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The impact of European governmental measures during COVID-19 on IPO underpricing

Sofia Correia Ganchas

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Miguel Augusto Gomes Sousa, PhD

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Biographical note

Sofia Correia Ganchas was born in Vila Nova de Gaia on the 9th of September 1999.

After completing her studies in Arts, more specifically, Contemporary Dance and Classical Ballet, Sofia enrolled in the Bachelor of Economics from the School of Economics and Management of the University of Porto – FEP, to which she graduated in 2021. In that same year, she began her journey toward the Master of Finance from the same academic institution, for which the present dissertation serves as the last step to its conclusion. In the winter semester of 2022, Sofia studied in Nice, France, at EDHEC Business School, one of the Top 10 European business schools, on their MSc Corporate Finance and Banking under the ERASMUS program.

Throughout her journey at FEP, Sofia participated in two student organizations, namely HeforShe FEP and Já T´Explico (in their financial departments) as well as the faculty´s Pedagogical council, and also in two faculty-internal competitions: "Pool de Talentos FEP" during her Bachelor's degree, to which she was a finalist, and FEP Master´s Challenge in 2022, winning the competition and going on a business trip to San Francisco the same year. This year, 2023, Sofia was invited to an interview for the magazine "Sábado" to share her personal, academic and professional journey until now.

While writing this dissertation, Sofia simultaneously began her professional career at Deloitte Corporate Finance in Financial Advisory, initially as a trainee but currently as a Financial Advisory analyst.

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Abstract

COVID-19 had its outbreak in early 2020, causing unprecedented economic disruption in global financial markets; the Initial Public Offerings (IPO) market was not an exception. Governments all over the world promptly took action to fight the pandemic, with measures across different dimensions. This study investigates the impact that the measures governments took to fight the pandemic had on IPO underpricing. Particularly, we investigate the impact of the restrictive measures imposed (e.g., school closings and international travel bans) and economic support given (e.g., debt relief and financial support) on underpricing for nine European countries, from the 1st of January 2020 to the 31st of March 2022.

We concluded that underpricing levels were greater during the COVID-19 period when compared to the period prior to it, in line with the existing literature. We also prove that, in accordance with our hypothesis, the restrictiveness of the measures imposed is positively related to underpricing levels, i.e., the more restrictive the measures in a country, the greater the "money left on the table", which suggests that IPO investors required higher premium (in the form of higher underpricing), likely due to increased uncertainty. On the other hand, and contrary to what we would expect, greater economic support also led to greater underpricing, which suggests that instead of counterbalancing the restrictive measures' impact on uncertainty, the economic support exacerbated that impact. Lastly, we confirm our expectations that countries that were most impacted by the virus (seen by their number of confirmed cases and deaths by COVID-19) experienced higher underpricing.

This study intends to contribute to the IPO research area while also providing more insights into the financial impact of the actions taken by the different European governments during the pandemic.

Keywords: IPO, underpricing, COVID-19, Governmental action, Europe

JEL codes: G12, G34, G38, Q54, O52

Sumário

A COVID-19 teve o seu surto no início de 2020, causando uma perturbação económica sem precedentes nos mercados financeiros mundiais; o mercado das Ofertas Públicas Iniciais (OPI) não foi exceção. Os governos mundiais prontamente tomaram medidas para combater a pandemia, atuando em diferentes dimensões. O presente estudo investiga o impacto que as medidas tomadas pelos governos para combater a pandemia tiveram no *underpricing* das OPI. Em particular, analisamos o impacto das medidas restritivas impostas (por exemplo, encerramento de escolas e fecho de fronteiras) e do apoio económico dado (por exemplo, redução da dívida e apoio financeiro) no *underpricing*, para nove países europeus, de 1 de janeiro de 2020 a 31 de março de 2022.

Concluímos que os níveis de *underpricing* são maiores durante o período de COVID-19 quando comparados com o período anterior, de acordo com a literatura existente. Comprovamos também que, de acordo com a nossa hipótese, a restritividade das medidas impostas está positivamente relacionada com os níveis de *underpricing*, ou seja, quanto mais restritivas forem as medidas num país, maior será o "dinheiro deixado em cima da mesa", o que sugere que os investidores de OPIs exigiram um prémio mais elevado (sob a forma de um *underpricing* mais elevado) possivelmente devido ao aumento da incerteza. Por outro lado, e contrário ao esperado, um maior apoio económico levou também a um maior *underpricing*, sugerindo que, em vez de contrabalançar o impacto das medidas restritivas na incerteza, o apoio económico exacerbou esse impacto. Por último, confirmamos as nossas expectativas de que os países mais afetados pelo vírus (visto através do número de casos confirmados e de mortes por COVID-19) registaram um maior *underpricing*.

Este estudo pretende contribuir para a área de investigação das OPI, simultaneamente proporcionando mais investigação sobre o impacto financeiro das medidas tomadas pelos diferentes governos Europeus durante a pandemia.

Palavras-chave: OPI, *underpricing*, COVID-19, ação governamental, Europa

Classificação JEL: G12, G34, G38, Q54, O52

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1. Introduction

When the World Health Organization (WHO) declared COVID-19 as an international health emergency on the 30th of January 2020 and elevated it to pandemic status on the 11th of March of the same year, the World faced an unprecedented challenge. As of 16th of January 2023, there were a cumulative total of 667 million cases of COVID-19 registered and 6.72 million deaths that resulted from it[1]. As of January 2023, however, close to 13.1 million vaccines had been administered worldwide, translating to an estimated 19.8 million lives saved in the first year of vaccination alone, 2021 (Watson et al., 2022).

The pandemic was, ultimately, a challenge for society as we know it and a test for world leaders and governments. Even though the infection and the difficulties countries faced were similar, overall, each country´s government reacted and responded differently: while some nations opted for strict measures, like China, South Korea and Denmark, others chose lighter policies, such as the United States, Russia, and Brazil (Greer et al., 2021). These policies ranged from voluntary to mandatory mask-wearing, school and workplace closing, public events cancellation, public transportation and international travelling restrictions to a lockdown mandatory stay at home. In 2020, the world´s collective gross domestic product (GDP) was estimated to have dropped 3.4%[2], 114 million people worldwide lost their jobs (Richter, 2021), 200,000 establishments closed permanently in the U.S. (Crane et al., 2021), and Euronext registered a market capital value of 4,227.03 billion U.S. dollars at the end of 2020[3].

Governments also created financial policies to alleviate the pandemic's financial pressure, such as income support and debt relief. As of December 2020, in North America and almost all European countries, governments provided income support that covered more than 50% of its workers' lost salary (Hale, 2021), and in the United States, 350 billion U.S. dollars were made available to respond to the pandemic and 10 billion U.S dollars were provided to help exposed homeowners[4].

[1] Accessed on the 16th of January 2023 from https://covid19.who.int/
[2] Accessed on the 17th of January 2023 from https://www.statista.com/topics/6139/covid-19-impact-on-the-global-economy/#topicOverview
[3] This amount is 45.33% lower than the value registered in late 2021 of 7,731.35 billion U.S. dollars. Statista, 2022. Accessed on the 17th of January 2023 from https://www.statista.com/statistics/1102751/change-in-market-capital-of-european-stock-exchanges-since-the-coronavirus-outbreak/
[4] Accessed on the 17th of January 2023 from https://home.treasury.gov/policy-issues/coronavirus

Nonetheless, companies still decided to go public during the COVID-19 pandemic. A total of 1,696 Initial Public Offerings took place in the U.S. stock market between 2020-2022, with a record of 1,035 IPOs in 2021 solely[5]. An IPO is one of the most important milestones in a firm´s life as it represents the moment when it sells its shares to the public for the first time. With it, however, comes a significant cost: underpricing; it is estimated that the average IPO totals up to 9.1 million U.S. dollars in underpricing alone (Loughran & Ritter, 2002), excluding all other costs and fees associated with the listing process. This phenomenon of underpricing has been recorded to happen worldwide in nearly every country with a stock market: the United States (Ritter, 1991), France (Chahine, 2008), Germany (Ljungqvist, 1997), South Korea (Kim et al., 1995), the United Kingdom (Chambers & Dimson, 2009), South Africa (Van Heerden & Alagidede, 2012), Japan (Kirkulak & Davis, 2005), Australia (Lee et al., 1996), etc.

This study intends to analyse the impact that the measures taken by European countries during the COVID-19 period had on the underpricing of IPOs that took place during such period. One of the main factors that influence IPO underpricing is the uncertainty that investors feel towards the company they plan on investing in (Baron, 1982; Rock, 1986; Beatty & Ritter, 1986; Beatty, 1989), and this has been proven to be higher during the pandemic, albeit for other geographies than the one we will consider (Baig & Chen, 2022).

This study aims to contribute to the IPO research area while also providing new insights regarding the COVID-19 pandemic's relationship with investors' activity. Additionally, this study aims to promote a reflection on the actions taken by the different European governments during the pandemic, analyse their effect on financial markets (particularly the IPO market) post-pandemic, and help governments and policymakers review and make more informed decisions in case of future crises.

Currently, the existing research on COVID-19 is still young, and this study plans on contributing to our knowledge on the matter, specifically relating the measures used by European governments for the period of 1st of January 2020 and the 31st of March 2022 and analysing their impact on the IPO underpricing.

[5] Accessed on the 17th of January 2023 from https://stockanalysis.com/ipos/

2. Literature Review

2.1. Governmental action during the COVID-19 pandemic

Government preparedness and international proactiveness are pointed out as vital aspects that should be taken in place to prepare countries from future pandemics. Globalization, economic interconnectedness, and worldwide connectivity are aspects of the contemporary society we live in that allowed COVID-19 to be as challenging to fight and as costly as it was; however, international cooperation and collective action via restrictive measures, vaccination developments, and tracing capabilities nation- and worldwide are indicated as crucial to protect countries and foster economic success (Pak et. al, 2020; Ross et al., 2015).

Hale et al. (2021) created a global database comprised of several restrictive measures governments took during the pandemic (this database will be used and explained in detail further in the present study) and concluded that, overall, in the initial phase of the pandemic, there were a lot of similarities in the actions taken by the different governments. The authors noted that countries did not consider their local epidemiological evolution but rather adopted a high level of response policies even before hitting their 10th death by COVID-19; almost all the countries analysed in this research changed their policies in the same two-week period in the middle of March 2020, even though the pandemic hit each one differently. This mirroring of responses, the "copycat effect", was thought to happen due to what bordering countries were doing, given the small amount of information available at the time. However, this event did not continue in the following months as nations diverged in terms of COVID-19 cases and, consequently, responses; as the virus progressed, Governments' responses became more heterogeneous (Hale et al., 2021).

Lockdowns, overall, seemed to be the most impactful measures governments took. In fact, Balmford et al. (2020) discovered that a single-week delay in lockdown costed more than 500,000 lives, and countries that were quicker to respond to the pandemic saved more lives than those who delayed their decisions. The authors estimated the implied "price of life"[6] that governments paid for the 37 OECD countries[7], which ranged between 100,000

[6] According to Balmford et al. (2020), the implied "price of life" can be seen as "the costs that national governments were implicitly prepared to pay to protect their citizens as reflected in the economic activity foregone to save lives".

[7] The study was conducted in 2020 but did not include Costa Rica, which became part of the OECD in 2021. As of January 2023, there are 38 member countries of the OECD.

U.S. dollars (for example, the United States and Italy) and more than 1,000,000 U.S. dollars (for example, Germany and South Korea). Balmford et al. (2020) warn, however, that under-recording of COVID-19 cases (which happened in the United Kingdom) may lead to a greater number of lives lost by deferred government interventions and an over estimation of the "price of life", concluding that (appropriate) policies were key to saving lives.

Regardless of the evolution of the disease in a country, Greer et al. (2020) identified, mid-pandemic, four aspects critical to understanding the reasons for COVID-19 responses taken by governments: the country´s social policies to both recovery and crisis management, the nations´ political regime type, the state of its formal political institutions, and the country´s capacity to control health care systems and public administration. Furthermore, the authors recommended that any agenda created against the pandemic should consider politics, alongside public health measures, to create more effective and sustainable policies. Following this line of thought, Kavanagh and Singh (2020) address three questions on the relationship between public health and politics, namely 1) how we should incorporate political capacity into pandemic preparedness, in light of how countries who seemingly had good capacity to respond to the outbreak failed to do so; 2) the advantages of the political regime type in the country, as some mechanisms that were previously beneficial for health in democratic nations failed when facing the pandemic, versus the advantage of authoritarian systems (China, for example, was praised for its swift and impressive decision making and implementation during the crisis, given the country´s concentration of power[8]); and lastly 3) whether the new measures taken during the pandemic (such as lockdowns and quarantine) will be effective in the long term and affect public health policies.

Zaremba et al. (2020) studied whether governmental action on COVID-19 impacted the stock market volatility in 67 countries and discovered that non-pharmaceutical policies implemented considerably rose stock market volatility, i.e., governmental intervention increased stock market volatility; information campaigns and public event cancellations are cited as the two main contributors for this phenomenon. The authors also note that pandemic-related restriction policies impact the trading environment, which, associated with high volatility, may lead the financial markets to increase the cost of capital, promote the sale of riskier assets, and make incorrect assumptions about the future. Nonetheless, travel

[8] Accessed on the 17th of April 2023 from https://thediplomat.com/2020/02/coronavirus-and-chinas-authoritarian-advantage/

restrictions and lockdowns were pointed out as the two most effective measures against COVID-19 transmission (Phan & Narayan, 2020).

It is also important to note that a substantial amount of the literature offers findings that have significant implications for governmental entities and policymakers. Liu et al. (2020), for instance, defend that an alliance between government officials, bank regulators and central banks is necessary to face pandemics by rolling over current loans and thus making it possible for businesses (particularly those in sectors that were highly affected by COVID-19 - Airlines, Hotels, Restaurants & Leisure, and Specialty Retail[9]) to stay afloat and minimize the economic impact. On a different note, the authors also advise health workers, particularly psychologists, to consider the influence of the public announcements of the pandemic and the restrictive measures taken on human lives. Hale et al. (2021) add that understanding the effects of individual policies on government response is critical for future action against worldwide events such as the COVID-19 pandemic.

2.2. COVID-19 and governmental measures impact on financial markets

Ever since the World Health Organization (WHO) declared the coronavirus outbreak as a global pandemic, on the 11th of March of 2020, financial markets reacted negatively to the new infection (Liu et al., 2020; Phan & Narayan, 2020; Ashraf, 2020a; Al-Awadhi et al., 2020; Heyden & Heyden, 2021).

The current literature found that the COVID-19 pandemic had a strong negative impact on global financial markets with significant rises in volatility and unpredictability: a country's stock market reaction varies according to the intensity of the pandemic in said country (Zhang et al., 2020), and it was concluded that the stock market returns reacted negatively to COVID-19 confirmed cases, and, additionally, that stock market's reaction to the pandemic varied according to the severity of the outbreak (Ashraf, 2020a). Following this line of thought, Ashraf (2020b) confirmed that stock markets negatively reacted as the number of COVID-19 confirmed cases increased and investigated that they reacted more proactively to the growth of confirmed cases than to the number of deaths. Additionally, it was also discovered that this negative reaction was stronger during the first days of confirmed

[9] Accessed 13th April 2023 from https://www.spglobal.com/marketintelligence/en/news-insights/blog/industries-most-and-least-impacted-by-covid-19-from-a-probability-of-default-perspective-january-2022-update

cases and then between 40-60 days after that moment. Heyden and Heyden (2021) demonstrated how differently countries and their stock markets reacted to their first confirmed case versus death by the virus: while there was virtually no significant reaction to the first case, the first death led stock markets to react negatively. Simultaneously, the reactions are distinct when governments first announce their fiscal policy (which increased uncertainty and negatively affected stock markets) versus when central banks announce their monetary policy (which calmed stock markets).

On the Chinese stock market, Al-Awadhi et al. (2020) found that both daily growth in total confirmed cases and in total deaths attributed to COVID-19 caused negative effects on stock market returns; particularly, larger market capitalization stocks were found to register more negative effects on returns when compared to smaller market capitalization stocks, and that stocks held by foreign investors experienced a greater price decrease than stocks held by local Chinese investors. Corbet et al. (2020) also found that, for Chinese markets, cryptocurrencies acted as "amplifiers of contagion" rather than hedges and enhanced stock market volatility, seen through the Shanghai Stock Exchange and the Shenzhen Stock Exchange. Additionally, Akhtaruzzaman et al. (2021) studied the effects of COVID-19 in China and the G7 countries[10] and found that both financial and non-financial firms in these countries faced an increase in conditional correlations between their stock returns, particularly financial institutions.

