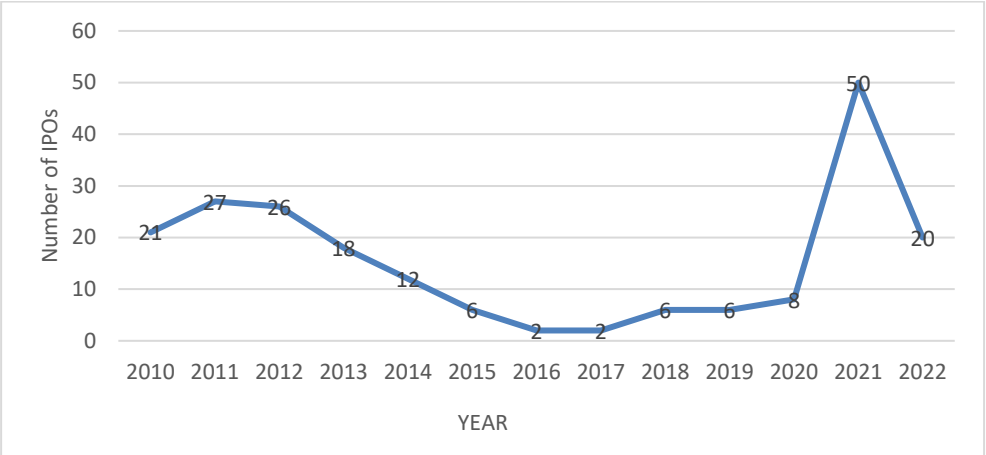
b. To examine the pricing of these IPOs to determine if there was any significant mispricing during this period for the long run (up to 1 year).

c. To identify the factors contributing to IPO mispricing in the Turkish market during the pandemic.

d. To examine the influence of COVID-19-related factors on investor sentiment and IPO pricing in Turkiye.

e. To propose potential measures or strategies to mitigate IPO mispricing in the face of future crises.

Figure 3: Frequency of IPOs by years in "Turkish Market"



Source: Borsa Istanbul (Istanbul Stock Exchange)

Table 3: Frequency of IPOs by sectors in "Turkish Market"

Sector	Pre-COVID	During&After-COVID	TOTAL
Financials	15	6	21
Basic Materials	16	12	28
Real Estate	16	3	19
Utilities	5	8	13
Consumer Non-Cyclicals	17	8	25
Industrials	23	12	35
Consumer Cyclicals	21	10	31
Technology	6	7	13
Healthcare	5	4	9
Energy	3	7	10
TOTAL	**127**	**77**	**204**

5. DATA & METHODOLOGY

5.1. Data Collection

The study uses a quantitative research approach, and data will be gathered on IPOs launched in the Turkish market during the period from January 2010 to December 2022 from the Borsa Istanbul website, company prospectuses, and financial news reports. BIST-ALL, BIST-100, and BIST-Sector returns have also been included in the research for the determination of the actual return performances of IPOs for the relevant time period. Additionally, pandemic-related data such as stock returns, offer prices, and market conditions.

5.2. IPO Initial Return Calculation

The study will employ regression analysis to determine whether there is a significant relationship between the COVID-19 pandemic and IPO mispricing. The analysis will also control for other variables such as market conditions, company size, and industry sector. The first step is calculating the initial returns of IPOs as a measure of mispricing. Then compare the IPO offer price with the closing price on the first day, on the week-end, on the month-end, on the 3-month-end, on the 6-month-end, and year-end trading.

$Initial\ Return_i = \frac{CP_i - AOP}{CP_i}$ where CP_i is the closing price on the trading date and AOP is the Adjusted-Offer-Price. (1)

Adjusted-Offer-Price (AOP) is the retroactively corrected version of the initial public offering (IPO) price due to subsequent capital increases through paid-in and bonus share issuances, as well as dividend payments by the company. So,

$AOP = OP\ x\ PAF$ where OP is the Offer-Price and PAF is the Price-Adjustment-Factor. (2)

$Adjusted\ Initial\ Return_i = Initial\ Return_i - MR_i$, where MR_i is the Market Return for the related time period. (3)

For this study, for market returns, the "Adjusted Returns" calculation includes not only the BIST-100 but also the BIST-ALL, calculated by considering all stocks, and sector-specific BIST-Sector indices.

5.3. Empirical Analysis

Utilize quantitative techniques such as event study methodology, regression analysis, and statistical modeling to investigate the relationship between COVID-19 and IPO mispricing. Explore factors such as market sentiment, industry characteristics, IPO characteristics, and pandemic-related variables.

