The effect of Derivative Usage on Firm Value During COVID-19, Evidence from The Netherlands

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Abstract

This study investigates how derivative usage impacts firm value of Dutch non-financial companies during COVID-19. The goal is to understand the advantages of employing derivatives in times of crisis and determine if companies benefit from them in challenging economic periods.

Based on a dataset comprising 68 non-financial companies listed on the Euronext Amsterdam during 2019-2022, I find no significant effect of derivative usage on firm value, before and during COVID-19. These findings align with prior research, which also yielded inconclusive results. The study enhances our understanding of risk management strategies in non-financial sectors during economic uncertainty. Future research should explore broader datasets with more longitudinal information to deepen these insights.

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1. Introduction

Derivatives, in financial terminology, are explained as contracts between one or more parties that derive their value from an underlying asset to either speculate or reduce risk, also known as hedging. The most common derivatives are futures contracts, forwards, options, and swaps. Future contracts involve a standardized agreement to buy or sell a certain type of commodity or security at a predetermined price and time. In these standardized contracts, the owner of the future is obliged to buy or sell the commodity when the contract expires. Forwards work practically the same except that they cannot be sold to third parties in the interim, whereas futures, can be traded on public exchanges. Options give buyers the right to buy an underlying asset, unlike futures and forwards, options, as the name suggests, give the option to buy the underlying asset. Finally, there are swaps, in swaps two different parties exchange cash flows for a specific period (Basu and Gavin, 2010; Bryan and Rafferty, 2006). Derivatives are predominantly traded on the aforementioned public exchanges. However, there is also the concept of over-the-counter (OTC) trading. Unlike normal derivatives, this is not a standardized contract but tailor-made. This of course also carries risks as intermediaries are removed from the formula. Eliminating intermediaries provides flexibility but also creates a form of credit risk because there is no clearing corporation.

Over the years, since the introduction of derivatives in 1973, there has been an increasing use of derivatives for risk management. By now, it has become a 1-quadrillion market (Stankovska, 2017). Over time, the market has expanded, and the introduction of several types of derivatives prompts an increase in research on derivatives. This research culminates in a paradigm shift in financial markets during the early 2000s. Many non-financial firms embraced derivatives for hedging investments (Bodnar and Gebhardt, 1999). This evolution spurs a growing interest among researchers, leading to more frequent and in-depth studies on derivatives over the years.

Companies often turn to derivatives as a means of managing their financial situation, seeking stability amongst fluctuating prices and interest rates. Derivatives help companies lock in prices, hedge against unfavourable market movements, and mitigate risk. This raises the question of whether companies that use derivatives are in better shape than those that do not (Bachiller et al., 2021). Of course, there is always some level of risk involved when using derivatives, particularly with over-the-counter (OTC) derivatives. Counterparty risk becomes a significant concern when the opposing party may not be able to meet the terms of the contract. Publicly traded and OTC derivatives both run the risk of facing liquidity issues, which can drive up costs for the seller due to a lack of buyers. In turn, this can lead to a

widening spread for the derivative and a drop in price, even if the underlying value of the derivative remains unchanged, due to the illiquid nature of the market (Du et al., 2023).

Previous studies conducted in various countries, including the US, Greece, and Turkey, have examined the influence of derivatives usage on firm value. The outcomes of these studies have been conflicting, with significant effects observed in some countries and no effects in others. Furthermore, a meta-study involving 51 studies revealed a lack of consistent evidence in empirical hedging literature. This inconsistency may stem from various factors, such as differences in data, model specifications, research methodologies, and the countries under examination (Bachiller et al., 2021). It's essential to note that the studies conducted before the COVID-19 pandemic significantly affected global markets in many ways. The measures implemented to control the pandemic, such as disruptions in supply chains, reduced economic growth, increased market volatility, and a staggering decline in job numbers, have profoundly affected the economy. Recent research suggests that further tightening of these measures could result in a loss of up to 15% in industrial production (Maital Ella Barzani, 2020). In times of crisis like the COVID-19 pandemic, derivatives should be beneficial as they help reduce risk and stabilize cash flows. However, it remains uncertain whether these financial instruments have effectively mitigated the impact of the pandemic.