It was also found that more than 4.5% of the U.S. real GDP contraction in the second quarter of 2020 was due to COVID-19 related uncertainty. In fact, Baker et. al (2020) concluded that, among all registered infectious diseases outbreaks in history, COVID-19 was the one who affected the U.S. stock market the most; governmental restrictions and social distancing are pointed out as some of the reasons that can explain this phenomenon (Baker et. al, 2020). However, while stock markets reacted negatively to infection cases and deaths by COVID-19 in early stages, Phan and Narayan (2020) also verified, that there is a market correction phenomenon that happens afterwards: as nations hit their 100,000th infection and 100 deaths mark, half of the stock markets in the analysed countries reacted positively[11].

[10] G7 countries, as of April 2023, are constituted by Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States of America.

[11] Phan and Narayan (2020) verified, via price returns as proxies for stock market reaction, that for 25 countries affected by COVID-19 across the globe (United States, Spain, Italy, France, Germany, United Kingdom, China, Turkey, Belgium, Netherlands, Brazil, Canada, Russia, Switzerland, Portugal, Austria, India, Israel, Ireland,

Nonetheless, Ali et al. (2020) concluded that nearly 30% of global wealth disappeared from the stock markets in 100 days, and that with the evolution of the pandemic, financial markets deteriorated and even a safe commodity, like gold, presented a negative return as COVID-19 entered the United States territory.

Altig et al. (2020) studied various uncertainty measures[12] for the United Kingdom and United States and concluded that all the measures accounted for registered a substantial increase in uncertainty during the pandemic when compared to the period prior to it, with most of them reaching its highest values ever recorded. Additionally, the authors noted that time paths were not constant as implied volatility rose from late February and reached its peak in mid-March, but then fell in late March while stock prices recovered. April 2020 saw an almost 580% rise in the CBOE VIX (Chicago Board Options Exchange Volatility Index) when compared to its value of January 2020 and as such, Baig et al. (2021) studied this phenomenon and concluded that the market volatility (and illiquidity) was linked to rises in confirmed cases and deaths by COVID-19.

While on the volatility dimension, Albulescu (2021) confirmed the negative effect of the pandemic on financial volatility: official announcements on new cases of infection and death rates significantly intensify the S&P 500 realized volatility (the proxy used for the United Sates financial market's volatility). In fact, Chien et al. (2022) observed that a 1.00% increase in global COVID-19 confirmed cases led to a decrease by 0.80% in stock returns and 0.56% in GDP. Engelhardt et al. (2021) further studied whether market volatility could be dependent on one´s trust on society and their respective governments, during the pandemic, following the words of Fukuyama (2020)[13]. And while overall the uncertainty felt by the virus translated to a rise in volatility globally, in countries with high societal and government trust, their stock markets registered significantly lower volatility in reaction to COVID-19 cases announcements.

Sweden, Peru, South Korea, Japan, Chile, and Poland), the stock market's reaction suggested a possible market overreaction and correction as time passed and the number of infected cases and deaths increased.

[12] The authors applied a total of six uncertainty measures namely "implied stock market volatility, newspaper-based policy uncertainty, Twitter chatter about economic uncertainty, subjective uncertainty about business growth, forecaster disagreement about future GDP growth, and a model-based measure of macro uncertainty" (Altig et al., 2020)

[13] In this study, the authors refer to the published article of Francis Fukuyama that mentions that "trust is the single most important commodity that will determine the fate of a society" (Fukuyama, 2020).

In a time where media outlets flooded households with COVID-19 related information, Haroon and Rizvi (2020) analysed the impact of media coverage on market volatility and concluded that the frenzy caused by the media on COVID-19 increased volatility in equity markets, particularly in sectors that were most affected by the pandemic. Baek et al. (2020) also found that COVID-19 related news played a stronger influence on market volatility than economic indicators[14]; the authors also found a negativity bias in their research: negative news (i.e., number of deaths) were twice as impactful as positive news on COVID-19 (i.e., recoveries statistics).

The announcement of the pandemic was found to be the most impacting event for stock markets (Phan & Narayan, 2020), but announcements of social distancing made by governments had a direct negative impact on stock market returns, and an indirect positive effect when confirmed infected cases of COVID-19 reduced. On the other hand, announcements that were related to income support, testing and quarantining had a positive market return (Ashraf, 2020b). Overall, it was concluded that the combination of three different measures (namely stimulus packages, lockdowns, and travel bans) were effective in controlling the stock markets and that lockdowns were the restrictive measure that most confidence restored to stock markets (Phan & Narayan, 2020)[15]. Additionally, Narayan et al. (2021) discovered that, for the G710[10] countries, lockdowns, economic stimulus packages and travel restrictions had a positive influence of their stock markets´ returns, with lockdowns being the most effective in toning down the effects of the pandemic[16]. Nonetheless, Baig et al. (2021) found that imposing lockdowns and restrictions contributed to worsening market stability and liquidity.

Liu et al. (2020) researched the short-term impact of COVID-19 on stock market indices. They found that, while virtually every stock market in the world was negatively

[14] Some economic indicators used include the CBOE VIX, Overnight LIBOR, Effective Federal Funds Rate, TED spread and Moody´s AAA Corporate Bond Yield from the 2nd of January 2020 to the 23rd of February 2020. (Baek et al., 2020)

[15] Out of the 25 analysed countries, seven (United States, Germany, Russia, India, Israel, Peru, and Chile) demonstrated that lockdown announcements had the best reactions from stock markets when compared to stimulus packages and travel bans (Phan & Narayan, 2020). It was also found that stimulus packages also succeeded in bringing a positive reaction out of the stock market (greater than travel bans announcements), but this achievement was only made possible in most countries that had already implemented travel bans and lockdowns.

[16] Particularly, on the countries stock market returns, lockdowns were effective in five countries (excluding Germany and Italy), economic stimulus packages were effective in three countries (Canada, United Kingdom, and United States), and travel restrictions were only effective in two countries (Canada and Germany).

impacted by confirmed cases of COVID-19, those in Asian countries presented more negative abnormal returns when compared to non-Asian stock markets. The authors also discovered that the fear sentiment investors felt during the outbreak was a transmission channel for the pandemic´s effect on the stock markets.

At the firm level, Ding et al. (2021) analysed corporations from 61 countries. They concluded that firms who had stronger finances (i.e., more cash available, less debt and larger profits) before the pandemic registered a smaller drop in stock prices when compared to companies whose financial position was not as solid. Simultaneously, the authors verified that companies who had less exposure to COVID-19 via international exposure (companies who were less exposed through their supply chain and customer location) and more CSR (Corporate Social Responsibility) plans before 2020 had smaller stock return variations. Additionally, it was also found that the ownership structure of a firm also worked as an immunity tool in the face of the pandemic: companies that were controlled by families, large corporations, and governments and who had less entrenched managers presented better stock returns than companies owned by hedge funds or other asset management entities.

2.3. IPO underpricing

IPO underpricing is considered a financial puzzle for researchers; it is when a company lists its IPO at a price that is lower than its market value, i.e., a stock is underpriced when its price at the end of the first trading day is higher than its defined IPO price. This phenomenon was first researched in 1975 by Ibbotson when the author concluded a positive 11.40% initial performance average for new issue offerings for IPOs of American firms from 1960 to 1969. In the decades after, the average underpricing was registered at 7.00% in the 80s, 15.00% in the 90s[17] and 12.00% during 2001-2003 (Loughran & Ritter, 2004). Following Ibbotson´s research, many reasons were pointed out to justify this puzzle.

The literature suggests that an ex-ante uncertainty by investors on an IPO is directly and positively related to its initial return, i.e., the higher the uncertainty investors feel regarding an IPO deal, the higher its underpricing is expected to be (Baron, 1982; Rock, 1986; Beatty & Ritter, 1986; Beatty, 1989). Baron (1982) defends that underpricing happens due to information asymmetry between investment bankers (underwriters) and issuers: since underwriters have better information about financial markets than issuers, new issues are

[17] Exceptionally, during 1999-2000, the underpricing was registered at 65.00% due to the internet bubble.

underpriced. Following a similar reasoning, Rock (1986) presents the winner´s curse as an explanation for this phenomenon, defending that the firm must underprice its new issues so that uninformed investors can participate in the market and acquire them since informed investors spot and abandon overpriced issues leaving uninformed investors facing the winner's curse. Consistent with this, the signalling theory (Allen & Faulhaber, 1989; Welch, 1989; Hoberg, 2007) is pointed as another justification for "leaving money on the table", providing that high-quality firms can underprice their issues to signal the market their quality, while low-quality firms must bear high expenses to seem to be high-quality; in other words, firm managers typically have more information about their firm´s quality than outside investors and as such, they must announce their firm´s quality via underpricing.

Certo et al. (2001b) found that consistent with the signalling theory, a firm's board size and reputation are negatively related to underpricing; in other words, a larger, well-reputed board may signal to investors that the company in question has good access to different kinds of resources and therefore presents a lower underpricing than poorly reputed companies.

Benveniste and Spindt (1989), and Benveniste and Wilhelm (1990) defend that the book-building process that underwriters go through after a roadshow ends happens so that underwriters can access true information from informed investors. Thus, IPO offer prices are low as a "natural consequence of the premarket auction" (Benveniste & Spindt, 1989) to reward investors for disclosing information. Barry and Jennings (1993) empirically confirm this theory by proving that almost all abnormal initial returns from underpricing are "corrected" at the opening trade. In fact, less than half of the analysed IPOs had positive returns on the first day (after its first transaction). As such, the authors further prove the theory that purchasers of the securities in the initial offering are those who benefit most from the underpricing phenomenon, as the continued price movement that happens after the security enters the secondary market "corrects" the underpricing.

Ibbotson (1975) and Tinic (1988) suggest the "implicit insurance" theory as an explanation for underpricing: IPOs are typically underpriced to protect underwriters against any possible legal liability and reputational damages they may face[18]. Complementing this

[18] Tinic (1988) verified the "implicit insurance" theory on IPOs before and after the Securities Act of 1933. The author proved that firms that went public after the enactment of the Securities Act exhibited greater IPO

finding, Hughes and Thakor (1992) demonstrated that litigation risk, while it is a cause for high initial returns, it is not its sole reason, for there was underpricing verified in countries where litigation risk is of not much importance (e.g., the United Kingdom).

Loughran and Ritter (2002) present the prospect theory to justify IPO underpricing, arguing that issuing firms pay more attention to a change in their wealth rather than the total level of wealth they have. As such, if the net wealth for pre-IPO shareholders is positive, if existing investors anticipate wealth increases after the deal, underpricing may take place.

2.4. COVID-19 and governmental measures impact on IPO market

As this is a relatively recent topic, there isn't much research published on the impact that the COVID-19 pandemic had on IPO underpricing in Europe, hence where our study intends to be of use, to fill this gap in the current literature.

The available studies show, however, that market-adjusted initial returns on IPOs are negatively related to fear levels of the pandemic (Mazumder & Saha, 2021) and that the pandemic had a significant impact on the IPO market and companies that went public for the first time during COVID-19 suffered from higher information uncertainty than those prior to the pandemic (Baig & Chen, 2022). Additionally, Baig and Chen (2022) also concluded, for the 421 American IPOs considered, that there is greater IPO underpricing and post-offering return volatility if the gravity of the pandemic rises. In fact, Zhang and Neupane (2023) concluded that IPOs during the pandemic period were 17.60% more underpriced than those prior to the pandemic.

This was also confirmed by Tutuncu (2022) for Turkish IPOs, as it was found that firms that went public amid the pandemic obtained substantially higher short-term (one month) returns than those prior to the pandemic. The author explained this to be the result of investments made by small retail investors (versus institutional investors who invest in assets with lower returns) since the larger short-term returns are associated with a higher level of retail investor participation in the markets during the pandemic. However, this study was published in 2022, during the health crisis, and as such, it was warned that the momentum experienced could have a short life and die as the pandemic ended.

initial returns than those before the Act. Some of the results obtained in this study are consistent with asymmetric information models previously discussed since much of the ground for legal action is based on the differences in knowledge between the parties involved (i.e., underwriters and investors).

Fedorova et al. (2022) concluded that action taken by the government to face the pandemic helped reduce IPO underpricing. The mere implementation of these measures is enough to impact financial markets, heedless of their resulting efficiency. The authors found that the more negative the company's risk factors were, the higher the underpricing, and that the more positive the prospectus of the deal was, the lower the underpricing.

In the case of India, Maheshwari and Kumar (2022) compared the IPOs listings on the National Stock Exchange and Bombay Stock Exchange before and after COVID-19. They concluded on solid evidence in favour of higher levels of underpricing and an increase in a total number of firms going public during the pandemic.

Panda and Guha (2023) also analysed the short-term performance of IPOs during the pandemic and the decade before it in a cross-country setup. They concluded that underpricing is greater in IPOs issued during COVID-19, even though it gets corrected five days later. Underwriter reputation, new shareholder participation, industry affiliation of the issuing firm and the severity of the pandemic in the specific country are pointed out as some of the causes of this phenomenon. However, it was also discovered that the success of the IPOs was not highly affected by the humanitarian crisis experienced; in fact, Panda and Guha (2023) found that the number of companies that successfully went public for the first time during the COVID-19 period was almost 50% higher than those during an average period (it was registered 232 more IPOs per year during the COVID-19 period than on an average period such as the one before the pandemic).

Notwithstanding, 2020 was a record year for biotech IPOs: there were over 100 initial public offerings in that year, almost twice the amount from the previous year, at a total of 20 billion U.S. dollars in proceeds (Cameron & Morrison, 2021). This result does not come entirely as a surprise, given the high focus and efforts on developing a vaccine against the virus at the time.

Please note that research on COVID-19 and IPO performance is an evolving field, given its actuality.

3. Methodology and data sample

3.1. Methodology

Here, it will be studied whether the different measures governments applied during COVID-19 impacted IPO underpricing. To address the gap in research on this topic, we propose the following research questions and hypotheses for this study:

(RQ1) Compared to the previous period, is there a difference in the underpricing of IPOs between the 1st of January 2020 and the 31st of March 2022?

Hypothesis 1 (H1): Firms that went public during COVID-19 (here defined as between the 1st of January 2020 and the 31st of March 2022) experienced greater underpricing than those that went public previously.

As seen throughout Chapter 2. of the present study, the pandemic negatively and heavily impacted financial markets, including the global IPO market, greatly derived from the uncertainty felt. Thus, as higher ex-ante uncertainty leads to higher underpricing (Baron, 1982; Rock, 1986; Beatty & Ritter, 1986; Beatty, 1989), we expect to verify a higher level of underpricing in IPOs that took place within the considered COVID-19 period than those issued before it, in accordance with Mazumder and Saha (2021), Maheshwari and Kumar (2022) and Panda and Guha (2023), among others.

(RQ2) In what way did the restrictive measures that each of the analysed European countries took impacted (attenuate or exacerbate) the underpricing of the IPOs for the period considered of 1st January 2020 to 31st March 2022?

Hypothesis 2 (H2): The higher the restrictiveness level of the measures taken by the governments, the greater the underpricing given the higher level of uncertainty associated with it.

As more restrictive measures (such as lockdowns) increased uncertainty when compared to lighter measures, and worsen market stability (Baig et al., 2021) we expect that underpricing will be more impacted by the former than the latter.

(RQ3) In what way did the economic support that each of the analysed European countries provided impact (attenuate or exacerbate) the underpricing of the IPOs during the COVID-19 period?

Hypothesis 3 (H3): The greater the economic support provided by the governments to families, the lower the underpricing registered.

As discussed in Chapter 2.2., economic support from the government had a positive impact on stock markets (Phan & Narayan, 2020; Narayan et al., 2021; Ashraf, 2020a). As financial support is given to families on top of the restrictive measures applied, some stability and confidence may return to investors, reducing uncertainty and, thus, we expect underpricing to decrease.

(RQ4) How did the IPO market react for countries most affected by the pandemic?

Hypothesis 4 (H4): Countries most affected by the pandemic (seen in the number of confirmed cases and deaths by the virus) experienced greater levels of underpricing.

Some of the most affected countries by the pandemic, measured by the relative and total numbers of total confirmed cases and deaths, include France, Germany, Italy and the United Kingdom (the "HIGH-impacted countries"). For these countries we expect to verify higher levels of underpricing for the period considered.