The study involves employing two methods: the traditional ordinary least squares (OLS) and the more appropriate quantile regression (QR). The OLS method focuses on assessing the average impact of independent variables on mispricing, disregarding the unexplored latent characteristics of the mispricing distribution, especially when it deviates from a normal distribution. In contrast, the QR method allows us to investigate the diverse effects of independent variables at different levels of mispricing due to the asymmetric distribution of returns. By employing the QR approach, it can be identified the specific impacts of each variable on IPOs within particular levels of mispricing. This robust method is capable of handling potential heterogeneity in the distribution, which was observed in the sample. The QR method also facilitates the examination of various segments of the mispricing distribution, including the tail regions, enabling a comparison of the effects of explanatory factors on IPOs that range from extremely overpriced to extremely underpriced.

5.4 Variables Used in Equations

Y1: Return on first trade date
Y2: Return on first week
Y3: Return on first month
Y4: Return on Month-3
Y5: Return on Month-6
Y6: Return on first year

SEC1	Basic Materials
SEC2	Consumer Cyclicals
SEC3	Consumer Non-Cyclicals
SEC4	Energy
SEC5	Financials
SEC6	Healthcare
SEC7	Industrials
SEC8	Real Estate
SEC9	Technology
SEC10	Utilities

$DYEAR_t$: Dummy variable for the year of IPO (t = 2010, 2011, …, 2022)
$DSEC_i$: Dummy variable for the sector/industry of Equity
P_0: Initial Return of the equity on a specific time period (First trade date, first week, first month, third month, sixth month, and first year)
P_{ALL}: Initial Return of the overall stock exchange on a specific time period (First trade date, first week, first month, third month, sixth month, and first year)
P_{100} : Initial Return of the BIST 100 (Borsa Istanbul 100 index) on a specific time period (First trade date, first week, first month, third month, sixth month, and first year)
P_{SEC}: Initial Return of the related Equity's Sector Index on a specific time period (First trade date, first week, first month, third month, sixth month, and first year)

5.5. Hypothesis and Equations

This research aims to analyze below hypothesis:

$H01$: In the long run (1-year) there is mispricing(underpricing) in Turkish IPO Market

$H02$: The COVID-19 pandemic has led to increased IPO mispricing in the Turkish market.

Based on these hypotheses, in the first section of the research, clarity will be provided regarding whether there is an error in the pricing of IPOs in the long term. While conducting this study, on the one hand, returns will be taken into account, and on the other hand, the effects of year and sector factors will be eliminated. In the second section, the impact of the COVID-19 period on this pricing will be examined based on the final values obtained.

For our research's specific analysis, data characteristics, and modeling techniques being employed, it is used Log returns, or logarithmic returns, which are commonly used in financial analysis, especially when analyzing equity investments, for several reasons:

- **Stationarity:** Log returns help stabilize the variance of the returns over time, making them more suitable for statistical analysis. In financial markets, asset prices often exhibit volatility clustering, where periods of high volatility are followed by periods of low volatility. Log returns help to mitigate this issue and make the data more stationary, which is a key assumption in many statistical models.
- **Symmetry:** Logarithmic returns have a symmetric distribution, which makes them easier to work with in mathematical and statistical models. This symmetry assumption simplifies many modeling techniques, such as linear regression.
- **Interpretability:** Log returns are additive over time. This means that if you have a series of log returns for different time periods, you can sum them to get the overall return for the entire period. This property is not true for simple percentage returns.
- **Compounding:** Log returns are particularly useful for understanding the effects of compounding. When you invest in an asset, your wealth grows or declines exponentially over time. Log returns allow you to easily track this compounding effect and calculate the final wealth based on a series of returns.
- **Normality assumption:** Many financial models assume that returns follow a normal distribution. While this assumption is not always valid, log returns tend to be closer to a normal distribution compared to simple percentage returns, making them more amenable to these models.
- **Comparability:** Log returns make it easier to compare the performance of different assets or investments over various time periods because they are additive and have consistent units (e.g., natural logarithms of wealth ratios).
- **Mathematical properties:** Logarithmic returns are mathematically convenient for various financial calculations, such as risk assessment (e.g., calculating volatility) and portfolio optimization.

Since the dummy variables DYEAR and DSEC are included in the equations, a constant term is not used in the equations to avoid the perfect **multicollinearity** problem.

Equations for IPO Mispricing and COVID Impact

Y1 First Trade Date

$$\Delta LnP_0 = COVID + \beta_1 \Delta LnP_{ALL} + \beta_2 \Delta LnP_{100} + \beta_3 \Delta LnP_{SEC} + \sum_{t=2010}^{2022} DYEAR_t + \sum_{i=1}^{10} DSEC_i + \varepsilon_j \quad (4)$$

H_0: $COVID\ has\ a\ significant\ impact\ on\ IPOs$
H_0: $\beta_1=\beta_2=\beta_3=0$