1.1 Relevance & research proposition

Over the years, researchers, both academic and non-academic, have conducted extensive studies to comprehend the impact of derivatives on the valuation of companies. However, most of these studies have primarily focused on US-companies listed on US-stock exchanges (Fauver and Naranjo, 2010; Howton and Perfect, 1998; Lau, 2016; Samant, 1996). The reason is that the US economy is the largest and one of the most transparent, making it easier to study US-companies (Alt and Thomson, 2019). Consequently, Europe, including the Netherlands, has received less attention from researchers.

Although researchers have conducted a few studies in Europe, most of them have focused on a single country or region (Ayturk et al., 2016; Bodnar et al., 2003; Clark and Mefteh, 2010), resulting in contradictory results due to the unique characteristics of each area (Guay, 1999; Hentschel and Kothari, 2001). In 2017, a large-scale study by Bartram, including 6,896 firms from 47 countries, found that non-financial companies mainly use derivatives to reduce risk. With the exception for commodity price derivatives, which slightly increase net commodity price exposure (Bartram and Bundesbank, 2017). In contrast, a study conducted in 2014, specifically focused on the Netherlands, found that usage of foreign

currency derivatives negatively impacts firm value, which is different from the findings of American studies (Zi, 2014). Despite the recent studies, there is still a lack of research on the effects of derivatives on non-financial companies in the Netherlands, which calls for further research in this field.

The COVID-19 pandemic significantly affected the global economy, and researchers are still investigating the extent of this impact. There has been little research on how COVID-19 has affected the use of derivatives and firm value. However, studies have shown that COVID-19 has caused a significant economic downturn, particularly due to containment measures imposed by governments (Açikgöz and Günay, 2020; Verschuur et al., 2021). From a macroeconomic perspective, several companies have researched and published on the impact of COVID-19[1]. Initially, the virus caused a supply-side shock, as it originated in China, leading to a sudden stagnation in the supply of goods worldwide (Akbulaev et al., 2020; Shohini, 2020). On the supply side, this contraction caused central banks to adjust their monetary policy, resulting in quantitative easing (Ditzen et al., 2022; Maital Ella Barzani, 2020) These global changes have affected the supply chains of businesses. As the risk of future pandemics remains[2][3], it is vital to research the effects of derivatives on firm value during these times. Previous crises have shown that hedging provides more stability and enhances value. Studies during the dot-com bubble of 2001 and the financial crisis of 2008 have supported this finding (Alam and Gupta, 2018; Rossi Júnior and Laham, 2008). Limited research has specifically addressed the impact of COVID-19 on this phenomenon. However, research from China shows that using derivatives can have a significant positive impact on enterprise value (Yang et al., 2022).

This study will examine the impact of derivatives on firm value in the Netherlands. The study will focus on the effect of derivatives on firm value before and during the COVID-19 pandemic. Prior research from Indonesia, Turkey and Malaysia suggests that the use of derivatives may have a positive effect on future performance (ROA & ROE), which is a key determinant of future firm value (Ayturk et al., 2016; Frendsidy and Mardhaniaty, 2019; Lau, 2016). This study aims to expand on existing research by investigating the effect of derivatives on firm value during COVID-19. As such, I will look at companies in the

[1] Addressing the financial impacts of COVID-19. (z.d.). Deloitte. https://www2.deloitte.com/ce/en/pages/about-deloitte/solutions/financial-impacts-of-COVID-19.html
[2] Q&A: Future pandemics are inevitable, but we can reduce the risk. (z.d.). Horizon Magazine. https://ec.europa.eu/research-and-innovation/en/horizon-magazine/qa-future-pandemics-are-inevitable-we-can-reduce-risk
[3] Lau, J. (2022, 28 juli). Preparing for the next pandemic. hsph.
harvard. https://www.hsph.harvard.edu/news/features/preparing-for-next-pandemic-g7-pact/

Netherlands where information is accessible, and no such study has been conducted following the pandemic. The research question will investigate the effects of derivative usage on firm value during and prior to COVID-19:

- *What was the impact of derivative usage on firm value of Dutch-listed companies both before and during COVID-19?*

1.2 Contribution

This study contributes to the literature on the effect of derivative usage on firm value during COVID-19 in several ways. Firstly, while several studies have investigated the relationship between financial derivatives and firm performance, little attention has been given to the role of COVID-19 as it is a relatively new phenomenon. Using derivatives can have varying effects on firm value, depending on several other factors such as market growth, volatility, firm size, country of origin, and more. Additionally, it is a valuable tool for limiting potential losses by fixing cash flows and buy/sell prices. Therefore, it is essential to assess the impact of derivative usage on firm value during the COVID-19 pandemic. Secondly, this study provides evidence for the Dutch context. So far, there has been a limited amount of research to examine the role derivative usage has on firm value for Dutch-listed firms. By conducting this study, I can evaluate whether the results hold for a developed country like The Netherlands and examine the effect of COVID-19 on the relationship between derivative usage and firm value in this context.