Following most finance literature (Ibbotson, 1975; Beatty & Ritter, 1986; Loughran & Ritter, 2004; McDonald & Fisher, 1972; Arthurs et al., 2008; Bruton et al., 2009; Daily et al., 2003; Baker, 2021; among others)[19], the IPO underpricing as initial return[20] will be defined as the difference between the stock´s price at the end of the first day of trading and the initial stock price defined by the IPO underwriters, relative to this initial offer price. A positive value indicates underpricing: the underwriter "miscalculated" the offer price and the newly public company "left some money at the table". As follows:

$$Underpricing_i = \frac{(1st\ DAY\ CLOSING\ PRICE_i - OFFER\ PRICE_i)}{OFFER\ PRICE_i} \times 100 \quad \textbf{(3.1)}$$

where i = each company analysed in the corresponding period

Regression **(3.1)** will be employed for both deals that occurred prior to the COVID-19 pandemic (from the 2nd of October 2017 to the 31st of December 2019) and for deals that

[19] Although it is extensively used and was considered **(3.1)** for underpricing in this study, some authors use the market-adjusted returns instead (Carter et al., 1998; Aggarwal & Rivoli, 1990; Ritter, 1991).
[20] According to Daily et al. (2003), "Underpricing is used synonymously in the literature with initial returns; the greater the underpricing the higher the initial returns."

happened during the COVID-19 period (from the 1st of January 2020 to the 31st of March 2022), allowing us to answer **(RQ1)**.

Previous studies in the literature have used Ordinary Least Squares (OLS) regressions to estimate the existence of underpricing and following the same methodology we created Regressions **(3.3)** and **(3.4)** to answer **(RQ2),** Regressions **(3.5)** and **(3.6)** for **(RQ3)**, Regressions **(3.7)** and **(3.8)** combining the effects of both independent variables, and Regressions **(3.9)**, **(3.10)** and **(3.11)**, for each country analysed, to answer **(RQ4)**:

$$Underpricing_i = \alpha + \beta_1 \ln\,(1 + AGE)_i + \beta_2 \ln(SIZE)_i + \beta_3 TECH_i + \beta_4 FINANCIAL + \beta_5 \ln(DEAL\,VALUE)_i + \beta_6 EXCHANGE_i + \beta_7 PENNY\,STOCK_i + \beta_8 COUNTRY_i + \beta_9 YEAR_i + \beta_{10} RETURN_i + \varepsilon_i \quad \textbf{(3.2)}^{21}$$

$$Underpricing_i = \alpha + \beta_1 RESTRICTIONS\,INDEX_i + \beta_2 \ln\,(1 + AGE)_i + \beta_3 \ln(SIZE)_i + \beta_4 TECH_i + \beta_5 FINANCIAL + \beta_6 \ln(DEAL\,VALUE)_i + \beta_7 EXCHANGE_i + \beta_8 PENNY\,STOCK_i + \beta_9 RETURN_i + \varepsilon_i \quad \textbf{(3.3)}$$

$$Underpricing_i = \alpha + \beta_1 RESTRICTIONS\,INDEX_i + \beta_2 \ln\,(1 + AGE)_i + \beta_3 \ln(SIZE)_i + \beta_4 TECH_i + \beta_5 FINANCIAL + \beta_6 \ln(DEAL\,VALUE)_i + \beta_7 EXCHANGE_i + \beta_8 PENNY\,STOCK_i + \beta_9 RETURN_i + \beta_{10} YEAR_i + \varepsilon_i \quad \textbf{(3.4)}$$

[21] Regression **(3.2)** represents the base model that was used to construct the Regressions we will employ. Given the number of observations, the number of countries analysed, the time period defined and the statistical properties of the variables, **(3.2)** cannot be applied to any of the research questions in the present study.

$$Underpricing_i = \alpha + \beta_1 ECONOMIC\ SUPPORT\ INDEX_i + \beta_2 \ln(1 + AGE)_i + \beta_3 \ln(SIZE)_i + \beta_4 TECH_i + \beta_5 FINANCIAL + \beta_6 \ln(DEAL\ VALUE)_i + \beta_7 EXCHANGE_i + \beta_8 PENNY\ STOCK_i + \beta_9 RETURN_i + \varepsilon_i \quad \textbf{(3.5)}$$

$$Underpricing_i = \alpha + \beta_1 ECONOMIC\ SUPPORT\ INDEX_i + \beta_2 \ln(1 + AGE)_i + \beta_3 \ln(SIZE)_i + \beta_4 TECH_i + \beta_5 FINANCIAL + \beta_6 \ln(DEAL\ VALUE)_i + \beta_7 EXCHANGE_i + \beta_8 PENNY\ STOCK_i + \beta_9 RETURN_i + \beta_{10} YEAR_i + \varepsilon_i \quad \textbf{(3.6)}$$

$$Underpricing_i = \alpha + \beta_1 RESTRICTIONS\ INDEX_i + \beta_2 ECONOMIC\ SUPPORT\ INDEX_i + \beta_3 \ln(1 + AGE)_i + \beta_4 \ln(SIZE)_i + \beta_5 TECH_i + \beta_6 FINANCIAL + \beta_7 \ln(DEAL\ VALUE)_i + \beta_8 EXCHANGE_i + \beta_9 PENNY\ STOCK_i + \beta_{10} RETURN_i + \varepsilon_i \quad \textbf{(3.7)}$$

$$Underpricing_i = \alpha + \beta_1 RESTRICTIONS\ INDEX_i + \beta_2 ECONOMIC\ SUPPORT\ INDEX_i + \beta_3 \ln(1 + AGE)_i + \beta_4 \ln(SIZE)_i + \beta_5 TECH_i + \beta_6 FINANCIAL + \beta_7 \ln(DEAL\ VALUE)_i + \beta_8 EXCHANGE_i + \beta_9 PENNY\ STOCK_i + \beta_{10} RETURN_i + \beta_{11} YEAR_i + \varepsilon_i \quad \textbf{(3.8)}$$

$$Underpricing_i = \alpha + \beta_1 RESTRICTIONS\ INDEX_i + \beta_2 \ln\ (1 + AGE)_i + \beta_3 \ln(SIZE)_i + \beta_4 \ln(DEAL\ VALUE)_i + \beta_5 RETURN_i + \varepsilon_i \quad \textbf{(3.9)}$$

$$Underpricing_i = \alpha + \beta_1 ECONOMIC\ SUPPORT\ INDEX_i + \beta_2 \ln\ (1 + AGE)_i + \beta_3 \ln(SIZE)_i + \beta_4 \ln(DEAL\ VALUE)_i + \beta_5 RETURN_i + \varepsilon_i \quad \textbf{(3.10)}$$

$$Underpricing_i = \alpha + \beta_1 RESTRICTIONS\ INDEX_i + \beta_2 ECONOMIC\ SUPPORT\ INDEX_i + \beta_3 \ln\ (1 + AGE)_i + \beta_4 \ln(SIZE)_i + \beta_5 \ln(DEAL\ VALUE)_i + \beta_6 RETURN_i + \varepsilon_i \quad \textbf{(3.11)}$$

where i = each company analysed and εi = the stochastic error.

It is also important to mention that due to the reduced number of IPO deals in each of the 10 countries considered, we do not have enough observations in each country to study whether all the control variables have an impact on underpricing. Therefore, to analyse the impact of underpricing in a particular country, we created Regressions **(3.9)** to **(3.11)** with the numerical deal-specific and market-specific control variables, alongside the two independent variables considered, for each country.

The independent and control variables considered in the Regressions above mentioned are described in the following section, divided by independent variables, firm-specific control variables, deal-specific control variables and market-specific control variables.

3.1.1. Independent variables

In our study, the (independent) variables of interest are the RESTRICTIONS INDEX and the ECONOMIC SUPPORT INDEX.

RESTRICTIONS INDEX is the Oxford COVID-19[22] Stringency Index that translates the restrictiveness of the measures each of the considered European governments took to fight the pandemic. It comprises nine metrics across containment and health dimensions[23]. The greater the index value, the more restrictive the measures applied.

According to our *H2*, we expect a positive relationship between the variable and underpricing.

ECONOMIC SUPPORT INDEX is the Oxford COVID-19[2222] Economic Support Index that accounts for the economic support given to families during the pandemic. It comprises two metrics, namely E1 – Income support, and E2 - Debt/contract relief for households, both numerical variables. The greater the index value, the greater the level of economic support in the country.

According to our *H3*, we expect a negative relationship between the variable and the underpricing.

3.1.2. Firm-specific control variables

Following most finance literature on the topic, a set of four firm-specific control variables was used as independent variables.

Ln (1+AGE)[24] controls for the firm´s age. Estimated as the natural logarithm of the difference between the year where the IPO took place, and the year the firm was founded, plus one, as in Carter and Manaster (1990), Ljungqvist and Wilhelm Jr. (2003), Loughran and Ritter (2004), and Chahine (2008).

A company´s age is a variable that impacts underpricing given that older, more mature companies create less ex-ante uncertainty about their value than younger companies[25] and, thus, reduce underpricing. These companies have more information available for

[22] The Oxford COVID-19 Government Response Tracker (OxCGRT) will be explained in Chapter 3.2.
[23] The nine metrics used in the Stringency value are C1 – School Closing, C2 – Workplace closing, C3 – Cancel public events, C4 – Restrictions on gathering size, C5 – Close public transport, C6 – Stay at home requirements, C7 – Restrictions on internal movement, C8 – Restrictions on international travel, and H1 – Public information campaign. All of these are numerical variables.
[24] To normalize the values, we applied a natural logarithm to the AGE and SIZE variables, in accordance with the literature (Loughran & Ritter, 2004).
[25] Younger companies present a greater risk of failure and suffer from a "liability of newness" (Singh et al., 1986; Freeman et al., 1983; Damodaran, 2009)

investors and their data is more probable to be followed by financial entities. A negative relationship between firm age and underpricing is expected (Ritter, 1984; Megginson & Weiss, 1991; Carter et al., 1998; Engelen & Van Essen, 2010).

Ln (SIZE)[232424] controls for the size of the firm. Estimated as the natural logarithm of the total assets of the firm the year prior to its IPO as in Habib and Ljungqvist (2001), Lowry and Schwert (2002), and Loughran and Ritter (2004).

Several studies report a negative relationship between firm size and underpricing, i.e., the larger the firm, the smaller the underpricing. This may happen because investors see larger firms as less uncertain when compared to smaller firms that may not have as many resources as the former (Ibbotson et al., 1988; Daily et al., 2003; Schenone, 2004). Additionally, it was also proved that larger firms will attract prestigious underwriters for their IPOs as opposed to smaller firms (underwriter prestige, as it will be discussed later, reduces underpricing).

TECH is a dummy variable that represents whether the firm belongs to a high-technological industry. The variable is equal to "1" if the firm belongs to a technological industry, and "0" otherwise.

As defended by Chahine (2008) and Bruton et al. (2009) and following the methodology of Lowry and Schwert (2002), a high-tech industry is one that belongs to biotech, computer equipment, electronics, communications, and general technology industry. Here, we will follow the methodology of Certo et al. (2001a) for the discrimination of industries, considering the high-technological industries to be those with the following 2-digit US SIC codes: SIC 35 ("computer hardware"), SIC 36 ("semiconductors and printed circuits"), SIC 73 ("computer software"), SIC 28 ("biotechnology", "pharmaceuticals" and "specialty chemicals"), SIC 48 ("telecommunication") and SIC 37 ("aerospace")[26].

Firms within the technological industry have been shown to display a higher level of IPO underpricing than those outside this industry since they are considered riskier than non-

[26] "For our current study, then, we compiled a listing of high-tech industries based on their associated 2-digit SIC codes as follows: computer hardware (SIC 35), computer software (SIC 73), semiconductors and printed circuits (SIC 36), biotechnology (SIC 28), telecommunications (SIC 48), pharmaceuticals (SIC 28), specialty chemicals (SIC 28), and aerospace (SIC 37)" (Certo et al., 2001a)

high-technological firms and thus display a greater level of ex-ante uncertainty (Lowry & Schwert, 2002; Chahine, 2008; Engelen & Van Essen, 2010).

FINANCIAL[27] is a dummy variable that takes the value of "1", if the firm belongs to a financial industry, and "0" otherwise.

Following Butler et al. (2014), we considered financial firms, those that presented a US SIC code between 6000 and 6999, to account for this industry. As these institutions are subject to strict regulations and are overlooked by agents, Alli and Yung (1994) have found that IPOs of financial institutions provide lower first-day initial returns when compared to non-financial institutions´ IPOs.

3.1.3. Deal-specific control variables

Following most finance literature on the topic deal-specific control variables were also included in the model.

Ln (DEAL VALUE) controls for the size of the IPO deal. Estimated as the natural logarithm of the deal value of the IPO to normalize the values, as defended by Carter et al. (1998) and Aggarwal et al. (2002).

The IPOs offer size (here defined as the deal value) is the total amount raised by the firm by issuing and selling new shares publicly. Since more established companies, who provide less risk to the markets (as explained earlier in this study), are the ones behind larger IPOs, the underpricing verified for these firms should be smaller than that of smaller offers (Carter et al., 1998). This negative relationship between IPO proceeds and underpricing is also verified by Habib and Ljungqvist (1998), Beatty and Ritter (1986) and Chemmanur´s model (1993) according to Aggarwal et al. (2002), who defends that smaller offerings are typically more speculative than larger offerings and, thus, present larger initial returns.

EXCHANGE is a dummy variable that represents the type of stock exchange in where the IPO was listed. Following Su and Fleisher (1999), the dummy will equal "1" if the IPO was

[27] Even though most literature excludes deals that involve financial companies and penny stocks (deals with offer prices below €5) from their sample, we opted to include the variables FINANCIAL and PENNY STOCKS in our study given their relevance and impact on the total size of our sample for the period considered, and study them, to account for possible effects.

listed on a considered "large" stock exchange and "0" if listed on a considered "small" stock exchange[28].

For this split, we considered the size of the market capitalization of the stock exchanges and their listing requirements (with larger and stricter exchanges being attributed "1" and "0" otherwise) as in Affleck-Graves et al. (1993). The author argued a "certification proposition" defending a negative relationship between the strictness and amount of listing standards and underpricing, i.e., "higher listing standards reduce the expected underpricing of an IPO by reducing ex-ante uncertainty about its value" (Affleck-Graves et al., 1993).

We argue that alongside the listing requirements, the prestige and market capitalization of the stock exchange similarly impacts underpricing. In our study, we have deals listed in 22 different stock exchanges, namely: Aquis Stock Exchange, Australian Securities Exchange, Boerse Berlin, Boerse Duesseldorf, Bolsa de Madrid, Borsa Italiana - MTA, Bucharest Stock Exchange, Deutsche Boerse (Frankfurt Stock Exchange), Euronext (Amsterdam and Paris), Hong Kong Stock Exchange, Istanbul Stock Exchange, London Stock Exchange, Mercado Alternativo Bursatil, Nasdaq National Market, Nasdaq OMX (Stockholm and Copenhagen), New York Stock Exchange, Nordic Growth Market, Oslo Bors, Spotlight Stock Market and Warsaw Stock Exchange.

Based on their size, the following 10 stock exchanges presented the highest market capitalization and were, thus, considered to be the "large" stock exchanges: New York Stock Exchange ($22.6 trillion, 2023), Nasdaq National Market ($18 trillion), Euronext[29] ($6.6 trillion), Hong Kong Stock Exchange ($4.9 trillion), London Stock Exchange ($3.2 trillion), Deutsche Boerse ($2.1 trillion), Nasdaq OMX[29] ($1.9 trillion) and Australian Securities Exchange ($1.7 trillion)[30].

[28] It is important to mention that some of the considered countries only have one major stock exchange to which the IPO deals take place in. Given the reduced number of observations in our sample (due to the selection criteria applied), this variable, as we previously explained, will not be considered when analysing the Regressions at country-level.

[29] Euronext includes both Euronext Amsterdam and Euronext Paris and Nasdaq OMX includes both Nasdaq OMX - Stockholm and Nasdaq OMX – Copenhagen.