Y2 Week 1

$$\Delta LnP'_0 = COVID + \Delta LnP_0 + \beta_1 \Delta LnP'_{ALL} + \beta_2 \Delta LnP'_{100} + \beta_3 \Delta LnP'_{SEC} + \sum_{t=2010}^{2022} DYEAR_t + \sum_{i=1}^{10} DSEC_i + \varepsilon_j \quad (5)$$

H_0: $COVID\ has\ a\ significant\ impact\ on\ IPOs$
H_0: $\beta_1=\beta_2=\beta_3=0$
H_0: $\alpha_1=0$

Y3 Month 1

$$\Delta LnP''_0 = COVID + \alpha_1 \Delta LnP_0 + \alpha_2 \Delta LnP'_0 + \beta_1 \Delta LnP''_{ALL} + \beta_2 \Delta LnP''_{100} + \beta_3 \Delta LnP''_{SEC} + \sum_{t=2010}^{2022} DYEAR_t + \sum_{i=1}^{10} DSEC_i + \varepsilon_j \quad (6)$$

H_0: $COVID\ has\ a\ significant\ impact\ on\ IPOs$
H_0: $\beta_1=\beta_2=\beta_3=0$
H_0: $\alpha_1= \alpha_2=0$

Y4 Month 3

$$\Delta LnP'''_0 = COVID + \alpha_1 \Delta LnP_0 + \alpha_2 \Delta LnP'_0 + \alpha_3 \Delta LnP''_0 + \beta_1 \Delta LnP'''_{ALL} + \beta_2 \Delta LnP'''_{100} + \beta_3 \Delta LnP'''_{SEC} + \sum_{t=2010}^{2022} DYEAR_t + \sum_{i=1}^{10} DSEC_i + \varepsilon_j \quad (7)$$

H_0: $COVID\ has\ a\ significant\ impact\ on\ IPOs$
H_0: $\beta_1=\beta_2=\beta_3=0$
H_0: $\alpha_1= \alpha_2= \alpha_3=0$

Y5 Month 6

$$\Delta LnP''''_0 = COVID + \alpha_1 \Delta LnP_0 + \alpha_2 \Delta LnP'_0 + \alpha_3 \Delta LnP''_0 + \alpha_4 \Delta LnP'''_0 + \beta_1 \Delta LnP''''_{ALL} + \beta_2 \Delta LnP''''_{100} + \beta_3 \Delta LnP''''_{SEC} + \sum_{t=2010}^{2022} DYEAR_t + \sum_{i=1}^{10} DSEC_i + \varepsilon_j \quad (8)$$

H_0: $COVID\ has\ a\ significant\ impact\ on\ IPOs$
H_0: $\beta_1=\beta_2=\beta_3=0$
H_0: $\alpha_1= \alpha_2= \alpha_3= \alpha_4=0$

Y6 Year 1

$$\Delta LnP'''''_0 = COVID + \alpha_1 \Delta LnP_0 + \alpha_2 \Delta LnP'_0 + \alpha_3 \Delta LnP''_0 + \alpha_4 \Delta LnP'''_0 + + \alpha_5 \Delta LnP''''_0 + \beta_1 \Delta LnP'''''_{ALL} + \beta_2 \Delta LnP'''''_{100} + \beta_3 \Delta LnP'''''_{SEC} + \sum_{t=2010}^{2022} DYEAR_t \ldots + \sum_{i=1}^{10} DSEC_i + \varepsilon_j \quad (9)$$

H_0: $COVID\ has\ a\ significant\ impact\ on\ IPOs$
H_0: $\beta_1=\beta_2=\beta_3=0$
H_0: $\alpha_1=\ \alpha_2=\ \alpha_3=\ \alpha_4=\ \alpha_5=0$

6. EMPIRICAL RESULTS

6.1. Delisted Companies

Before starting the empirical results, it would be more useful to provide more detailed information about the IPO data used in terms of evaluating the results. As mentioned before, the study examines the data of a total of 204 companies for the relevant periods between 2010 and 2022. However, a total of 20 companies are currently delisted from Borsa Istanbul. It is planned to conduct a separate study on the reasons for this (Figure 4 & Table 4).

Figure 4: Enlisted IPOs by years in "Turkish Market"