1.3 Structure

The structure of this paper is as follows. Chapter 2 delves into the implications of derivative usage, accompanied by relevant theories. It also provides a summary of the most significant theories regarding differences in sectors and the potential impact of COVID-19. Furthermore, it features an in-depth discussion on the development of specific hypotheses. Chapter 3 explains the research methods employed in this study, providing an overview of diverse research methods utilized in previous studies. Subsequently, it selects the most appropriate method for this study. The chapter then presents the empirical model, clarifying how it measures variables, tests hypotheses, and describes the data used. Chapter 4 will discuss the results obtained in this study, which includes descriptive statistics, correlations, assumptions, regressions, and robustness checks. Finally, Chapter 5 summarizes the main

findings of this study. It also discusses the limitations of this study and suggests potential avenues for future research.

2. Literature Review

This chapter provides an overview of the main subject of this study, which is to understand the impact of derivative usage on firm value. Firstly, various theories regarding the implications of derivative usage will be discussed. Secondly, the main theories related to different sectors and the impact of COVID-19 are described.

2.1 Hedging theories

Derivatives are financial instruments that have become increasingly popular due to their potential to help firms align the availability of internal funds with investment needs, reduce the cost of underinvestment, and mitigate the risk of financial distress. They can also provide the market with information based on their use. However, the use of derivatives entails potential risks, highlighting the importance of sound risk management practices. This is especially crucial in minimizing potential conflicts of interest between managers and shareholders (Basu and Gavin, 2010; Bryan and Rafferty, 2006; Nance et al, 1993). In the following discussion, I will delve into the corresponding theories and draw up several hypotheses.

2.1.1 Financial distress theory

The financial distress theory suggests that companies can use derivatives to reduce the risk of financial distress and bankruptcy. By using derivatives, companies can hedge against unfavorable market movements, which can help mitigate the impact of unexpected events on their financial position. This theory implies that companies try to avoid the costs associated with financial distress by hedging (Brown et al., 2006; Gordon, 1971).

Previous research has highlighted the direct costs that companies may face due to financial distress, such as administrative and legal costs related to bankruptcy. By using derivatives, companies can reduce the probability of falling into such a scenario, hence avoiding these foreseeable costs. In this way, the advantages of using derivatives to mitigate risk outweigh the disadvantages, making it a valuable strategy for companies. Nance et al. (1993) suggests that smaller firms are more likely to use derivatives for hedging as the costs of financial distress are more severe for them. On the other hand, larger firms often have a dedicated financial management team that specializes in using derivatives, which makes them more inclined to use these financial instruments. In either case, the use of derivatives can help firms manage their financial risks and protect themselves against potential losses (Altman, 1984).

Hence, the size of the company does play a role in whether or not to use derivatives, this applies both non-financial and financial companies (Purnanandam et al., 2004).

Reducing the probability of financial distress has other benefits as well, for instance it can also increase the optimal debt-equity ratio, therefore the associated tax shield of debt (Myers, 1993, 1984, 1977). Additionally, if firms face a convex tax schedule, reducing the volatility of taxable income will lower the average tax liabilities. This reduction is because fluctuations in taxable income lead to variations in the amount of taxes owed and smoothing out these fluctuations can result in a more stable and predictable tax liability (Smith and Stulz, 1985). Therefore, using derivatives to hedge against market movements and reduce income volatility can be an effective tax planning strategy for firms. These tax implications predict that firms with higher leverage, shorter debt maturity, lower interest coverage, and less liquidity (e.g., a lower acid test) are often more inclined to use derivatives for hedging purposes. At the same time, this is less of a concern for companies with higher dividends yield, given that these businesses often have stable cash flows and less financial leverage (Bartram et al., 2009).