[30] The data regarding the stock exchanges market capitalization was retrieved from the following websites: https://www.statista.com/statistics/270126/largest-stock-exchange-operators-by-market-capitalization-of-listed-companies/ (*Statista*, 2023); https://www.statista.com/statistics/693587/stock-exchanges-market-capitalization-europe/ (*Statista*, 2023); https://www.statista.com/statistics/265236/domestic-market-capitalization-in-the-asia-pacific-region/ (*Statista*, 2023); https://www.insidermonkey.com/blog/5-largest-stock-exchanges-in-the-world-2-1125009/2/ (*Yahoo Finance*, 2023); https://finance.yahoo.com/news/21-

PENNY STOCK[27] is a dummy variable that equals to "1" if the offer price is lower than €5 (the "penny stocks"), and "0" otherwise (the "ordinary stocks"), as in Bradley et al. (2006).

Penny stocks, a common phenomenon in IPOs, are when a company lists its stock with an offer price lower than €5; Bradley et al. (2006) found that these stocks present a higher level of underpricing than ordinary stocks, longer lockup periods and larger gross spreads, even though they register worse long run performances. In the present study, we expect to verify the same result.

Alongside the three variables above described, it is also common practice in the literature to account for the presence of Venture Capitalists in the deal and the rankings of the underwriters of the IPO. A VC-backed IPO has been showed to negatively relate to IPO underpricing (Lerner, 1994; Cyr et al., 2000) although the contrary has been proven recently (Bradley & Jordan, 2002; Brav & Gompers, 2000). A more reputed underwriter translates into a lower underpricing (Carter et al., 1998) but this has also been proven incorrect in recent studies, after the decade of 1990 (Cooney et al., 2001; Brav & Gompers, 2003). However, given the data available to us, we were not able to test these variables.

3.1.4. Market-specific control variables

Following most finance literature on the topic, we also include in the model market-specific control variables.

COUNTRY[31] are dummy variables that represent the country in which the IPO took place and therefore control for country-fixed effects.

Different European governments took different restrictive measures in their countries: some opted for stricter measures, while others employed lighter ones. However, in addition, there are other factors at the country level that can affect IPO underpricing, such as the country's own regulations on the financial markets and differences in investor

largest-stock-exchanges-world-154737743.html (*Yahoo Finance*, 2023); all of the links above were accessed on the 31st of July 2023.

[31] These variables (YEAR and COUNTRY) are used together solely in Regression **(3.2)** for our base model. Separately, these variables are considered in Regressions **(3.4)**, **(3.6)** and **(3.8)** when we account for year-fixed effects (for the variable YEAR), and in Regressions **(3.9)**, **(3.10)** and **(3.11)** when we specify the country in our analysis (for the variable COUNTRY), for all the years in our period.

sentiment. In fact, Schmeling (2009) found that Italy, Germany, and France display a higher impact of investor sentiment on returns when compared to the United States. While in the present study, we solely considered European countries, we expect to verify some differences between them, with the countries with a higher number of confirmed cases and deaths by COVID-19 presenting a stronger value.

YEAR[31] is a dummy variable with the year where the IPO took place, between 2020-2022 and therefore controls for year-fixed effects.

Similar to that of Su and Fleisher (1999), Dolvin and Jordan (2008), and Loughran and Ritter (2004), we will be using year dummies in this study to control for the timing and for possible "hot issue" market effect (Ritter, 1984). This phenomenon happens when IPOs are gaining a lot of attention from investors. It is a period marked with considerable levels of IPO activity (Ritter, 1984), and allowing us to control for this variable will give us more understanding of the market timing and its impact on IPO underpricing. While COVID-19 worsened financial markets overall, we still expect to verify a difference between the years of the pandemic as the virus became more controlled over time and more health-related information came to light.

RETURN, measured by the overall market return, three months prior to the IPO date.

The stock market is witness to investors' optimism and pessimism, and these moods impact market return (Derrien & Womack, 2003; Finkle, 1998): optimistic market momentums translate into large positive short-term returns and many new issues, while the opposite is true for pessimistic moments (Bruton et al., 2009). Underpricing has been shown to be higher when the market return is high (Ritter, 1984) – a phenomenon linked to the "equity market timing" where firms plan to issue stocks when the market value of their issues is higher compared to their book market is displaying high valuations, compared to their book values or previous market values (Baker & Wurgler, 2002). To measure this variable, we calculated the market return of the stock index STOXX Europe 600 three months prior to the day of each IPO considered, as all countries considered are part of Europe.

However, as we have seen throughout the present study, the pandemic period was categorized by depressing financial markets in general, and thus, in accordance with our *H1*, we expect to verify low market returns and greater underpricing given the increased level of

uncertainty. **Table 1** below summarizes the expected relationship between all the variables considered and the underpricing.

Table 1 - Expected relationship between variables and underpricing

This table presents the expected relationships between the variables and underpricing. Appendix B contains the variables´ descriptions.

Variable	Variable type	Brief description	Expected relationship
RESTRICTIONS INDEX	Numerical variable	The OxCGRT Stringency Index that accounts for the economic support given to families during the pandemic	+
ECONOMIC SUPPORT INDEX	Numerical variable	The OxCGRT Economic Support Index that accounts for the economic support given to families during the pandemic	-
AGE	Numerical variable	The difference between the year where the IPO took place and the year the firm was founded	-
SIZE	Numerical variable	Total assets of the firm the year prior to its IPO	-
TECH*	Categorical variable (dummy)	To differenciate between technological (those with US SIC codes 35, 36, 73, 28, 48 and 37)(dummy=1) and non-technological companies (dummy=0)	+
FINANCIAL*	Categorical variable (dummy)	To differenciate between financial (those with US SIC codes between 6000 and 6999)(dummy=1) and non-financial companies (dummy=0)	-
DEAL VALUE	Numerical variable	The size of the IPO	-
EXCHANGE*	Categorical variable (dummy)	To differenciate between "large" stock exchanges (dummy=1) and "small" stock exchanges (dummy=0)	-
PENNY STOCK*	Categorical variable (dummy)	To differenciate between penny (those with offer price below €5)(dummy=1) and ordinary stocks (dummy=0)	+
COUNTRY**	Categorical variable (dummy)	Represents the country in which the IPO took place	**n.a.**
YEAR**	Categorical variable (dummy)	Represents the year in which the IPO took place	**n.a.**
RETURN	Numerical variable	The overall market return on the day the IPO took place, represented by the STOXX Europe 600	+

Notes: * the relationship here expected is that of when the dummy variable equals "1"; ** we expect the underpricing to be greater in the countries (and during the years) that registered a greater number of confirmed cases and death by COVID-19.

3.2. Data Sample

Our sample was mainly collected from the Zephyr[32] database and complemented with information from the Orbis[33] database, as these contained the information needed for the present study. Information that was not available in the databases

[32] Availabe at https://zephyr.bvdinfo.com. Accessed from January to August 2023.
[33] Availabe at https://orbis.bvdinfo.com. Accessed from January to August 2023.

was supplemented with information from the IPO prospectus, the stock exchanges where the IPOs were listed, related news and Google searches. We used a sample of firms that became public for the first time between the 1st of January 2020 and the 31st of March 2022 (the COVID-19 period); this period was selected due to its relevance in the context of the COVID-19 pandemic and has already been considered in the relevant literature (Zhang & Neupane, 2023) and as the starting date for the Oxford COVID-19 Government Response Tracker (OxCGRT). Given the lack of research on this specific topic, we opted to conduct the present study for European countries. As such, from the database retrieved, we selected the top 10 countries with the most IPOs in the period considered, namely (by alphabetical order): Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey and the United Kingdom. **Table 2** shows the number of IPOs each country had during the period considered. The final sample consisted of 321 IPOs from 10 European countries after a series of exclusion criteria applied to the original sample retrieved from the databases. Table **3** summarises all the requirements applied. The exclusion criteria in question are:

1. Exclusion of deals whose date of completion does not match the final IPO date to not contemplate potential daily effects;
2. Exclusion of companies who, at the period considered, were delisted;
3. Exclusion of Special Purpose Acquisition Companies that underwent an IPO deal (whose Target Business description, according to Zephyr, mentioned "Special Purpose Acquisition Company (SPAC)" and "Special Purpose Acquisition Vehicle (SPAC)");
4. Exclusion of companies whose size, i.e., the pre-deal target total assets from the last available year, was not available;
5. Exclusion of companies whose deal value was not available (i.e., whose IPO size, deal value, or gross proceeds were not available via prospectus, deal comments or databases);
6. Exclusion of companies whose offer price was not available (via prospectus, deal comments or databases) and deals whose offer price was €0.01.

Table 3 - Sample selection criteria and corresponding number of IPOs

This table presents the sample selection criteria and the number of IPOs considered in this study. Our final sample consists of 321 companies that went public for the first time on the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis

databases and complemented with data from finance websites (such as Yahoo Finance and Google Finance)

	Selection criteria	Description	Number of IPO matches
1.	Target world region: Eastern Europe, Western Europe, Baltic States, Balkan States, Scandinavia	Exclusion of deals outside the European continent	**55,267**
2.	Time period: on and after 01/01/2020 and up to and including 31/03/2022 (completed-confirmed, completed-assumed)	Exclusion of deals outside the considered pandemic time period	**3,285**
3.	Deal types: IPO	Exclusion of deals other than IPOs	**822**
4.	Selected countries (by number of IPOs in the considered period): United Kingdom, Sweden, Italy, France, Germany, Turkey, Spain, Denmark, Poland and Romania	Only the top ten countries with highest number of IPOs were considered in this research	**633**
5.	IPO date: completed date = IPO date	Exclusion of deals whose date of completion does not match the final IPO date, in order to not contemplate potential daily effects	**492**
6.	Exclusion of delisted companies	Exclusion of companies who, at the time period considered, were delisted from their main exchanges	**483**
7.	Exclusion of SPAC IPO deals	Exclusion of Special Purpose Acquisition Companies that underwent an IPO deal (whose Target Business description according to Zephyr mentioned "Special Purpose Acquisition Company (SPAC)" and "Special Purpose Acquisition Vehicle (SPAC)")	**467**
8.	Exclusion of deals which have no size information available	Exclusion of companies whose size, i.e., the pre-deal target total assets from the last available year, was not available	**387**
9.	Exclusion of deals which have no offer price information available	Exclusion of companies whose deal value was not available (i.e., whose IPO size, deal value, or gross proceeds was not available via prospectus, deal comments or databases)	**352**
10.	Exclusion of deals which have no offer price information available	Exclusion of companies whose offer price was not available (via prospectus, deal comments or databases) and deals whose offer price was €0.01	**321**

For the OLS regressions presented in Chapter 3.1., the following variables were obtained through the Zephyr and Orbis databases: OFFER PRICE, 1st DAY CLOSING PRICE[34], AGE, SIZE, TECH, FINANCIAL, DEAL VALUE, EXCHANGE, PENNY STOCK, COUNTRY, and YEAR. The data for the variable RETURN (the European STOXX 600 index's market return, three months before the IPO date) was obtained through Yahoo Finance[35]. Lastly, the data for the variables ECONOMIC SUPPORT INDEX and RESTRICTIONS INDEX were provided by the Oxford COVID-19 Government Response Tracker. All the values presented are in Euros (€), and as such, some original values

[34] For those companies whose closing price was not available on the Zephyr or Orbis database, we used Yahoo Finance, Google Finance and the MarketWatch website (available at https://www.marketwatch.com/). Accessed on the 28th of July 2023.

[35] Available at https://finance.yahoo.com/. Accessed on the 30th of July 2023.

had to be converted to the currency, namely those for OFFER PRICE and 1st DAY CLOSING PRICE.

To test *H1*, we considered the period from the 2nd of October 2017 to the 31st of December 2019 as the period "pre-COVID-19" given that it is the same number of days as our COVID-19 period (between the 1st of January 2020 and the 31st of March 2022), i.e., 820 days. We also restricted the search to the 10 European countries considered and following a similar methodology as the one for the COVID-19 period, we obtained a total of 560 IPO deals. After applying the selection criteria of **Table 3**, our sample consisted of 355 IPO deals for the pre-COVID-19 period.

The Oxford COVID-19 Government Response Tracker[36], a research project created by the University of Oxford and accessed from January to July 2023 for the present study, is a cross-national and cross-temporal recording that evaluates several dimensions related to the pandemic and the government responses against the virus from the 1st of January 2020 to the 31st of December 2022, for 185 countries and territories, including the 10 countries here analysed. The dimensions covered by the research tracker are the following: Containment and Closure, Economic Response, Health Systems Policies, Vaccines Policies, and Miscellaneous Policies, with a total of 25 indicators of government response that served as the basis to create a series of composite indices [two of which will be applied here, for **(RQ2)**, **(RQ3)** and **(RQ4)**].

[36] The most recent version of the research project is available at https://www.bsg.ox.ac.uk/research/covid-19-government-response-tracker (July 2023). Accessed from January to August 2023.

4. Results

4.1. Univariate Analysis

Firstly, in **Table 2,** we investigate the dimension of the IPO market for the conditions considered in the present study (time- and geographic-wise, that is). We clearly see an emphasis on 2021, which accounts for 68% of all the IPOs in our sample (followed by 2020 with 23% and 2022 with solely 9%). This can be justified by our timeframe (from the 1st of January 2020 to the 31st of March 2022), which entails all 12 months of 2021 and presents a disadvantage to 2022. Even though all 12 months of 2020 were considered, as this was officially the first year the world faced the pandemic, the stock market could have fell short of IPO deals for this. This phenomenon was also present when considering more European countries (and even the United States with 1,035 deals, as presented in Chapter 1.). **Figure 1** visually represents these differences[37].

Table 2 – Number of IPOs per country, per year, by size order

This table presents, discriminated by country, the total number of IPOs undertaken during the COVID-19 period (from the 1st of January 2020 to the 31st of March 2022), by size order. Our sample consists of 321 companies that went public for the first time in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Country	2020	2021	2022	Total
United Kingdom	20	64	10	94
Sweden	16	47	3	66
Italy	13	33	6	52
France	3	24	3	30
Denmark	9	13	0	22
Turkey	1	11	3	15
Poland	5	10	0	15
Germany	4	8	1	13
Spain	3	6	1	10
Romania	1	2	1	4
Total	**75**	**218**	**28**	**321**

[37] In fact, 2021 registered 422 IPO deals in Europe, the highest number since 2017 (**Figure 2** in Appendix A), justified by the reopening of economies and backed by Central Banks' support of the economies (PwC, 2022a). Given the pandemic, we can also speculate that a part of the IPOs meant to take place in 2020 was postponed to the following year, 2021. Contrarily, the year after, 2022, was marked as the year with the lowest number of IPO deals: solely 102 European firms became public for the first time, a drop of nearly 76%, attributable to the economic (inflation and interest rates increase and energy crisis) and geopolitical instability (Russian invasion of Ukraine). This decrease can also be partially explained by investors' uncertainty, given the "disappointing debuts" in 2021, with stock prices ending the year under their offer price (PwC, 2022b).

Moving onto our dependent variable, UNDERPRICING, in **Table 4**, we show the underpricing for each of the 10 countries considered for both periods (pre-COVID-19 and during COVID-19) and for both time periods combined. For a total of 676 IPOs considered, we clearly see a predominance in the United Kingdom market, with 3.7 times more IPOs than the average number of IPOs for the other nine countries in the COVID-19 period (and 4 times in the period prior). Nonetheless, the underpricing verified in the country more than doubled from one period to the other. However, that does not seem to be the case for the remaining countries (besides Denmark, who's underpricing more than tripled between periods), as their underpricing difference between periods is negative, meaning that the initial first returns of the COVID-19 period are smaller than those from the period before when analysing individually for the countries. It is, though, important to note that underpricing was verified for each country in the period prior to COVID-19 and in eight countries in the COVID-19 period; the two countries that present a negative average underpricing are the countries with the smallest number of observations which, given the properties of average calculations, undermines the power of the result.