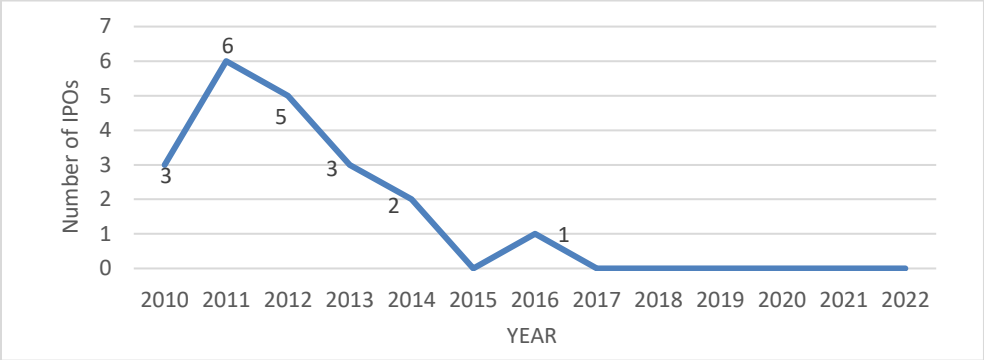


Table 4: Frequency of Delisted IPOs by Sectors

Sector	# of Companies
Financials	2
Basic Materials	2
Real Estate	1
Utilities	0
Consumer Non-Cyclicals	4
Industrials	4
Consumer Cyclicals	4
Technology	1
Healthcare	1
Energy	1
TOTAL	**20**

6.2 Further Analysis

The pandemic has led to increased uncertainty and volatility in financial markets, which could have resulted in mispricing. The study finds evidence of increased IPO mispricing during the Covid-19 pandemic. Additionally, the study may reveal differences in mispricing levels before and after the outbreak of the pandemic.

The results include:

- As seen in Table 5 and in Figure 5, statistical results present a detailed analysis of returns, BIST-ALL adjusted returns, BIST-100 adjusted returns, and BIST-Sector adjusted returns for three different periods: Full Period (n=204), Pre-Covid (n=127), and During-After Covid (n=77).
    - Full Period (n=204):
        - The mean returns range from 6% to 244%, indicating significant variation across different time intervals.
        - The standard deviations are also large, suggesting considerable dispersion in returns.
        - Minimum and maximum values show the range of returns, with some extreme values.
        - Positive kurtosis values indicate relatively peaked distributions.
        - Positive skewness values indicate a skew to the right in the distribution.
    - Pre-Covid (n=127):
        - Similar to the Full Period, there is variation in mean returns and standard deviations across different time intervals.
        - Minimum and maximum values show the range of returns during the pre-COVID period.
        - Positive kurtosis values suggest relatively peaked distributions.
        - Positive skewness values indicate a skew to the right in the distribution.
    - During-After Covid (n=77):
        - The mean returns range from 7% to 244%, showing variation across different time intervals.
        - Standard deviations are relatively high, indicating significant dispersion in returns.
        - Minimum and maximum values illustrate the range of returns during and after the Covid period.
        - Positive kurtosis values suggest relatively peaked distributions.
        - The skewness values vary, indicating different skewness in the distribution.

  In summary, there are significant differences in Means and Standard Deviations in "Adjusted Market Returns" which means IPO companies have higher returns compared to the market or in other words, IPOs in general were underpriced during offerings.

- COVID impact tested for each equation and the results show that we cannot reject the H0, which means COVID-19 pandemics have a significant impact on IPO results (Table 6). For Equation 1, the variable "COVID" has a negative coefficient (-0.059) with a significant probability (0.009), suggesting that it is associated with a decrease in the dependent variable. For Equation 2, "COVID" has a strong negative impact (-1.219) with a highly significant probability (0.000), indicating a significant association with a decrease in the dependent variable. For Equation 3, "COVID" has a positive coefficient (1.142) with a significant probability (0.001). For Equation 4, "COVID" has a negative coefficient (-2.122) with a significant probability (0.003). For Equation 5, "COVID" has a positive coefficient (2.018) with a significant probability (0.001) and finally in Equation 6, "COVID" has a very negative coefficient (-6.113) with a highly significant probability (0.001). This result is predictable since, the impact of COVID-19, including increased asymmetric information, reduced IPO volume, and decreased demand, is expected to result in a higher rate of "IPO underpricing" in IPOs conducted during the COVID-19 period compared to the periods before and after the pandemic.
- H0: $\beta1 = \beta2 = \beta3 = 0$ also tested for each equation and when the H0 cannot be rejected the equation is estimated as the restricted form.
- "Y3" (Month-End Returns) has a positive coefficient (0.782) with a strong significant probability (0.001) in Equation 4 and "Y1" (First Date Returns) has a positive coefficient (3.036) with a significant probability (0.032) in Equation 6.
- While all index values are insignificant for Equation 4, we see that only the Borsa Istanbul-All Index is significant in our equation in Equation 9, that is when we consider 1-year returns. Due to the broadened definition of "IPO underpricing" in this study (considering not only initial day returns but also returns for various periods, including up to one year), the previously observed high values of "IPO underpricing" in earlier studies are lower.