2.1.2 Underinvestment

Raising capital by issuing shares is a common practice for companies, but it comes with significant costs. The primary expenses are transaction costs, which usually include legal fees, underwriting fees, and other expenses related to issuing securities. These costs can be relativily high, which may tempt companies to underinvest. However, managers can use derivatives to align the availability of internal funds with the firm's investment needs, thereby increasing shareholder value (Subramaniam, 1996).

Apart from the cost of raising capital, there can also be a conflict of interest between shareholders and debt holders. This conflict can lead to underinvestment, especially in highly leveraged companies where shareholders have all the residual claims. In the event of bankruptcy, shareholders would retain a larger share compared to the debt holders. To mitigate this risk, companies can implement a robust risk management strategy that reduces the cost of underinvestment by minimizing the variability of firm value. (Bessembinder, 1991; Myers, 1977).

2.1.3 Managerial incentive theory

According to the Incentive Theory, managers are more likely to use derivatives if they have incentives. These incentives come at the expense of shareholders and could lead to managers acting purely for their gain. When using convex pay structures, managers tend to

strive for high performance as the rate of pay increase is higher than the rate of decrease for poor performance. (Smith and Stulz, 1985; Tufano, 1996). Striving for high performance could result in them rejecting riskier, long-term projects that would potentially benefit shareholders in the long run but have a negative net present value in the short term. Instead, they would focus on ensuring that the short-term share price rises as fast as possible, making their options worth more. (Froot et al., 1993; Tufano, 1996).

Recent studies support this theory, highlighting that managers prioritize their fortune over that of shareholders when incentivized. The suggestion is that managers should decrease the use of derivatives in scenarios where they are more likely to benefit more than shareholders (Huang et al., 2018). For instance, in the gold-mining industry, firms with managers holding more company stock tend to manage gold price risk more actively, while managers holding a larger number of options are associated with decreased levels of gold price risk management (Tufano, 1996). This suggests that some managers may be using derivatives in a potentially value-destroying way.

2.1.4 Signaling theory and information asymmetry

Asymmetry in information is a common phenomenon, where some individuals possess more information than others. Asymmetry particularly occurs when company executives who have early knowledge of their company's performance and can act on it by buying back or selling shares. Investors perceive these actions as signals to the market about the company's health. To overcome this information asymmetry, companies often take large positions in derivatives to hedge their significant output. For instance, a company mining iron ore might secure the price by selling futures or forwards at a predetermined price. This way, investors can still reasonably assess how the company is performing. However, using derivatives is costly, especially options, making it difficult for companies to imitate this phenomenon. Recent research by Anjos and Winegar (2022) demonstrates that companies can actively resolve friction arising from asymmetry and find alternative ways to signal their expected output, aiding investors in making informed decisions.

The study reveals that companies expected to perform well have an incentive to use combinations of options and forwards, while companies that underperform will only use forwards. Companies using both options and forwards actively speculate on a price rise, while the forwards serve purely as a hedge (Anjos and Winegar, 2022). Additionally, Australian research shows that companies listed on the Australian Stock Exchange (ASX) that used swaps could also purchase them at a "discount," making it extra advantageous to hedge with these

instruments. This phenomenon implies that using these derivatives can also have another positive effect on the company's value (Nguyen and Faff, 2008). However, there is a difference by sector; Jin and Jorion (2006) emphasize that there is generally no difference in the effect of derivatives on firm value for gold mining companies, and the same applies to oil and gas producers. In the biotech industry, where information asymmetry and underinvestment problems are common, companies also heavily use derivatives. This seems to have a positive effect on firm value in this industry. It appears, the greater the information asymmetry and underinvestment, the more pronounced the impact of derivatives on firm value is. (Choi et al., 2013).

2.1.5 Efficient market theory

In an ideal scenario, market efficiency dictates that traders always trade the prices of derivatives or shares at their "true" value, which implies that the theory of information asymmetry does not exist. Therefore, buying shares on derivatives with inflated or undervalued prices is impossible. As a result, it is impossible to outperform the market (Awrey, 2016; Craig et al., 1995). Miller and Modigliani's (1958) proposition, known as the capital structure irrelevance theory, argues that in the absence of taxes and bankruptcy costs, the value of a firm is independent of its capital structure. According to this theory, a firm's risk management activities should not affect its overall value. However, this is not always the case, as organizations have gained popularity and widely adopted risk management activities. These activities aim to identify, assess, and mitigate risks that could potentially impact a company's operations and financial performance. This contradicts Modigliani and Miller's proposition because it suggests that risk management can have an impact on a firm's value. By implementing risk management practices, companies can reduce the likelihood and severity of adverse events, such as financial losses or operational disruptions. This can lead to improved financial performance, increased investor confidence, and a potentially higher market value for the firm. The adoption of risk management practices implies that firms recognize the importance of managing risks and believe that doing so can positively impact their value, hence its widespread use (Alti, 2006; Ardalan, 2017; Luigi and Sorin, 2009).