Table 4 - Underpricing comparison by country

This table presents, discriminated by period, the number of IPOs, the average underpricing and the median underpricing per country. Our sample consists of 321 companies for the COVID-19 period (from the 1st of January 2020 to the 31st of March 2022) and 355 companies for the pre-COVID-19 period (from the 2nd of October 2017 to the 31st of December 2019) that went public for the first time in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

	Both periods			**Pre-COVID-19 period**			**COVID-19 period**		
Country	# of IPOs	Average underpricing	Median underpricing	# of IPOs	Average underpricing	Median underpricing	# of IPOs	Average underpricing	Median underpricing
Denmark	33	26.94%	0.26%	11	10.67%	4.53%	22	35.08%	0.13%
France	59	3.15%	0%	29	2.43%	0.51%	30	3.86%	0%
Germany	38	4.48%	2.01%	25	10.77%	2.48%	13	-7.61%	0%
Italy	115	19.85%	5.33%	63	20.97%	0.6%	52	18.51%	13.82%
Poland	39	22.21%	8.59%	24	24.83%	3.78%	15	18.02%	12.16%
Romania	6	-26.63%	-25.86%	2	16.52%	16.52%	4	-48.2%	-51.97%
Spain	54	6.92%	0.19%	44	7.71%	0.19%	10	3.47%	3.67%
Sweden	103	14.41%	3.01%	37	19.08%	-0.5%	66	11.78%	6.28%
Turkey	25	5.34%	1.04%	10	6.98%	-0.17%	15	4.25%	1.33%
United Kingdom	204	28.56%	7.46%	110	18.84%	7.3%	94	39.93%	7.88%
Total	**676**	**10.52%**	**1.53%**	**355**	**13.88%**	**1.54%**	**321**	**7.91%**	**2.50%**

Additionally, half of the "HIGH-impacted countries" (**Table 5**, in Appendix D), i.e., France and Italy (as we have seen, the United Kingdom presents high underpricing between the years, while Germany is on the opposite side) have some of the highest number of observations in the sample for the COVID-19 period but lower underpricing differences, 1.43% and -2.46%, respectively. Lastly, we must also note that while the average underpricing for the COVID-19 period for all the countries is relatively smaller (7.91%) than that from the prior period (13.88%), the median underpricing went up by nearly 1 p.p.. As it is less affected by outliers, it provides a more robust measure when compared to the simple mean. In **Table 6,** we show the underpricing levels by year. Another interesting point in this analysis is that there seems to be a great variation in underpricing percentages yearly, for both periods, with the transitional years (2019-2020) providing the least variation, at 5 p.p.. We calculate an average underpricing and median underpricing for the pre-COVID-19 period of 12.66% and 2.34% versus 14.62% and 6.44% for the following period; as the percentages for both calculations increase in the COVID-19 period, we begin to prove *H1*.

Table 6 - Underpricing comparison by year

This table presents discriminated by year, the number of IPOs, the average underpricing, and the median underpricing. Our sample consists of 321 companies for the COVID-19 period (from the 1st of January 2020 to the 31st of March 2022) and 355 companies for the pre-COVID-19 period (from the 2nd of October 2017 to the 31st of December 2019), that went public for the first time in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Year	# IPOs	Average underpricing	Median underpricing
2017	59	3.94%	1.54%
2018	175	23.01%	2.48%
2019	121	11.04%	3.01%
2020	75	16.07%	9.52%
2021	218	23.55%	5.56%
2022	28	4.25%	4.23%
Total	**676**	**13.64%**	**3.62%**

Moving on to our descriptive statistics, **Table 7** shows us that the companies that went public during the COVID-19 period are very young, averaging two years old, with some even being constituted in the same year they became listed. We can also see that the average IPO firm in our sample has a total asset value prior to the deal that is nearly half of the IPO deal value, and that this fact also happens on the median value. The average market return equals 3.9% for this period, which, contrary to expected, is higher than the average market

return for our pre-COVID-19 period (that presents an average market return of 1.08%)[38]. Additionally, we can conclude that both independent variables, the ECONOMIC SUPPORT INDEX and the RESTRICTIONS INDEX, are at par with each other, presenting similar average values and similar medians, which are also close to the mean values meaning that the distribution is relatively symmetric and not influenced by outliers. This result seems viable, as countries that increased the strictness of their anti-COVID-19 measures typically provided families with more economic support. Lastly, looking at our dependent variable, UNDERPRICING, we register a vast range of values in our observations, from a minimum of -0.898 to a maximum of 25.175, signaling the presence of outliers. To avoid any bias in our results, we decided to winsorize the variable at the 5th and 95th percentiles to minimize the impact of these extreme values. We will, from this point onwards, use the winsorized observations of the variable.[39]

Table 7 - Descriptive statistics: numerical variables

This table presents the descriptive statistics of the numerical research variables. Appendix B contains the variables´ descriptions. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variable	Obs.	Mean	Median	Min	Max	Std. Dev.
UNDERPRICING	321	0.2012	0.0627	-0.8983	25.1753	1.4719
RESTRICTIONS INDEX	321	52.6157	52.2300	0.0000	87.9600	18.1762
ECONOMIC SUPPORT INDEX	321	56.8925	50.0000	0.0000	100.0000	31.7722
AGE	321	2.0194	2.0794	0.0000	5.1475	1.0743
SIZE	321	9.0912	9.2414	-6.7856	16.2123	2.9977
DEAL VALUE	321	17.8262	17.8883	6.9078	23.7979	2.8169
RETURN	321	0.0389	0.0413	-0.2384	0.1671	0.0615

[38] This conclusion goes against what has been found in the relevant literature, as authors find that stock market returns decreased significantly with the pandemic (Zhang et al., 2020; Ashraf, 2020a;). Many major indices, such as the S&P500 (in the United States), the DAX (in Germany) and the FTSE 100 (in the United Kingdom) experienced a decrease. We can hypothesize that this phenomenon was particularly strong in the first year of COVID-19 and that the market recovered significantly in the following year of 2021. I.e., the average market return for 2020 reaches a negative percentage of -0.57%, only for that value to increase more than 10 times to 6.01% in 2021, as we can see in **Table 8** in Appendix D. This extreme variation translates investors sentiment in the early stages of the pandemic as uncertainty haunted the stock markets.

[39] To avoid outliers, we winsorized our non-dummy and non-logarithmic variables, i.e., the variables UNDERPRICING, RESTRICTIONS INDEX, ECONOMIC SUPPORT INDEX and RETURN. However, as the winsorized results of the last three variables did not present significant changes when compared to their non-winsorized results, and their range of values is either small (in the case of the variable RETURN) or understandable for that variable (as it is the case of the two independent variables), we solely winsorized our dependent variable.

Table 9 allows us to conclude that nearly half of the IPO deals in our sample are within the technological industry (48%), but merely 12% of our deals are from the financial sector. Nonetheless, almost 65% of the deals considered were placed in one of the considered "large" stock exchanges and nearly 70% of the deals had offer prices below €5.

Table 9 - Descriptive statistics: categorical variables

This table presents the descriptive statistics of the categorical research variables. Appendix B contains the variables´ descriptions. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variable	Obs.	Dummy	Frequency	Frequency (%)
TECH	321	1	154	48%
		0	167	52%
FINANCIAL	321	1	37	12%
		0	284	88%
EXCHANGE	321	1	207	64%
		0	114	36%
PENNY STOCK	321	1	223	69%
		0	98	31%

It is important to note, once again, that given the reduced number of observations, per country, in our sample, we were not able to control for the categorical variables when analysing **(RQ4)**, for each country, for which the Regressions created for that purpose do not include these variables.

Table 10 below allows us to test our first hypothesis and answer **(RQ1)**. As we explained earlier, we winsorized the dependent variable for the COVID-19 period given its wide range of values; that same procedure was also conducted for the underpricing calculated for the non-COVID-19 period for consistency purposes and because the variable presented extreme values as well (**Table 14** presents the descriptive statistics of the underpricing variable for both periods, without winsorizing). Considering the two time periods analysed, we calculated an average underpricing of 10.93% for the 321 observations of the COVID-19 period, 3.90 p.p. higher than the average underpricing for the 355 observations in the period prior to it. This confirms our *H1* (i.e., we accept *H1*) that firms who went public for the first time during the considered COVID-19 period between the 1st of January 2020 and the 31st of March 2022 experienced greater underpricing than those prior to it. This result reinforces the already existent studies on the topic, as it is in accordance with the work of Mazumder and Saha (2021), Maheshwari and Kumar (2022), and Baig and Chen (2022).

Panda and Guha (2023) also verified this conclusion, even though the percentage difference between periods that we register (3.90%) is considerably lower than the one registered by the authors (17.60%)[40].

Looking at **Table 10**, we also see that the COVID-19 period presents a greater disparity in values, with a median 2.6 times greater, a higher maximum value and a standard deviation, meaning that there is more variability and a less concentrated distribution around the mean value when compared to the pre-COVID-19 period.

Table 10 - Underpricing comparison by period

This table presents the descriptive statistics of the dependent variable, underpricing, winsorized at the 5th and 95th percentiles for both periods. Appendix B contains the variables´ descriptions. Our sample consists of 321 companies for the COVID-19 period (from the 1st of January 2020 to the 31st of March 2022) and 355 companies for the pre-COVID-19 period (from the 2nd of October 2017 to the 31st of December 2019), that went public for the first time in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Period	Duration	Obs.	Mean	Median	Min	Max	Std. Dev.
Pre-COVID-19 period	02/10/2017 - 31/12/2019	355	0.0703	0.0241	-0.3018	0.5482	0.1867
COVID-19 period	01/01/2020 - 31/03/2022	321	0.1093	0.0627	-0.6537	1.0257	0.3554

4.2. Multivariate Analysis

In the present study, we employed OLS Regressions to test our hypothesis. As such, we had to verify some assumptions prior to our estimations to make sure our models were correctly used. We tested for homoscedasticity, normality and multicollinearity.

We have tested for heteroscedasticity in every model using the White test and the Breusch-Pagan-Godfrey test (for the country-specific Regressions that have a smaller number of observations) and, when it was detected heteroscedasticity, we used White´s heteroscedasticity-consistent standard errors. For the normality assumption, we can use the Central Limit Theorem to justify the assumption of normality for Regressions **(3.3)** to **(3.8)** as these contain all observations in our samples and the Theorem proposes that with a large sample size, the sampling distribution will have approximately a normal distribution. For

[40] The authors considered 2020 and 2021 as their COVID-19 period, with a total of 2,248 observations and 2015 to 2019 as their non-COVID-19 period, with a total of 3,865 observation, across 32 countries. As we saw in Chapter 2., these differences in countries, timeframe and number of observations impact the level of underpricing and can explain such a great difference between underpricing levels registered.

Regressions **(3.9)** to **(3.11)**, as these have a smaller number of observations (on average, 32 observations), we conducted the Jarque-Bera test and concluded on normality. Lastly, to test for multicollinearity, we looked at the Variance Inflation Factors (VIF) – **Tables 11** and **12** – and the correlations coefficients matrix – **Table 13**. All the VIF values are under 10, meaning that there is no perfect multicollinearity, as researchers state that a VIF above that threshold translates to multicollinearity (Chatterjee & Hadi, 2013; Midi & Bagheri, 2010). Likewise, from our correlation matrix we can observe that there is no significant correlation between the variables[41].

When calculating our models, we were not able to estimate the country specific Regressions **(3.9)**, **(3.10)** and **(3.11)** for the country Romania given that it did not have enough observations to do so. Hence, from now on, we will exclude that country from our analysis. To answer our Research Questions, we divided this Chapter into four subchapters.

4.2.1. Restrictions Index and underpricing

Table 15 below presents the impact of the independent variable RESTRICTIONS INDEX on underpricing for the two Regressions considered (without and with year-fixed effects).

We can see that our independent variable, RESTRICTIONS INDEX, is statistically significant at all levels (1%, 5% and 10%) in **(3.3)** and that this holds true even when we account for year effects (Regression **(3.4)**), in line with the relevant literature. The coefficients of our independent variable, apart from being statistically significant, are also positive which means that the restrictive measures taken by the different European countries overall did, in fact, positively impact underpricing, with more restrictive measures increasing the levels of underpricing; specifically, a one-unit increase in the level of restrictiveness of the measures translates to an estimated increase, on average, of 0.0033 (in **(3.3)**) in the level of underpricing, *ceteris paribus*. Once again, this proves to be true also in Regression **(3.4)** when we add the year-fixed effects, even if for a slightly smaller coefficient. However, it is also important to note that the coefficient of our independent variable, while positive and significant, is rather small, which means that the restrictive measure, even though impacting

[41] Gujarati (2003) defended that a coefficient greater than 0.8 (absolute value) could translate to multicollinearity. As we do not have any correlation coefficient greater than that reference value, we can conclude that our study has no multicollinearity.

underpricing, have a small influence on the dependent variable. Nonetheless, with this we accept *H2* and answer our **(RQ2)**.

Apart from the independent variable, the control variables that correspond to a firms' size, technological industry and exchange are also statistically significant at 10%, 10%, and 5% levels, respectively, even when we add the year effects. The variable SIZE (estimated as the natural logarithm of the total assets of the firm the year prior to its IPO) presents a positive coefficient, which is not in line with our expectations that larger firms tend to experience lower underpricing. On the other hand, the dummy variable TECH (that represents whether the firm belongs to a high-technological industry) presents a positive coefficient which is aligned with our expectations and the relevant literature (Lowry & Schwert, 2002; Chahine, 2008; Engelen & Van Essen, 2010) that high technological firms have higher levels of ex-ante uncertainty and, thus, experience higher levels of underpricing. Lastly, the dummy variable EXCHANGE (that represents the type of stock exchange where the IPO was listed on) also presented positive coefficients, contrary to our anticipations. This discrepancy between the expected versus the actual relationships between the variables coefficients and underpricing may be attributed to several reasons: the localised characteristics of our dataset given that we focused solely on the selected European countries, the number of observations that may be compromising representation, and the time period in question; first and foremost, the pandemic was a first-of-its-kind event, with unpredictable effects and enormous impacts hence why the conclusions verified under normal periods (i.e., non-pandemic periods) may not be applicable. The remaining control variables are not statistically significant.

In Regression **(3.4)**, we verify that the addition of the yearly dummies, in general, lightly increases the coefficients of the variables, but their relationship with underpricing does not change. When we control for year-effects, the model does not change much, overall, even though the goodness of fit slightly increases. The yearly dummies present opposite signals, but both variables are not statistically significant[42].

[42] The yearly dummy variables have opposite signals, with the one corresponding to 2020 providing a positive coefficient and the one corresponding to 2021 providing a negative coefficient. This could be partly explained by the frenzy that surrounded the IPO market in 2021 (as seen earlier in this Chapter) and the levels of underpricing, as a result.

Table 15 - Multivariate regression analysis: independent variable RESTRICTIONS INDEX

This table presents the estimation of the OLS Regressions **(3.3)** and **(3.4)**, with UNDERPRICING as the dependent variable, winsorized at the 5% and 95% levels. Regression **(3.4)** adds the year-fixed effects components to Regression **(3.3)**. The independent variable is RESTRICTIONS INDEX. The remaining variables are presented in Chapter 3. and Appendix B contains the variables´ descriptions. Significance levels of 1%, 5% and 10% are represented by ***, ** and *, respectively. Conventional t-statistics are in parentheses and White adjusted t-statistics are in brackets (for Regression (3.3)). Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variables	**(3.3)**	**(3.4)**
Constant	-0.2293	-0.2169
	[-1.4167]	(-1.2184)
RESTRICTIONS INDEX	0.0033***	0.0032***
	[2.7619]	(2.6836)
AGE	-0.0173	-0.0172
	[-1.0307]	(-0.8402)
SIZE	0.0122*	0.0123*
	[1.7065]	(1.6733)
TECH	0.0734*	0.0742*
	[1.6772]	(1.7527)
FINANCIAL	0.0704	0.0678
	[1.000]	(1.0180)
DEAL VALUE	-0.0030	-0.0029
	[-0.4133]	(-0.3713)
EXCHANGE	0.0925**	0.0925**
	[2.1636]	(2.0260)
PENNY STOCKS	0.0639	0.0635
	[1.6426]	(1.3597)
RETURN	-0.0696	0.0354
	[-0.1581]	(0.0906)
YEAR 2020		0.0025
		(0.0307)
YEAR 2021		-0.0254
		(-0.3330)
Observations	321	321
F-Statistics	2.3010***	1.9010**
R-Squared	0.0624	0.0634
Adjusted R-Squared	0.0353	0.0300

4.2.2. Economic Support Index and underpricing

Table 16 below provides a similar analysis to **Table 15** and Chapter 4.2.1., but with ECONOMIC SUPPORT INDEX as our independent variable.