- Equation-4:
  - ΔLnP_ALL has a coefficient of 0.832 with a probability of 0.823. The coefficient is positive, suggesting a positive relationship with the dependent variable.
  - Other variables in the equation are not significantly different from zero, as their p-values are greater than the conventional significance level of 0.05.
- Equation-5:
  - ΔLnP_100 has a negative coefficient (-1.026), but the probability value is 0.759, indicating that it is not statistically significant at the 0.05 level.
  - The variable with the lowest p-value in this equation is ΔLnP_SEC with a coefficient of 0.109 and a p-value of 0.776, suggesting it is not a significant predictor.
- Equation-6:
  - ΔLnP_ALL has a substantial coefficient of 16.600 with a highly significant probability of 0.001, indicating a strong positive relationship with the dependent variable.
  - Other variables in the equation do not appear to be statistically significant, as their p-values are greater than 0.05.

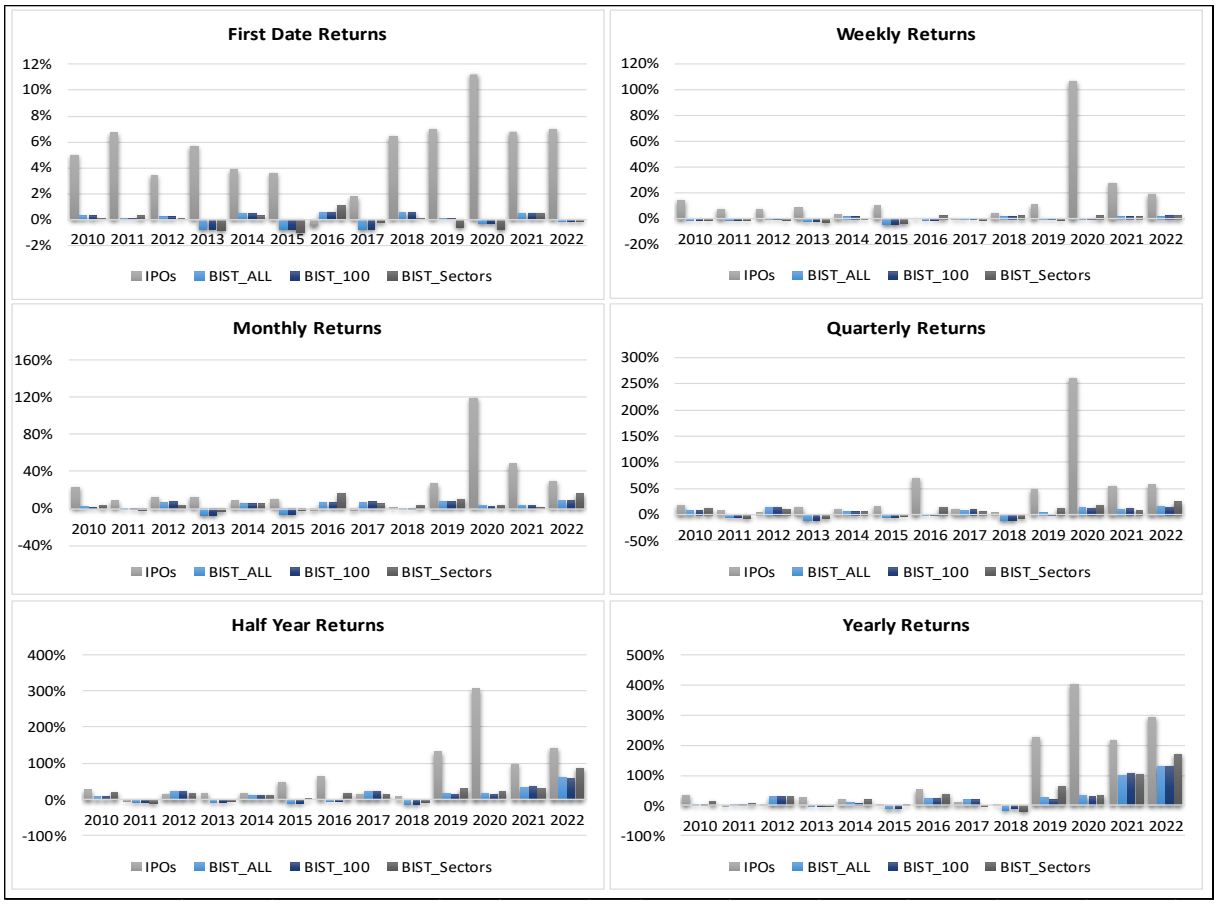
Table 5: Descriptive Statistics of IPO Returns in "Turkish Market"