2.2 Differences in sector

Companies use derivatives for host of different reasons. For instance, one company may emphasize futures when it needs to purchase large amounts of commodities. Meanwhile, other companies find swaps crucial due to substantial cash flows coming in with foreign

currencies. Previous research underscores this variation, particularly among companies in different sectors. For instance, companies in heavily regulated environments must exercise caution and adhere to specific guidelines (Drever and Hutchinson, 2014; Kester, 1986).

2.2.1 Regulatory Environment

The use of derivatives may be more prevalent in certain sectors due to regulatory requirements or guidelines. For example, banks and other financial institutions may be required to use derivatives as part of their risk management system, while in other sectors it is heavily frowned upon (Kuritzkes & Schuermann, 2006).

Research shows certain sectors more commonly use derivatives due to regulatory requirements or guidelines. For example, financial institutions like banks may require the use of derivatives as part of their risk management system, while in other sectors, it may not be encouraged. Research conducted by Marsden and Prevost in (2005) suggests that there is a noticeable difference between sectors regarding the impact of derivative use on the firm's value. For example, research conducted in New Zealand illustrates that the sector in which the company operates heavily influences the use of derivatives. Thus, changes in laws and regulations do not affect every sector equally. Surprisingly, the research found that sectors with growth did not exhibit a disproportionate increase in using derivatives to lower the probability of requiring more expensive external funds. However, research found that the size of the company, capital structure, and liquidity significantly impact the use of derivatives. These factors also vary among different sectors. Every company has its interpretation of this, but generally, there are differences among sectors (Drever and Hutchinson, 2014; Kester, 1986).

Simply examining the effect of laws and regulations in a sector and their impact on the use of derivatives, one can observe a significant difference, especially between the financial and non-financial sectors (Asli, 2010). Financial corporations, after all, must contend with regulations such as capital adequacy requirements, risk management standards, and regulatory frameworks like Basel III, which establish guidelines on the use of derivatives for hedging and risk management purposes. These regulations impose limits on leverage and require adequate collateral.[4]. Basel III, however, is a framework specifically designed for internationally active banks, which puts it outside the scope of this study. It is on the other hand a perfect example of how regulations can affect the derivative market, as the capital

[4] Trinidad, C. (2022). Basel III. *Corporate Finance Institute*. https://corporatefinanceinstitute.com/resources/risk-management/basel-iii/

requirements, leverage ratios, and liquidity requirements are stricter than before. Basel III imposes capital charges based on the risk profile of that trade. Regulators calculate the capital charge using specific methodologies outlined in the Basel framework, such as the standardized approach or the internal models approach.[5].

Turning to non-financial firms, they must comply with The European Market Infrastructure Regulation (EMIR), a set of regulations designed to create transparency in the OTC derivatives market, reduce credit risk, and mitigate operational risk. EMIR extends the regulatory scope of financial regulation to non-financial sectors on the assumption that systemic risks can be transferred from non-financial sectors to the financial sector as a consequence of derivative usage (Kerste et al., 2015). Prior research suggests that EMIR's impact on companies and their treasuries is straightforward, primarily necessitating the establishment of a well-defined hedging strategy (Zdeněk Závora et al., n.d.).

2.2.2 Market Volatility

The use of derivatives by companies operating in highly volatile environments, as suggested by the market volatility theory, aims at reducing the impact of sudden market price swings on their financial performance. Sectors such as technology or biotechnology are particularly susceptible to price volatility and can benefit from derivative usage to provide stability and predictability for investors (Bazih and Vanwalleghem, 2021; Schiller, n.d.).