Our independent variable, ECONOMIC SUPPORT INDEX, is statistically significant at 5% and 10% levels, for Regressions **(3.5)** and **(3.6)**, respectively, in line with the relevant literature. However, not only is the significance percentage lower than the first independent variable, but it also has a smaller coefficient. As such, even though the variable ECONOMIC SUPPORT INDEX is positive and significant, its impact is nearly 3 times smaller than the impact of the RESTRICTIONS INDEX, which means that the economic support that families received had a lower influence on underpricing when compared to the restrictive measures that governments imposed. Nonetheless, regardless of this situation, the variable´s relationship with our dependent variable goes against our hypothesis even when we account for year-fixed effects in **(3.6)**, i.e., the greater the economic support given to families, the greater the impact on underpricing; specifically, a one-unit increase in the level of economic support translates to an estimated increase, on average, of 0.0012 (for **(3.5)**) or 0.0011 (for **(3.6)**) in the level of underpricing, *ceteris paribus*. This means that we reject our *H3* and answer our **(RQ3)**. Even though the coefficient for this variable is considerably small, we can still interpret this result considering our rejection of *H3*: a positive coefficient may be justifiable by the idea that economic support provides families with more safety, which may increase underpricing, as proven by Zhang and Neupane (2023)[43], even though this goes against our hypothesis.

It is important to mention that a particularity of this index is that it measures the income and debt relief given to families, not to companies. As such, the stock markets in general do not react very strongly to this (including the IPO market) (Ashraf, 2020a). This provides a limitation to our analysis but allows us to better understand the small impact of its coefficients. Unlike this, the RESTRICTIONS INDEX, our first independent variable, is applicable to both families and companies and as such, does not experience this limitation.

[43] Other studies that included the OxCGRT Economic Support Index include Ashraf (2020a), Baig et al. (2021), Narayan et al. (2021), Baig and Chen (2022), and others. However, these studies focus on the impact of economic support and stimulus packages on the stock market overall, and at the time of writing this study and to the best of our knowledge, there were no other studies on the impact of the economic support received on underpricing.

Similar to what we just saw in the previous Chapter, the control variables SIZE, TECH, and EXCHANGE are also statistically significant, respectively, at the 10%, 10% and 5% levels for both **(3.5)** and **(3.6)**. Additionally, these variables also present the same signal as those in **(3.3)** and **(3.4),** which means that only the variable TECH holds true to our expected relationships. Once again, this discrepancy between the expected versus the actual relationships between the variables' coefficients and underpricing may be attributed to several reasons, as we mentioned earlier. The remaining control variables are not statistically significant.

When we add the year-effects in Regression **(3.6)**, the models´ goodness of fit slightly improves. Regardless, when we control for year-effects, the model does not change much overall. The yearly dummies present positive signs contrary to the previous regressions, but both variables are not statistically significant as well. Overall, this analysis is very similar to what we saw in the previous Chapter, except for the analysis that was made for the independent variable.

Table 16 - Multivariate regression analysis: independent variable ECONOMIC SUPPORT INDEX

This table presents the estimation of the OLS Regressions **(3.5)** and **(3.6)**, with UNDERPRICING as the dependent variable, winsorized at the 5% and 95% levels. Regression **(3.6)** adds the year-fixed effects components to Regression **(3.5)**. The independent variable is ECONOMIC SUPPORT INDEX. The remaining variables are presented in Chapter 3. and Appendix B contains the variables´ descriptions. Significance levels of 1%, 5% and 10% are represented by ***, ** and *, respectively. Conventional t-statistics are in parentheses, and White adjusted t-statistics are in brackets (for Regression **(3.5)**). Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variables	**(3.5)**	**(3.6)**
Constant	-0.1150	-0.1281
	[-0.6978]	(-0.7362)
ECONOMIC SUPPORT INDEX	0.0012**	0.0011*
	[2.1210]	(1.7136)
AGE	-0.0148	-0.0148
	[-0.8501]	(-0.7120)
SIZE	0.0124*	0.0124*
	[1.7000]	(1.6696)
TECH	0.0811*	0.0815*
	[1.8409]	(1.9174)
FINANCIAL	0.0704	0.0679
	[1.0114]	(1.0122)

DEAL VALUE	-0.0044	-0.0042
	[-0.5876]	(-0.5286)
EXCHANGE	0.0929**	0.0915**
	[2.1399]	(1.9716)
PENNY STOCKS	0.0567	0.0572
	[1.3996]	(1.2146)
RETURN	0.1167	0.2291
	[0.2750]	(0.5998)
YEAR 2020		0.0412
		(0.5167)
YEAR 2021		0.0023
		(0.0302)
Observations	321	321
F-Statistics	1.7724*	1.4964*
R-Squared	0.0488	0.0506
Adjusted R-Squared	0.0213	0.0168

4.2.3. Independent variables and underpricing

After analysing the independent variables individually, we have computed Regressions **(3.7)** and **(3.8)** that include both variables (with **(3.8)** adding the yearly dummies). **Table 17** below allows us to analyse the impact of the independent variables RESTRICTIONS INDEX and ECONOMIC SUPPORT INDEX on underpricing for the two Regressions considered (without and with year-fixed effects).

Our first independent variable, RESTRICTIONS INDEX, has a positive coefficient and is statistically significant. However, unlike in Chapter 4.2.1., this variable is only significant at the 10% and 5% levels. Our second independent variable, ECONOMIC SUPPORT INDEX, although also having a positive coefficient, is not statistically significant, contrary to what we concluded in Chapter 4.2.2. As such, if we were to answer our **(RQ3)** solely based on Regressions **(3.7)** and **(3.8)**, we would conclude that the economic support that each of the analysed European countries provided did not impact the underpricing of IPOs for the period considered. Moreover, again we accept our *H2* and reject our *H3* as it was not proven, contrary to what we expected and in line with what we concluded in the previous Chapter. Nonetheless, this may be due to several reasons, particularly our sample size as we may not have sufficient data to detect the effect and as it has already been demonstrated that financial support (e.g.: stimulus packages) positively impacts stock markets (Phan & Narayan, 2020; Narayan et al., 2021; Ashraf, 2020a). Additionally, when we

have both independent variables in the same Regression, the coefficients for both independent variables decrease significantly. This shows that both variables, when together (as it truly happened), partially cancel each other out, but given that one remains significant, the other is not cancelled in its entirety.

Overall, the coefficients are like what we have seen before for the control variables, and only the variables SIZE, TECH and EXCHANGE are statistically significant, at 10%, 10% and 5% levels, respectively, as it happened when we analysed the Regressions with each independent variable. Likewise, solely the variable TECH presents a coefficient signal that goes in accordance with our expectations and the remaining variables, although not statistically significant, like what we concluded for **(3.3)** and **(3.4)**.

In **(3.8)**, with the addition of the yearly dummies, the models´ goodness of fit barely improves and is still rather small when compared to ones found in the relevant literature[44] (nonetheless, it is still greater than the percentages found in the previous four models). This may also be due to the localised characteristics of our dataset and the period analysed, and, by consequence, the number of observations.

We must also point out the correlation between the two independent variables: 0.5503. This correlation is the greatest positive correlation registered in our study, as we can see from **Table 13**. Regardless, it is still a considerably low value, comparably to what we would expect, as reality showed that at the time governments were imposing restrictions on their citizens, stimulus packages and other financial support was also being given to families. As such, we would expect these two variables to go "hand-in-hand" together, and that their correlation would be greater than the one, in fact, registered.

[44] When looking at papers that use a similar OLS methodology, we verify levels of R-squared such as 16.50% (Affleck-Graves et al., 1993, when testing their OLS model (1)) and 17.46% (Aggarwal et al., 2002, for their Adjusted R-squared of Model 3). Still, we also find results similar to the ones we estimated, namely 5.9% (Megginson & Weiss, 1991, in their Regression (3) with Initial Returns, R_1, as the dependent variable) and 3.0% (Tinic, 1988, in the Regression of Table IV when considering all IPOs). However, those studies represent research on the effect of a particular variable on underpricing, even if their OLS regressions contain almost the same explanatory variables. When we focus specifically on studies that approach the COVID-19 period, we verify an R-squared of 68.9% (Mazumder & Saha, 2021, in their baseline regression (1)), 66% (Maheshwari & Kumar, 2022, on their regression of listing day raw returns) and 33.1% (Zhang & Neupane, 2023, in model (3) of their baseline regression). Nonetheless, each author defined different OLS regressions, the present study included, while still considering the pandemic's particularity on underpricing.

Table 17 - Multivariate regression analysis: independent variables RESTRICTIONS INDEX and ECONOMIC SUPPORT INDEX

This table presents the estimation of the OLS Regressions **(3.7)** and **(3.8)**, with UNDERPRICING as the dependent variable, winsorized at the 5% and 95% levels. Regression **(3.8)** adds the year-fixed effects components to Regression **(3.7)**. The independent variables are RESTRICTIONS INDEX and ECONOMIC SUPPORT INDEX. The remaining variables are presented in Chapter 3. and Appendix B contains the variables´ descriptions. Significance levels of 1%, 5% and 10% are represented by ***, ** and *, respectively. Conventional t-statistics are in parentheses, and White adjusted t-statistics are in brackets (for Regression **(3.7)**). Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variables	**(3.7)**	**(3.8)**
Constant	-0.2312	-0.2185
	[-1.4249]	(-1.2256)
RESTRICTIONS INDEX	0.0029**	0.0029**
	[2.0791]	(2.0981)
ECONOMIC SUPPORT INDEX	0.0003	0.0003
	[0.5000]	(0.4334)
AGE	-0.0159	-0.0158
	[-0.9202]	(-0.7617)
SIZE	0.0123*	0.0124*
	[1.7038]	(1.6786)
TECH	0.0739*	0.0746*
	[1.6954]	(1.7599)
FINANCIAL	0.0713	0.0687
	[1.0152]	(1.0299)
DEAL VALUE	-0.0033	-0.0032
	[-0.4483]	(-0.4039)
EXCHANGE	0.0955**	0.0954**
	[2.1981]	(2.0649)
PENNY STOCKS	0.0625	0.0622
	[1.5968]	(1.3260)
RETURN	-0.0726	0.0285
	[-0.1638]	(0.0728)
YEAR 2020		0.0008
		(0.0101)
YEAR 2021		-0.0258
		(-0.3372)
Observations	321	321
F-Statistics	2.0866**	1.7537*
R-Squared	0.0631	0.0639
Adjusted R-Squared	0.0328	0.0275

4.2.4. Country-specific impact and underpricing

After analysing the impact on underpricing of the restrictive measures that different European governments took to fight the pandemic and of the economic support that was given to families, we now turn our attention to how those two variables affected each country's underpricing, individually. **Table 18** below presents the results for Regressions **(3.9)**, **(3.10)**, and **(3.11),** where we consider the RESTRICTIONS INDEX, ECONOMIC SUPPORT INDEX and both indexes simultaneously as the independent variables, respectively. As mentioned throughout this study, the considered nine countries are: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey and the United Kingdom (as explained earlier, the country Romania had to be excluded since the number of observations it contained was not enough to proceed with the Regressions estimations).

Given the reduced number of IPO deals per country (on average, 32 deals) we do not have enough observations to study whether all the control variables have an impact on underpricing, including the year dummies, hence why we accounted solely for the numerical deal-specific and market-specific control variables, besides the independent variables.

Italy, one of the highly affected countries, does not have a single statistically significant variable. Similarly, Spain, Sweden, and the United Kingdom do not have any statistically significant variables either. We cannot find a pattern here since this range includes countries that are HIGH, MEDIUM and LOW-impacted by the pandemic (as defined in **Table 5**, in Appendix D). Nor can we attribute this to the number of observations as it contains the country with the least observations (Spain, with 10 observations) and the country with the highest number of observations (the United Kingdom, with 94 observations). Nonetheless, for countries that do have statistically significant variables, these are typically the independent variables or/and the variable RETURN.

Specifically, in Denmark, the country with the most statistically significant variables, solely the first independent variable, RESTRICTIONS INDEX, is significant from the two, at 1% and 5% levels, for **(3.9)** and **(3.11)**, respectively. Additionally, the control variables SIZE and RETURN are also statistically significant at the 10% and 5% levels, for **(3.9)** and **(3.11)**, respectively. In fact, Regression **(3.10)** does not have any statistically significant variable, which questions the explanatory power of our second independent variable, ECONOMIC SUPPORT INDEX. In France, the variable RETURN is statistically significant for all three Regressions, at the 10%, 5% and 1% levels, respectively. Both

independent variables are statistically significant at the 1% level, solely when combined for Regression **(3.11)**, with this model explaining 46.24% of the variability of our dependent variable. Germany´s only significant variable is the independent variable RESTRICTIONS INDEX, significant at the 10% level in regression **(3.11)**. Closely, Poland also only has the first independent variable as statistically significant, at 1% and 5% levels for **(3.9)** and **(3.11)**, respectively. Lastly, Turkey is the only country that, among the ones that have statistically significant variables, does not include the independent ones; in fact, it is the control variables AGE and SIZE that are significant, both at 10% level, solely for Regression **(3.9)**.

Moreover, when we analyse the coefficients signals of the variables, in a very general overview, we can say that the countries that belong to the HIGH-impacted category present coefficients signals closer to what we expect and that countries in the LOW-impacted category present coefficients the farthest away from what we anticipated. Overall, the coefficients of the significant explanatory variables all seem considerably small, particularly the values of the two independent variables, whether positive or negative, and although a small coefficient means that the impact of that variable on underpricing is rather modest, the goodness of fit of these Regressions are considerably larger than the ones for Regressions **(3.3)** to **(3.8)**. This may be greatly due to the minor number of observations in each Regression (since for **(3.3)** to **(3.8)** we used every observation in our sample, 321) combined with the reduced number of variables in the country-specific Regressions, all being numerical variable (i.e., no dummy variables). We cannot, once again, find a pattern here given how different these countries are, namely in category and in number of observations. Every country is different, all have particular specifications, hence why it is very hard to detect and establish patterns, even after dividing them according to the impact that the pandemic had.

Focusing now our attention on Regression **(3.11)** as it contains all analysed variables, we can investigate our **(RQ4)**. We want to know how the IPO market reacted for the countries that were most affected by COVID-19 (the country categorisation is explained in **Table 5**, in Appendix D) and for that, we hypothesised that those countries would experience higher levels of underpricing. For that, we look at the constant coefficient of the Regression; the constant value here tells us the average underpricing value for a company born in the same year of its IPO deal, that is from a country that had no restrictions nor economic support given to its families, in a market with no return, for a company with its size equal to the unit. In other words, it gives the average value of the dependent variable

when all other variables are equal to zero. Looking at the HIGH-impacted countries, France, Germany, Italy and the United Kingdom, we register constant values of 0.1761, 0.9739, 0.5401 and -0.3801, respectively. Germany has the highest constant value, followed by Spain (with 0.9275), Italy and France. As such, except for the United Kingdom, the three most affected countries occupy the top four positions with the greatest constant values[45]. This means the impact on underpricing in Germany was stronger than in any other country of our sample. On the other side of the spectrum, we find Turkey as the country with the lowest constant value (with -0.7393) followed by Sweden (with -0.4808), which means that out of the two LOW-impacted countries, only one occupies the bottom two position.

Nonetheless, we are aware of the flaws and limitations that come from analysing solely the constant value of a Regression: this interpretation might not have a meaningful real-world context as having all the control variables in our Regression equal to zero is neither realistic nor meaningful and hence why the direct interpretation of the constant values is limited. Additionally, none of the constant variables are statistically significant.

To complement this analysis, we can look again at **Table 4**, for the COVID-19 period. We can see that the average underpricing of the HIGH-impacted countries equals 13.67%, the MEDIUM-impacted countries equals 8.58%, and the LOW-impacted countries equals 23.43%. This result is not in accordance with our hypothesis nor with what we analysed earlier, and this may be due to the number of countries in each category. Given that there are only two LOW-impacted countries compared to the four in the HIGH-impacted category, the results may be biased, and we cannot conclude from these averages of the average underpricing. As such, we estimate the average underpricing per category, for which we have a value of 25.04% for the HIGH-impacted countries, 9.22% for the MEDIUM-impacted countries, and 15.66% for the LOW-impacted countries[46]. While this corroborates what we have just seen, it does not explain why the MEDIUM-impacted countries have an underpricing value lower than the LOW-impacted countries, as we would expect. Once again, this may be due to the reduced number of observations given the localised characteristics of our dataset, combined with the time period in question and the selection

[45] Spain, although presenting a high constant value, belongs to the MEDIUM-impacted countries, as the sixth country most affected by the pandemic, from our sample.