	Full Period (n=204)																							
	Returns						BIST-ALL Adjusted Returns						BIST-100 Adjusted Returns						BIST-Sector Adjusted Returns					
	D1	W1	M1	M3	M6	Y1	D1	W1	M1	M3	M6	Y1	D1	W1	M1	M3	M6	Y1	D1	W1	M1	M3	M6	Y1
Mean	6%	18%	27%	36%	62%	110%	6%	18%	25%	31%	45%	66%	6%	18%	24%	31%	45%	65%	6%	18%	24%	30%	41%	58%
Std	8%	35%	55%	87%	131%	234%	9%	35%	55%	85%	125%	212%	9%	35%	55%	85%	126%	213%	9%	34%	54%	84%	124%	213%
Min	-17%	-29%	-35%	-100%	-59%	-75%	-17%	-23%	-38%	-96%	-86%	-110%	-17%	-23%	-38%	-96%	-88%	-119%	-17%	-23%	-55%	-99%	-156%	-354%
Max	41%	240%	314%	749%	895%	1543%	40%	241%	323%	726%	878%	1381%	40%	241%	323%	726%	878%	1376%	41%	226%	319%	741%	893%	1343%
Median	5%	4%	8%	12%	18%	41%	5%	5%	7%	9%	8%	1%	5%	5%	7%	9%	7%	0%	5%	4%	7%	12%	3%	0%
Kurtosis	1.08	8.37	5.81	26.10	16.15	11.82	1.30	8.69	6.36	26.36	18.68	13.19	1.31	8.71	6.30	26.12	18.37	13.03	1.36	7.46	6.38	28.81	19.96	12.13
Skewness	0.66	2.36	2.22	4.12	3.36	3.16	0.71	2.37	2.27	4.15	3.61	3.39	0.71	2.37	2.26	4.13	3.57	3.37	0.76	2.26	2.24	4.30	3.73	3.13
	Pre-Covid (n=127)																							
Mean	5%	10%	13%	15%	24%	31%	5%	11%	12%	14%	20%	22%	5%	11%	12%	14%	20%	23%	5%	11%	12%	13%	16%	16%
Std	10%	30%	40%	57%	74%	126%	10%	31%	40%	58%	74%	123%	10%	31%	40%	58%	75%	125%	10%	30%	40%	55%	70%	119%
Min	-17%	-29%	-35%	-100%	-59%	-75%	-17%	-23%	-38%	-96%	-86%	-100%	-17%	-23%	-38%	-96%	-88%	-101%	-17%	-23%	-38%	-99%	-106%	-203%
Max	41%	240%	231%	459%	398%	1020%	40%	241%	222%	471%	404%	983%	40%	241%	221%	473%	410%	995%	41%	226%	228%	441%	368%	952%
Median	1%	2%	3%	0%	2%	-8%	2%	3%	2%	-1%	2%	-9%	2%	3%	2%	-1%	2%	-8%	1%	3%	0%	0%	-2%	-16%
Kurtosis	0.60	26.50	9.29	28.16	6.35	30.94	0.78	26.17	8.07	29.86	6.19	30.07	0.79	26.11	7.96	29.71	6.24	29.86	0.77	22.98	8.91	27.92	5.68	30.78
Skewness	0.95	4.31	2.71	4.05	2.19	4.69	0.97	4.26	2.54	4.14	2.03	4.59	0.97	4.25	2.53	4.13	2.03	4.57	0.99	4.03	2.63	3.95	1.98	4.55
	During-After Covid (n=77)																							
Mean	7%	31%	49%	71%	126%	244%	7%	29%	44%	59%	88%	139%	7%	29%	44%	58%	86%	135%	7%	29%	44%	57%	83%	126%
Std	5%	38%	68%	112%	173%	304%	5%	38%	69%	111%	173%	294%	5%	38%	69%	112%	173%	295%	5%	38%	68%	112%	174%	300%
Min	-10%	-25%	-28%	-32%	-43%	-15%	-9%	-23%	-34%	-44%	-72%	-110%	-9%	-23%	-35%	-49%	-78%	-119%	-9%	-23%	-55%	-89%	-156%	-354%
Max	10%	135%	314%	749%	895%	1543%	15%	142%	323%	726%	878%	1381%	15%	141%	323%	726%	878%	1376%	16%	142%	319%	741%	893%	1343%
Median	10%	19%	32%	38%	61%	126%	9%	17%	31%	27%	32%	27%	9%	17%	31%	27%	30%	21%	9%	17%	31%	33%	29%	36%
Kurtosis	1.79	-0.21	2.70	17.53	8.92	5.02	1.13	-0.14	3.32	17.11	9.97	5.04	1.03	-0.15	3.24	16.90	9.78	4.97	1.34	-0.08	3.25	18.32	10.16	4.28
Skewness	-1.62	0.85	1.59	3.49	2.67	2.21	-1.32	0.84	1.68	3.44	2.84	2.25	-1.30	0.84	1.67	3.42	2.81	2.24	-1.27	0.86	1.62	3.54	2.85	1.96

Note: The table presents a summary statistic of the dependent variable underpricing. The sample is divided into three categories: (1) the average of all IPOs in the full period of time. (2) IPOs issued pre-COVID-19, meaning IPOs before March 2020. (3) IPOs issued during IPO, IPOs after March 2020. It includes simple returns and marked adjusted returns for each period. We include the market adjusted Return, which is adjusted for interim market movement, by using the IPO-specific indexes (BIST-All, BIST-100, and BIST-Sectors).