During the 2008 financial crisis, which saw several prominent financial institutions fail, the stock market significantly declined and spreads on diverse loan types relative to equivalent U.S. Treasury securities considerably expanded, leading to an increased number of companies using derivatives (Chari et al., 2008). Evidence from Finland shows that Finnish firms use derivatives to protect themselves against price fluctuations. However, the study found no link between derivative usage and an increased firm value. It identified a significant negative effect on firm value for some derivatives. The only derivative that did have a positive effect was foreign exchange derivatives, but this effect was not significant. This study did not make sectoral distinctions, but it clearly showed that in times of high volatility, more and more companies were actively using derivatives. (Dahlberg, 2012).

[5] https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/financial-markets/post-trade-services/derivatives-emir_en#:~:text=The%20European%20Market%20Infrastructure%20Regulation,(CCPs)%20and%20trade%20repositories.

2.2.3 Operational risk theory

Firms who operate in sectors with higher operational risk, such as oil and gas, may use derivatives to manage their exposure to potential losses from operational failures or accidents. By using derivatives, these firms can transfer some of their risk to other parties, reducing the likelihood of financial losses (Chernobai et al., n.d.; Juan De Witt, 2013; van Mieghem, 2011).

2.3 Effect of COVID-19

The COVID-19 pandemic had a global impact, causing financial markets to decline worldwide and creating significant disparities in the performance of different sectors. The currency market experienced heightened uncertainty, which in turn had a ripple effect on the derivatives market. Consequently, the derivatives market came under greater pressure than ever before.

2.3.1 COVID-19 impact on firm value

The effect of COVID-19 on firm value was evident, firms generally suffered from this, given that this virus had an impact on a global scale like never before. However, it did appear that firms engaging in sustainability experienced this effect to a lesser extent. Earlier research already showed that sustainability can help companies with relatively high leverage to avoid falling into financial distress. Therefore, it was expected that companies with a solid sustainability outlook would experience fewer adverse effects from COVID-19. In particular, companies with a more stakeholder-oriented approach were less likely to be affected by the implications of COVID-19 (Bose et al., 2022). This stakeholder-oriented approach is confirmed by other research, indicating that companies that intensively engage in corporate social responsibility activities fare better coming out of the COVID-19 crisis than those that did nothing with it. The study shows that hospitality firms that improved stock market performance during the COVID-19 pandemic invested in CSR to protect customers and employees (Qiu et al., 2021).

Besides exploiting sustainability, Chinese companies initially benefited from diversification, especially currency wise. Chinese companies whose geographical exposure was mainly to the Hubei were significantly worse off than those with more foreign exposure. This had a value-enhancing diversification effect after the domestic outbreak of the virus but a value-destroying effect following an outbreak overseas (Ding et al., 2022).

2.3.2 Effect of COVID-19 on derivative usage

The COVID-19 pandemic also left its mark on the derivatives market. Thus, the volume increased enormously, up to 2 or 3 times as much as the years before. Even in crises prior to COVID-19, this volume was not as high. This increase was consistent across countries and asset classes. However, the number of trades fell in the first months of the pandemic (Emm et al., 2022). In terms of risk management, one study argues that the pandemic has increased the importance of risk management and the use of derivatives for firms, as they face increased uncertainty and volatility. The article also provides several examples of how firms have used derivatives to manage risk during the pandemic. Other studies argue that the pandemic has increased the importance of risk management and derivative usage by companies as they face increased uncertainty and volatility (Emm et al., 2022; Nguyen and Hoang Dinh, 2021).

3. Hypothesis development

This chapter outlines the hypotheses tested in this study. The first and second hypotheses are related to the effect of derivative usage on firm value prior to and during COVID-19.

3.1 Effect of derivative usage on firm value

The main objective of this study is to investigate the connection between the use of derivatives and the value of a company during a crisis, in this case, the COVID-19 pandemic. There is no clear answer in the literature regarding this issue, hence its importance to determine if there is any effect at all in the Netherlands. Previous research conducted in Turkey, for instance, revealed that the use of derivatives, with some minor exceptions, did not have any significant effect on the value of a company. Overall, the study concluded that there was no significant effect (Ayturk et al., 2016). However, a study conducted in France found that derivative usage was a crucial factor in determining the value of French companies, especially larger ones. The study also discovered that the company's exposure profile influenced the impact of derivatives on firm value. Specifically, the effect was 1.5 times greater for firms with higher levels of exposure and over 5.5 times greater for firms with exposure to the depreciation of the euro compared to those with exposure to its appreciation. In other words, the study suggests that companies that use derivatives and have heightened degrees of exposure to market movements tend to see a greater impact on their value. Nevertheless, the magnitude of the effect depends on the company's exposure profile, with higher levels of exposure leading to a more pronounced impact on the company's value (Clark and Mefteh, 2010). These findings imply that companies should carefully evaluate their exposure profiles and the use of derivatives to mitigate risks and maximize the value of their business.