[46] For the HIGH-impacted countries (France, Germany, Italy and the United Kingdom), we have a combined underpricing value of 4732.07% for 189 deals (which averages 25.04%). For the MEDIUM-impacted countries (Poland, Spain and Turkey), we have 368.77% for 40 observations (averaging 9.22%). For the LOW-impacted countries (Denmark and Sweden), we have 1613.33% for 103 observations (averaging 15.66%).

criteria (we have 103 observations for the two LOW-impacted countries, but only 40 observations for the three MEDIUM-impacted countries). However, as this is not the scope of our research question, we offer this topic for future research to investigate.

With this we accept our *H4* and answer **(RQ4)** that, in fact, the countries most affected by the pandemic (given by the relative and total number of confirmed cases and confirmed deaths by COVID-19) experienced greater levels of underpricing, for the time period considered of 1st of January 2020 to 31st of March 2022.

Table 18 - Multivariate regression analysis: country-specific impact

This table presents the estimation of the OLS Regressions **(3.9)**, **(3.10)** and **(3.11)**, with UNDERPRICING per country as the dependent variable, winsorized at the 5% and 95% levels. The independent variables are RESTRICTIONS INDEX and ECONOMIC SUPPORT INDEX. The remaining variables are presented in Chapter 3. and Appendix B contains the variables´ descriptions. Significance levels of 1%, 5% and 10% are represented by ***, ** and *, respectively. Conventional t-statistics are in parentheses and White adjusted t-statistics are in brackets. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variables	**Denmark**			**France**			**Germany**		
	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)
Constant	0.0863	1.5701	-0.0221	0.0480	0.2588	0.1761	-0.1577	-0.158	0.9739
	(0.0549)	(0.8596)	(-0.0136)	(0.2144)	(1.1826)	(0.9139)	(-0.2649)	(-0.1292)	(0.8764)
RESTRICTIONS INDEX	0.0277***		0.0301**	0.0012		0.0082***	0.0094		0.0134*
	(2.9395)		(2.8429)	(0.5667)		(2.9346)	(1.7886)		(2.1939)
ECONOMIC SUPPORT INDEX		0.0034	-0.0029		-0.0032	-0.0102***		0.0006	-0.0153
		(0.5652)	(0.5358)		(-1.3928)	(-3.2735)		(0.0049)	(-1.1922)
AGE	0.0281	0.0523	0.0233	0.0110	0.0051	-0.0058	0.0029	0.0172	-0.0339
	(0.1397)	(0.2113)	(0.1130)	(0.2921)	(0.1390)	(-0.1794)	(0.0352)	(0.1691)	(0.3997)
SIZE	0.1906*	0.1136	0.1929*	-0.0105	-0.0078	-0.0105	-0.0657	-0.0472	-0.0438
	(1.9023)	(0.9581)	(1.8803)	(-0.6467)	(-0.4984)	(-0.7704)	(-1.2987)	(-0.7245)	(-0.8352)
DEAL VALUE	-0.1620	-0.1432	-0.1517	-0.0028	-0.0079	-0.0077	0.0011	0.0183	-0.0384
	(1.5637)	(-1.1069)	(-1.4080)	(-0.2637)	(-0.7592)	(-0.8458)	(0.0318)	(0.3743)	(-0.8169)
RETURN	-3.6481**	-2.0084	-4.3630**	0.9687*	1.5610**	2.0183***	3.7998	3.9557	1.1797
	(-2.3469)	(-0.8784)	(-2.1017)	(1.7578)	(2.5055)	(3.5736)	(1.5096)	(1.0491)	(0.3589)
Observations	22	22	22	30	30	30	13	13	13
F-Statistics	2.8916**	0.8344	2.3501*	1.2905	1.6958	3.2967**	1.7488	0.7611	1.7820
R-Squared	0.4747	0.2068	0.4846	0.2119	0.2611	0.4624	0.5554	0.3522	0.6405
Adjusted R-Squared	0.3105	-0.0411	0.2784	0.0477	0.1071	0.3221	0.2378	-0.1105	0.2811

Table 18 - Multivariate regression analysis: country-specific impact – continued

This table presents the estimation of the OLS Regressions **(3.9)**, **(3.10)** and **(3.11)**, with UNDERPRICING per country as the dependent variable, winsorized at the 5% and 95% levels. The independent variables are RESTRICTIONS INDEX and ECONOMIC SUPPORT INDEX. The remaining variables are presented in Chapter 3. and Appendix B contains the variables´ descriptions. Significance levels of 1%, 5% and 10% are represented by ***, ** and *, respectively. Conventional t-statistics are in parentheses and White adjusted t-statistics are in brackets. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variables	**Italy**			**Poland**			**Spain**		
	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)
Constant	0.4931	0.3618	0.5401	0.0059	0.6854	-0.0310	0.9698	0.6529	0.9275
	(1.4259)	(0.8459)	(0.9510)	(0.0057)	(0.4826)	(-0.0280)	(1.0274)	(0.6870)	(0.7987)
RESTRICTIONS INDEX	-0.0017		-0.0018	0.0137***		0.014**	-0.0097		-0.0084
	(-0.4863)		(-0.4825)	(3.0067)		(2.7714)	(-1.4632)		(-0.5460)
ECONOMIC SUPPORT INDEX		0.0004	-0.0005		0.0031	-0.0011		-0.0059	-0.0011
		(0.0987)	(-0.1051)		(0.5122)	(-0.2251)		(-1.2672)	(-0.1041)
AGE	-0.0014	-0.0010	-0.0036	0.2026	0.0499	0.2126	-0.1423	-0.1057	-0.1364
	(-0.0218)	(-0.0139)	(-0.0514)	(0.9429)	(0.1691)	(0.9183)	(-0.7571)	(-0.5366)	(-0.6087)
SIZE	0.0094	0.0087	0.0101	0.1489	0.1745	0.1467	0.0469	0.0203	0.0429
	(0.2018)	(0.1782)	(0.2218)	(0.9839)	(0.8266)	(0.9151)	(0.4906)	(0.2043)	(0.3661)
DEAL VALUE	-0.0204	-0.0199	-0.0211	-0.1218	-0.1212	-0.1170	-0.0387	-0.0088	-0.0334
	(-1.0293)	(-0.9618)	(-1.0023)	(-1.2791)	(-0.8924)	(-1.1373)	(-0.4803)	(-0.1014)	(-0.3165)
RETURN	0.5316	0.3131	0.5789	-1.3344	-2.1711	-1.2493	1.9405	0.5189	1.7013
	(0.5270)	(0.3257)	(0.5193)	(-1.0866)	(-1.2549)	(-0.9239)	(0.6764)	(0.1683)	(0.4224)
Observations	52	52	52	15	15	15	10	10	10
F-Statistics	0.4260	0.3788	0.3493	2.5517*	0.4343	1.9106	0.7150	0.5831	0.4503
R-Squared	0.0443	0.0396	0.0445	0.5864	0.1944	0.5889	0.4719	0.4216	0.4738
Adjusted R-Squared	-0.0596	-0.0648	-0.0829	0.3566	-0.2532	0.2807	-0.1881	-0.3015	-0.5785

Table 18 - Multivariate regression analysis: country-specific impact – continued

This table presents the estimation of the OLS Regressions **(3.9)**, **(3.10)** and **(3.11)**, with UNDERPRICING per country as the dependent variable, winsorized at the 5% and 95% levels. The independent variables are RESTRICTIONS INDEX and ECONOMIC SUPPORT INDEX. The remaining variables are presented in Chapter 3. and Appendix B contains the variables´ descriptions. Significance levels of 1%, 5% and 10% are represented by ***, ** and *, respectively. Conventional t-statistics are in parentheses and White adjusted t-statistics are in brackets. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variables	**Sweden**			**Turkey**			**United Kingdom**		
	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)
Constant	-0.5378	-0.5603	-0.4808	-0.7469	-0.3266	-0.7393	-0.3498	-0.3097	-0.3801
	(-0.9872)	(-1.0617)	(-0.8757)	(-0.5626)	(-0.2253)	(-0.5301)	[-1.0031]	[-0.9116]	[-1.0777]
RESTRICTIONS INDEX	0.0001		-0.0022	-0.0149		-0.0168	0.0009		0.0026
	(0.0470)		(-0.5656)	(-1.4999)		(-1.4636)	[0.3187]		[0.7991]
ECONOMIC SUPPORT INDEX		0.0028	0.0048		-0.0020	0.0038		-0.0005	-0.0014
		(0.7244)	(0.9146)		(-0.2211)	(0.3973)		[-0.5028]	[-1.1513]
AGE	-0.0694	-0.0676	-0.0627	0.1791*	0.1325	0.1835	-0.0308	-0.0287	-0.0264
	(-1.0268)	(-1.0071)	(-0.9211)	(1.8623)	(1.3073)	(1.8058)	[-1.3834]	[-1.2585]	[-1.1419]
SIZE	0.0322	0.0389	0.0347	0.1835*	0.1256	0.1912	-0.0003	0.0004	0.0005
	(0.6863)	(0.8391)	(0.7351)	(1.8939)	(1.2668)	(1.8456)	[-0.0309]	[0.0428]	[0.0579]
DEAL VALUE	0.0228	0.0151	0.0139	-0.0684	-0.0753	-0.0703	0.0239	0.0251	0.0247
	(0.5398)	(0.3509)	(0.3216)	(-1.2053)	(-1.1878)	(-1.1757)	[1.2693]	[1.3733]	[1.3170]
RETURN	0.8669	0.8756	1.0747	3.9924	1.5172	3.5651	0.4173	0.7457	0.6189
	(1.0972)	(1.1835)	(1.3056)	(1.1583)	(0.4074)	(0.9440)	[0.4756]	[0.8669]	[0.6932]
Observations	66	66	66	15	15	15	94	94	94
F-Statistics	1.5187	1.6364	1.4015	1.6267	0.9563	1.2550	1.1215	1.1426	1.1413
R-Squared	0.1123	0.1200	0.1247	0.4747	0.3469	0.4849	0.0599	0.0610	0.0730
Adjusted R-Squared	0.0384	0.0467	0.0358	0.1829	-0.0159	0.0985	0.0065	0.0076	0.0090

5. Conclusions, Limitations and Future Research

The present dissertation aims to study the impact of the different governmental measures taken on underpricing, during the COVID-19 period, by 10 European countries. Our sample consisted of 321 IPO deals that happened during our defined COVID-19 period from the 1st of January 2020 to the 31st of March 2022. At the time of writing this dissertation, the existing literature on COVID-19 globally is still young, even more so on the European continent, on financial markets, specifically the IPO market. As such, this study, to the best of our knowledge, is the first of its kind to examine the impact of the two chosen European governmental measures during the pandemic, on IPO underpricing in the defined countries for the specified period.

As uncertainty leads investors to demand lower prices and, consequently, higher underpricing levels, we intended to explore how adding two independent variables would impact underpricing levels. These variables translate the restrictive measures imposed on each country and the economic support given to families to alleviate the financial pressure the pandemic brought. The 10 countries considered were, alphabetically, Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom; however, the country Romania was not analysed given that its number of observations did not make it possible to estimate the necessary Regressions.

As hypothesised, the levels of underpricing are, overall, greater during the pandemic, corroborating the work of Mazumder and Saha (2021), Baig and Chen (2022), and others. We estimated an average underpricing of 10.93% (versus a 7.03% underpricing level for the prior period), a value slightly below the 11.40% first estimated by Ibbotson in 1975. Additionally, we verified our hypothesis that increasingly more restrictive measures translated into higher levels of IPO underpricing. However, a similar analysis of the impact of economic support on underpricing showed that it also led to greater underpricing, contrary to our hypothesised relationship. When combining the two variables, we found that they partially cancel each other out, opposing our initial anticipations. Given how connected they seemed, we would anticipate a strong correlation between the variables, yet the observed correlation was severely lower than expected. The pandemic was a first-of-its-kind event with unpredictable effects and impacts. Thus, some of the results we obtained that go against what was expected and defended in the literature may be justified because the conclusions

verified under normal periods (i.e., non-pandemic periods) may not be applicable here. Lastly, when studying the impacts of the pandemic on underpricing per country, we confirmed our hypothesis that countries that were greatly affected by COVID-19 experienced higher levels of underpricing. This is in line with the results of Zhang et al. (2020), Ashraf (2020b), Al-Awadhi et al. (2020), and others. As research revolving around the pandemic and its consequences evolves, this harmony between our results and those of past authors strengthens the consistency of the identified relationships.

Nonetheless, our study presents some limitations as well. The localised characteristics of our dataset, given that we focused solely on the selected European countries, the period in question, the selection criteria and consequently our sample size, may compromise representation. Additionally, some of our Regressions presented very few statistically significant variables, low coefficients, and R-squared values that can be caused by, among other aspects, the omission of significant variables. While we followed the relevant literature and used similar methodologies as previous authors, we were conditioned by the data that was available to us (even after contacting Bureau van Dijk representatives, the owners of the databases used in this study) and as such, we were not able to incorporate all the control variables that are typically employed (for example, the presence of venture capitalists and underwriters rankings in the deal, as we mentioned earlier in Chapter 3.1.3.).

Regardless, we can provide some additional topics to consider in future research. One of the reasons that led to an increased underpricing level during the COVID-19 period was uncertainty, as this has already been proved by Altig et al. (2020), Baig et al. (2021) and Albulescu (2021) for different geographic regions; as such, this dissertation could be complemented with a study on the impact that uncertainty had on underpricing, derived from the governmental measures taken by European countries, using, for example, a GARCH (1,1) model to confirm this relationship. Future research could also include more countries (both European and non-European countries) and control variables and investigate the impact of governmental measures on underpricing, combining a larger dataset and more explanatory variables. Finally, another interesting aspect to analyse could be the impact of each governmental measure, such as the schools closing, vaccination policies, international bans, stimulus packages, etc., on the level of underpricing per country during COVID-19.

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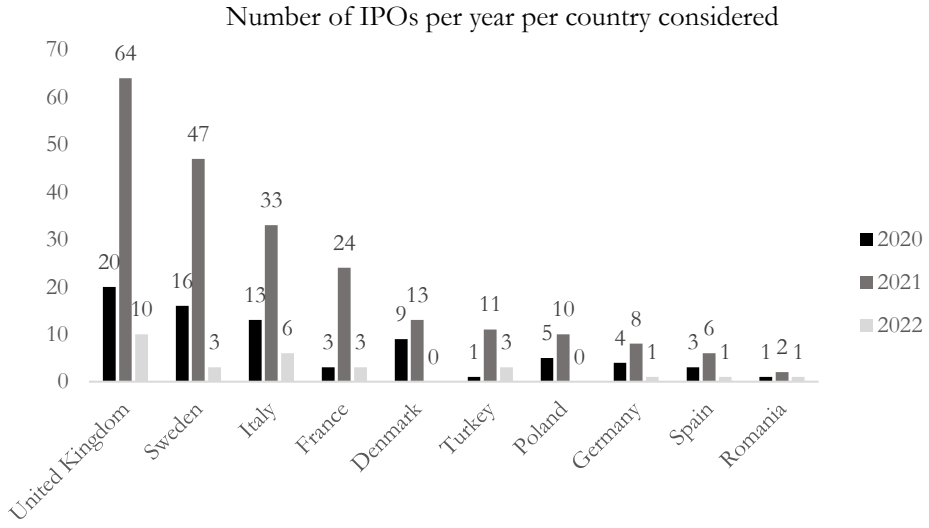
7. Appendices

7.1. Appendix A – Evolution of IPOs

Figure 1 - Number of IPOs per country, per year, by size order

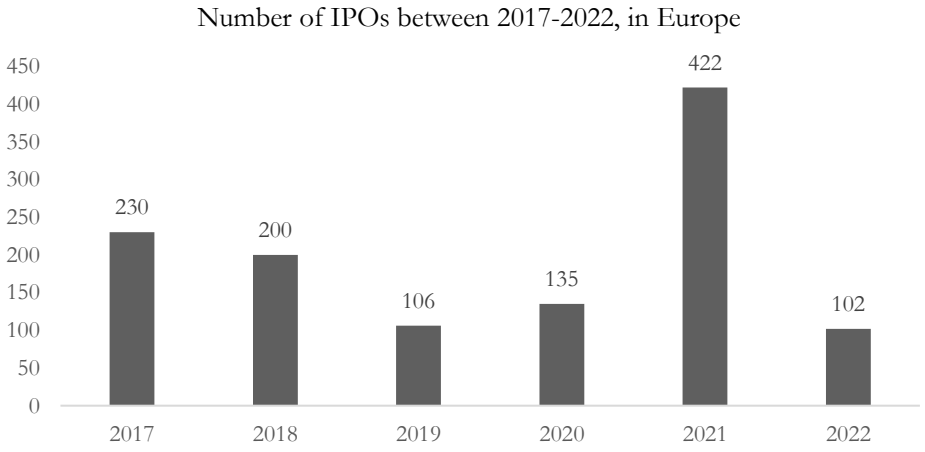
This graph presents, discriminated by country, the total number of IPOs undertaken between our considered COVID-19 period (from the 1st of January 2020 to the 31st of March 2022), by size order. Our sample consists of 321 companies that went public for the first timein the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey and theUnited Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)