- Equation-7:
  - ΔLnP_SEC has a negative coefficient (-0.226) with a probability of 0.516, indicating that it is not statistically significant.
  - Other variables in the equation do not appear to be statistically significant.
- Equation-8:
  - ΔLnP_ALL has a positive coefficient of 7.681 with a probability of 0.032, indicating a statistically significant positive relationship.
  - ΔLnP_100 also has a negative coefficient of -7.560 with a probability of 0.027, suggesting a statistically significant negative relationship.
  - Other variables are not statistically significant.
- Equation-9:
  - ΔLnP_ALL has a positive coefficient of 8.220 with a probability of 0.063, suggesting a positive relationship, but the p-value is slightly above the conventional significance level.
  - Other variables in the equation do not appear to be statistically significant.

Figure 5: Average Returns of IPOs by years in "Turkish Market" compared with BIST-ALL, BIST-100, and BIST-Sector



- In addition to this, it can be seen that the dummy variables D2020, D2021, and D2022 are also significant in all equations. These results had already emerged while conducting the COVID-19 analysis. However, it is understood from these results that the impact of COVID continues not only in the relevant period but also in 2022 (Table 6).
- Considering the first-day returns of IPOs, all sector values except SEC 3 (Consumer Non-Cyclicals) are significant (SEC 3 has a non-significant p-value (0.142)), while based on 1-year returns, it is possible to say that the effect of only SEC5 (Financials) and SEC4 (Energy), which is slightly above the 10% limit, continues. Particularly in recent times, there has been an increasing demand for energy companies, which may lead to higher levels of "IPO underpricing" in specific IPOs, especially those conducted in these sectors.
    - For Equation 1 Except SEC 3, all sectors have significant p-values
    - For Equation 2 SEC 3 and SEC 7 have significant p-values (0.018;0.042). SEC 2 and SEC 4 are also considered significant since the p-values are 10% level.
    - For Equation 3, only SEC 2 has a significant p-value (0.024)
    - For Equation 4, SEC 2 (0.018) and SEC 8 (0.050) has significant p-values.
    - For Equation 5, only SEC 6 has a significant p-value (0.005)
    - For Equation 6, none of the sectors have a significant p-value in a 95% confidence interval. But Sec 4 and SEC 5 have a significant 90% confidence interval.