Source: Zephyr and Orbis database

Figure 2 - Number of IPOs between 2017-2022, in Europe

This graph presents, discriminated by year, the total number of IPOs undertaken between our considered COVID-19 period (from the 1st of January 2020 to the 31st of March 2022) and pre-COVID-19 period (from the 2nd of October 2017 to the 31st of December 2019), that took place in Europe, free of all selection criteria. The information regarding these IPOs was retrieved from the PwC (PricewaterhouseCoopers) studies "IPO Watch Europe" 2021 and 2022



Source: PwC "IPO Watch Europe" 2021 and 2022

7.2. Appendix B – Description of research variables

This table contains a brief description of all the variables employed in this study

Variable	Description
Dependent variable	
UNDERPRICING	The difference between the stock´s price at the end of the first day of trading and the initial stock price defined, relative to this initial offer price
Independent variable	
RESTRICTIONS INDEX	The Oxford COVID-19 Stringency index that translates the restrictiveness of the measures each of the considered European governments took to fight the pandemic
ECONOMIC SUPPORT INDEX	The Oxford COVID-19 Economic Support Index that accounts for the economic support given to families during the pandemic
Firm-specific control variables	
AGE	The firm´s age, estimated as the natural logarithm of the difference between the year where the IPO took place and the year the firm was founded
SIZE	The size of the firm, estimated as the natural logarithm of the total assets of the firm the year prior to its IPO
TECH	A dummy variable that represents whether or not the firm belongs to a high-technological industry, where technological industries will be attributed a dummy value of "1", and "0" otherwise.
FINANCIAL	A dummy variable that represents whether the firm belongs to a financial or non-financial industry, to which the first will be attributed a dummy value of "1", and "0" otherwise.
Deal-specific control variables	
DEAL VALUE	The size of the IPO deal, estimated as the natural logarithm of the deal value of the IPO
EXCHANGE	A dummy variable that represents the type of stock exchange where the IPO was listed on, with dummy equal to "1" if the IPO was listed on a considered "large" stock exchange, and "0"otherwise
PENNY STOCK	A dummy variable that categorizes the type of stock offered, where the dummy will equal "1" if the offer price is lower than €5 (the "penny stocks"), and "0" otherwise (the "ordinary stocks")
Market-specific control variables	
COUNTRY	A dummy variable that represents the country in which the IPO took place. The dummy variable will equal "1" if the IPO occurred in the specified country, and "0" otherwise
YEAR	A dummy variable with the year where the IPO took place. The dummy variable will equal "1" if the IPO occurred in the specified year, and "0" otherwise
RETURN	The overall market return, given by the STOXX Europe 600 index, three months prior to the IPO date

7.3. Appendix C – Multicollinearity tests

Table 11 - VIF (Variance Inflation Factors) testing for Regressions (3.3) – (3.8)

This table presents the VIF values for every explanatory variable of our study. Appendix B contains the variables´ descriptions. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variables	**Regression 3.3**	**Regression 3.4**	**Regression 3.5**	**Regression 3.6**	**Regression 3.7**	**Regression 3.8**
RESTRICTIONS INDEX	1.1315	1.2458			1.5752	1.6681
ECONOMIC SUPPORT INDEX			1.2576	1.1365	1.5158	1.5212
AGE	1.2569	1.2573	1.5966	1.2876	1.2881	1.2882
SIZE	1.2675	1.2689	1.2523	1.2693	1.2679	1.2693
TECH	1.1703	1.1715	1.3638	1.1651	1.1710	1.1721
FINANCIAL	1.1784	1.1843	1.4632	1.1854	1.1794	1.1855
DEAL VALUE	1.2992	1.2996	1.3794	1.3030	1.3071	1.3078
EXCHANGE	1.2469	1.2505	1.2332	1.2756	1.2729	1.2776
PENNY STOCKS	1.2121	1.2128	1.5211	1.2151	1.2174	1.2182
RETURN	1.1565	1.5101	1.1695	1.4224	1.1570	1.5125
2020		3.1081		2.9419		3.1151
2021		3.3328		3.2311		3.3332

Table 12 - VIF (Variance Inflation Factors) testing for Regressions (3.9) – (3.11)

This table presents the VIF values for every explanatory variable of our study. Appendix B contains the variables´ descriptions. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. As we were not able to estimate the country specific Regressions (3.7) and (3.8) for the country Romania given that it did not have enough observations to do so, from now on, we will exclude that country from our analysis. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variables	**Denmark**			**France**			**Germany**		
	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)
RESTRICTIONS INDEX	1.1518		1.3799	1.1951		2.8719	1.6274		2.3176
ECONOMIC SUPPORT INDEX		1.7004	2.0372		1.7666	4.2451		3.1022	4.4180
AGE	1.8022	1.8012	1.8056	1.0809	1.0943	1.1089	2.0301	2.1634	2.3393
SIZE	2.4961	2.3157	2.5005	1.3704	1.3641	1.3704	5.4901	6.2516	6.2571
DEAL VALUE	1.9011	1.9623	1.9639	1.4884	1.5295	1.5296	1.4901	2.0661	2.9599
RETURN	1.4145	2.0269	2.4106	1.1784	1.6066	1.7389	4.7220	7.2732	8.5384

Variables	**Italy**			**Poland**			**Spain**		
	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)
RESTRICTIONS INDEX	1.2051		1.4392	1.0676		1.1835	1.0564		4.2070
ECONOMIC SUPPORT INDEX		1.2395	1.4803		1.1926	1.3221		1.1494	4.5775
AGE	2.0721	2.2525	2.2663	1.4562	1.4139	1.5110	1.7304	1.7342	1.8506
SIZE	3.2479	3.5285	3.5608	2.7234	2.7228	2.7335	2.3277	2.2966	2.6226
DEAL VALUE	1.9753	2.1454	2.1734	3.0197	3.1532	3.1539	4.5513	4.8173	5.8927
RETURN	1.2702	1.1475	1.5182	1.1223	1.1437	1.2173	2.0013	2.1104	2.9685

Table 12 - VIF (Variance Inflation Factors) testing for Regressions 3.9 - 3.11 – continued

This table presents the VIF values for every explanatory variable of our study. Appendix B contains the variables´ descriptions. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. As we were not able to estimate the country specific Regressions (3.7) and (3.8) for the country Romania given that it did not have enough observations to do so, from now on, we will exclude that country from our analysis. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Variables	**Sweden**			**Turkey**			**United Kingdom**		
	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)	(3.9)	(3.10)	(3.11)
RESTRICTIONS INDEX	1.2163		2.1405	2.3136		2.8011	1.3730		2.3321
ECONOMIC SUPPORT INDEX		1.0828	1.9057		1.5388	1.8630		2.5416	2.5265
AGE	1.1602	1.1547	1.1738	1.2011	1.0724	1.2157	1.0381	1.2927	1.0553
SIZE	3.9675	3.8815	3.9798	1.5710	1.3234	1.6281	1.1761	1.2220	1.1881
DEAL VALUE	3.5950	3.7745	3.7831	1.2194	1.2234	1.2273	1.1913	1.1711	1.1939
RETURN	1.1496	1.0167	1.2444	1.8688	1.7547	2.0339	1.4188	2.3514	1.5411

Table 13 - Correlation matrix

This table presents the correlation matrix of every explanatory variable in our study. Appendix B contains the variables´ descriptions. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. As we were not able to estimate the country specific Regressions (3.7) and (3.8) for the country Romania given that it did not have enough observations to do so, from now on, we will exclude that country from our analysis. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	UNDERPRICING	RESTRICTIONS INDEX	ECONOMIC SUPPORT INDEX	AGE	SIZE	TECH	FINANCIAL	DEAL VALUE	EXCHANGE	PENNY STOCKS	RETURN
(1)	1.0000										
(2)	0.1569	1.0000									
(3)	0.1043	0.5503	1.0000								
(4)	-0.0759	0.0020	-0.1339	1.0000							
(5)	0.0505	-0.0060	-0.0405	0.1893	1.0000						
(6)	0.0817	0.0969	0.0103	0.1776	-0.0263	1.0000					
(7)	0.0305	-0.0651	-0.0285	-0.2042	0.0161	-0.3466	1.0000				
(8)	0.0272	-0.0437	0.0113	-0.1329	0.2924	-0.1095	0.0670	1.0000			
(9)	0.1094	-0.0762	-0.1107	-0.2521	-0.0344	-0.0301	0.0436	0.3377	1.0000		
(10)	0.0512	-0.0349	0.0721	-0.2415	-0.3428	-0.0269	-0.0361	-0.1584	-0.0255	1.0000	
(11)	0.0463	0.2999	0.1537	0.0457	0.0275	0.0448	-0.0649	0.0847	0.1463	-0.1067	1.0000
(12)	0.0758	0.0290	0.0625	0.1085	-0.0696	0.2084	-0.0979	0.0208	0.1241	0.1263	-0.0217
(13)	-0.0640	-0.1477	-0.2047	0.1731	0.0313	0.0130	-0.0824	-0.2414	0.2383	-0.3913	0.0687
(14)	-0.0872	0.0461	-0.0945	0.0839	0.0679	-0.0075	0.0248	-0.0276	-0.1117	-0.2413	0.0631
(15)	0.0887	0.2057	0.2310	0.2277	0.1109	0.1024	-0.0793	-0.4110	-0.5571	0.0161	-0.1291
(16)	0.0399	0.0380	0.0915	0.0103	-0.0541	0.1124	-0.0799	0.0117	-0.2675	-0.1417	0.0448
(17)	-0.0369	-0.0219	0.1236	0.0160	0.0968	0.0073	0.1037	0.0367	-0.2042	-0.1147	-0.0119
(18)	-0.0172	-0.0374	-0.2989	0.0164	0.0467	-0.0257	0.0336	0.1937	0.2970	-0.0142	0.0469
(19)	-0.0419	-0.2118	-0.3738	0.1783	0.1040	-0.1239	0.0587	0.0271	-0.2675	0.1468	-0.0374
(20)	0.0372	0.0312	0.3026	-0.5289	-0.2078	-0.1795	0.1107	0.2711	0.3774	0.3077	0.0170
(21)	0.0386	0.0710	0.0889	-0.0542	-0.0186	-0.0439	0.0773	-0.0468	-0.0518	0.0461	-0.4015
(22)	-0.0086	0.1226	0.0284	0.0605	0.0433	0.0723	-0.1072	0.0592	0.0756	-0.0789	0.5014
(23)	-0.0435	-0.3094	-0.1803	-0.0189	-0.0437	-0.0538	0.0613	-0.0278	-0.0474	0.0611	-0.2274

Table 13 - Correlation matrix – continued

This table presents the correlation matrix of every explanatory variable in our study. Appendix B contains the variables´ descriptions. Our sample consists of 321 companies that went public for the first time between the 1st of January 2020 and the 31st of March 2022 in the following nine European countries: Denmark, France, Germany, Italy, Poland, Spain, Sweden, Turkey, and the United Kingdom. As we were not able to estimate the country specific Regressions (3.7) and (3.8) for the country Romania given that it did not have enough observations to do so, from now on, we will exclude that country from our analysis. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
	DENMARK	FRANCE	GERMANY	ITALY	POLAND	SPAIN	SWEDEN	TURKEY	UNITED KINGDOM	YEAR 2020	YEAR 2021	YEAR 2022
(1)												
(2)												
(3)												
(4)												
(5)												
(6)												
(7)												
(8)												
(9)												
(10)												
(11)												
(12)	1.0000											
(13)	-0.0871	1.0000										
(14)	-0.0557	-0.0660	1.0000									
(15)	-0.1193	-0.1412	-0.0903	1.0000								
(16)	-0.0601	-0.0711	-0.0455	-0.0973	1.0000							
(17)	-0.0486	-0.0576	-0.0368	-0.0788	-0.0397	1.0000						
(18)	-0.1379	-0.1633	-0.1045	-0.2237	-0.1126	-0.0912	1.0000					
(19)	-0.0601	-0.0711	-0.0455	-0.0973	-0.0490	-0.0397	-0.1126	1.0000				
(20)	-0.1746	-0.2066	-0.1322	-0.2829	-0.1425	-0.1154	-0.3273	-0.1425	1.0000			
(21)	0.1125	-0.1014	0.0359	0.0169	0.0522	0.0281	0.0106	-0.0874	-0.0318	1.0000		
(22)	-0.0513	0.0832	-0.0281	-0.0419	-0.0059	-0.0304	0.0360	0.0257	0.0024	-0.7033	1.0000	
(23)	-0.0839	0.0145	-0.0075	0.0439	-0.0684	0.0081	-0.0753	0.0885	0.0437	-0.1707	-0.4497	1.0000

7.4. Appendix D – Complementary Tables

Table 5 - Country categorization based on the impact of COVID-19

This table presents the impact of the COVID-19 virus on each country, discriminated by number of confirmed cases and confirmed deaths and divided into HIGH, MEDIUM and LOW-impacted countries. In parenthesis we have the percentage of confirmed cases and deaths by COVID-19 by the total population of the country at the end of our analysed period. Our sample consists of 321 companies that went public for the first time in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the pandemic statistics was retrieved from the *Worldometers* databases, for the COVID-19 period of 1st of January 2020 and 31st of March 2022.

	HIGH impacted countries				**MEDIUM impacted countries**			**LOW impacted countries**		
	France	Germany	Italy	United Kingdom	Turkey	Spain	Poland	Romania	Denmark	Sweden
Total number of confirmed cases	40,138,560 (62%)	38,428,685 (46%)	25,912,481 (44%)	24,641,596 (37%)	17,232,066 (20%)	13,914,811 (29%)	6,518,138 (16%)	3,409,402 (17%)	3,182,479 (54%)	2,712,743 (26%)
Total number of confirmed deaths	167,642 (0.26%)	174,352 (0.21%)	191,012 (0.32%)	228,144 (0.34%)	102,174 (0.12%)	121,760 (0.26%)	119,635 (0.30%)	68,249 (0.35%)	8,771 (0.15%)	24,536 (0.23%)

Table 8 - Market return by year

This table presents the average market return, discriminated by year. Our sample consists of 321 companies for the COVID-19 period (from the 1st of January 2020 to the 31st of March 2022) and 355 companies for the pre-COVID-19 period (from the 2nd of October 2017 to the 31st of December 2019), that went public for the first time in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the market return was retrieved from Yahoo Finance.

Year	# IPOs	Average market return
2017	59	3.38%
2018	175	-1.31%
2019	121	3.47%
2020	75	-0.57%
2021	218	6.01%
2022	28	-0.62%
Total	**676**	**1.73%**

Table 14 - Underpricing comparison by period considered (underpricing variables not-winsorized)

This table presents the descriptive statistics of the dependent variable (not winsorized), underpricing, for both periods. Table 10 presents a similar analysis, with the dependent variable being winsorized at the 5th and 95th percentiles. Appendix B contains the variables´ descriptions. Our sample consists of 321 companies for the COVID-19 period (from the 1st of January 2020 to the 31st of March 2022) and 355 companies for the pre-COVID-19 period (from the 2nd of October 2017 to the 31st of December 2019), that went public for the first time in the following 10 European countries: Denmark, France, Germany, Italy, Poland, Romania, Spain, Sweden, Turkey, and the United Kingdom. The information regarding the IPOs was retrieved from Zephyr and Orbis databases and complemented with information from finance websites (such as Yahoo Finance and Google Finance)

Period	Duration	Obs.	Mean	Median	Min	Max	Std. Dev.
Pre-COVID-19 period	02/10/2017 - 31/12/2019	355	0.1576	0.0241	-0.9297	9.7000	0.8617
COVID-19 period	01/01/2020 - 31/03/2022	321	0.2012	0.0627	-0.8983	25.1753	1.4719