Table 6: Results of Equations – IPO Mispricing and COVID Impact

	Equation-1			Equation-2			Equation-3			Equation-4			Equation-5			Equation-6		
Variable	Coefficient	Prob.		Coefficient	Prob.		Coefficient	Prob.		Coefficient	Prob.		Coefficient	Prob.		Coefficient	Prob.	
COVID	- 0.059	0.009		- 1.219	0.000		1.142	0.001		- 2.122	0.003		2.018	0.001		- 6.113	0.001	
Y1				1.770	-		- 0.150	0.607		- 0.854	0.280		- 0.077	0.897		3.036	0.032	
Y2							1.258	-		0.217	0.553		- 0.543	0.104		- 0.830	0.134	
Y3										0.782	0.001		- 0.057	0.430		0.373	0.204	
Y4													1.281	-		- 0.187	0.435	
Y5																1.284	-	
ΔLnP_ALL	0.832	0.823		5.902	0.096	**	16.600	0.001	***	- 0.156	0.987		7.681	0.032	***	8.220	0.063	**
ΔLnP_100	- 1.026	0.759		- 5.838	0.145		- 15.653	0.000	***	1.096	0.909		- 7.560	0.027	***	- 5.663	0.202	
ΔLnP_SEC	0.240	0.709		0.663	0.549		0.109	0.776		- 0.226	0.516		0.451	0.036	***	- 0.010	0.964	
D2011	0.009	0.038	***	- 0.101	0.000	***	0.049	0.212		0.103	0.282		0.033	0.636		0.142	0.723	
D2012	- 0.024	0.000	***	- 0.050	0.001	***	0.046	0.118		- 0.191	0.111		0.179	0.021	***	- 0.621	0.149	
D2013	0.003	0.558		- 0.050	0.019	***	0.062	0.215		0.178	0.040	***	0.166	0.011	***	0.247	0.562	
D2014	- 0.010	0.181		- 0.085	-	***	0.009	0.766		0.033	0.276		0.126	0.012	***	- 0.179	0.710	
D2015	- 0.024	0.060	**	0.009	0.765		- 0.022	0.714		0.101	0.073	**	0.369	-	***	- 0.143	0.817	
D2016	- 0.055	0.000	***	- 0.060	0.023	***	0.034	0.577		- 0.006	0.947		- 0.293	0.128		- 0.244	0.859	
D2017	- 0.035	0.008	***	- 0.059	0.093	**	- 0.025	0.378		0.186	0.003	***	0.089	0.162		- 0.261	0.789	
D2018	0.009	0.369		- 0.136	0.000	***	- 0.080	0.196		0.177	0.140		0.197	0.022	***	0.328	0.598	
D2019	0.010	0.206		- 0.091	0.027	***	- 0.062	0.281		0.199	0.157		0.236	0.075	**	- 0.853	0.238	
D2020	0.110	0.000	***	1.833	-	***	- 1.353	0.001	***	3.345	-	***	- 1.786	0.002	***	5.163	0.006	***
D2021	0.072	0.005	***	1.319	0.000	***	- 0.943	0.005	***	2.169	0.010	***	- 1.413	0.016	***	4.935	0.006	***
D2022	0.072	0.004	***	1.219	0.001	***	- 1.078	0.002	***	2.324	0.001	***	- 1.750	0.003	***	3.785	0.041	***
SEC1	0.028	0.104		0.012	0.732		- 0.037	0.614		- 0.028	0.553		- 0.060	0.583		0.031	0.936	
SEC2	0.073	0.000	***	0.064	0.093	**	- 0.137	0.024	***	- 0.076	0.472		- 0.122	0.251		- 0.420	0.299	
SEC3	0.034	0.142		0.104	0.018	***	0.045	0.691		- 0.244	0.018	***	- 0.043	0.385		- 0.385	0.325	
SEC4	0.039	0.025	***	0.074	0.103		0.080	0.407		0.226	0.080	**	- 0.125	0.692		0.901	0.102	
SEC5	0.078	0.048	***	0.045	0.430		- 0.067	0.287		0.115	0.151		- 0.058	0.661		- 0.702	0.089	**
SEC6	0.077	0.009	***	0.046	0.330		0.087	0.562		- 0.134	0.232		- 0.336	0.005	***	- 0.144	0.796	
SEC7	0.070	0.000	***	0.091	0.042	***	0.083	0.424		0.291	0.183		- 0.020	0.875		- 0.275	0.474	
SEC8	0.030	0.023	***	0.030	0.264		0.025	0.590		- 0.178	0.050	***	- 0.087	0.225		- 0.170	0.658	
SEC9	0.090	0.001	***	0.099	0.325		- 0.053	0.540		0.045	0.699		0.766	0.114		0.070	0.890	
SEC10	0.036	0.076		- 0.020	0.781		- 0.038	0.443		0.075	0.623		- 0.554	0.089		- 0.252	0.598	

***: Significant at 95% confidence level

** : Significant at 90% confidence level

7. CONCLUSIONS

Understanding the effects of COVID-19 on IPO mispricing in the Turkish market is crucial for developing effective strategies to mitigate pricing anomalies during future crises. This research proposal outlines the objectives, research methodology, results, and implications of the study.

Market Returns Analysis: There are significant differences in means and standard deviations in "Adjusted Market Returns" across various periods, indicating that IPO companies had higher returns compared to the market. This implies a trend of underpricing during offerings.

COVID-19 Impact Analysis: The study tests the impact of COVID-19 on IPO results for each equation. The results suggest a significant impact, with coefficients and probabilities varying across equations. Notably, the impact includes increased asymmetric information, reduced IPO volume, and decreased demand, leading to higher rates of IPO underpricing during the COVID-19 period compared to before and after the pandemic.

Equation-Specific Results: Each equation reveals specific insights into the factors influencing IPO underpricing. For instance, Equation 3 shows a substantial positive relationship between ΔLnP_ALL and the dependent variable, while Equation 4 indicates that ΔLnP_SEC is not statistically significant. The results vary across equations, emphasizing the importance of considering different variables.

D2020, D2021, D2022 Impact: The dummy variables D2020, D2021, and D2022 are found to be significant in all equations, indicating that the impact of COVID-19 continues not only in the relevant pandemic period but also extends into 2022.

Sector-Specific Analysis: The study explores sector-specific impacts on IPO returns. While the first-day returns of IPOs across sectors are mostly significant, 1-year returns show continued effects primarily in the Financials and Energy sectors.

Month-End and First-Date Returns: Specific variables, such as "Y3" (Month-End Returns) in Equation 4 and "Y1" (First-Date Returns) in Equation 6, demonstrate significant positive coefficients, indicating their influence on the dependent variables.

Limitations and Implications: The study notes that the broadened definition of "IPO underpricing," considering returns for various periods, has led to lower values compared to earlier studies. This underscores the importance of refining measurement metrics.

Continued Impact of COVID-19: The results highlight that the impact of COVID-19 continues, as evidenced by the significant coefficients associated with the "COVID" variable in various equations.

In conclusion, the study provides valuable insights into the dynamics of Turkish IPOs during and after the COVID-19 pandemic. The findings contribute to the understanding of market behavior, IPO underpricing trends, and the persistent impact of external shocks on financial markets.

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