Besides empirical evidence, certain theories indicate a possible positive effect of derivatives on firm value before COVID-19. For instance, the financial distress theory proposes certain tax benefits related to optimizing the debt-equity ratio, which can serve as a tax shield from debt. Also, the volatility of taxable income may decrease, resulting in a lower average tax liability (Myers, 1993, 1984, 1977). Apart from the financial distress theory, the managerial incentive theory suggests that managers are inclined to use derivatives when they personally benefit. For example, the manager, prioritizing short-term share price gains for the benefit of his options, may opt to greenlight only projects with an immediate positive Net Present Value (NPV) (Froot et al., 1993; Tufano, 1996).

The first hypothesis tested in this study is whether companies using derivatives had a higher firm value before the COVID-19 crisis. This hypothesis assumes that derivative usage is a sophisticated financial strategy that can help companies manage their risks more effectively, which leads to higher firm values. This corresponds to the studies of Ayturk et al., (2016) and Clark and Mefteh, (2010), implying that derivative usage might have a positive effect on firm value.

H1: Companies using derivatives have higher firm value prior to COVID-19.

If the data supports the hypothesis, it could suggest that companies actively using derivatives are better at maintaining their value. However, it is also possible that other factors, such as the industry sector, firm size, and financial performance, may be more important in determining firm value. Therefore, the study should also consider controlling for these variables to isolate the impact of derivatives on firm value.

3.2 Effect of derivative usage on firm value during COVID-19

The COVID-19 pandemic has posed unprecedented challenges for businesses, particularly affecting industries such as energy, travel, hospitality, entertainment, and consumer finance (Szczygielski et al., 2022). Companies in these industries may have been particularly vulnerable to market shocks, and derivative usage may have helped them navigate the crisis more effectively and preserve their value.

Previous studies have shown that regarding the effect of derivative usage on firm value during COVID-19, some studies have suggested that firms that use derivatives may have been better able to manage the financial risks associated with the pandemic. For instance, a study by Nguyen and Hoang Dinh (2021) published in the China Finance Review International revealed that companies using derivatives to hedge against currency risk had a higher market value during the COVID-19 crisis compared to those not using derivatives. This finding aligns with research in the United States and Finland, where academics provided evidence indicating that derivatives usage is associated with higher firm value during the COVID-19 pandemic. The studies also found a positive relationship between derivatives usage and firm value more pronounced for firms with higher liquidity and larger size. In addition, the positive relationship between derivatives usage and firm value was stronger for firms in the healthcare and consumer staples industries. The authors suggest that these findings may reflect the higher risk exposure of firms in these industries during the COVID-

19 pandemic, which may benefit more from derivatives usage (Li et al., 2021; Pakkanen, 2021) This would be consistent with previous research from other countries and prior crises where derivative usage seemed to have a stabilising effect, while firms that did not use them declined relatively faster, in terms of firm value (Bazih and Vanwalleghem, 2021; Qiu et al., 2021; Schiller, n.d.).

H2: The positive effect of derivative usage on firm value prior to COVID-19 becomes stronger during COVID-19.

If the data supports the hypothesis, it could imply that companies actively using derivatives are better positioned to manage the risks associated with the COVID-19 crisis and maintain their value. However, it's also possible that other factors, such as the industry sector, firm size, and financial performance, may play a more crucial role in determining firm value during the pandemic. Therefore, this study also accounts for these variables to isolate the impact of derivatives on firm value.

4. Methodology

This study aims to test two hypotheses related to the effect of derivative usage on firm value. The first hypothesis examines the relationship between derivative usage and firm value prior to the COVID-19 pandemic, while the second hypothesis examines this relationship during the pandemic. In order to test these hypotheses, I conduct a multivariate regression analysis, controlling for pertinent variables such as firm size, leverage, and profitability. The analysis will utilize a sample of Dutch-listed companies, with data collected from financial reports and databases. Statistical software SPSS will be used to conduct the analysis and evaluate the significance of the results.

4.1 Dependent variable

For this study, I use a comparison test of derivative usage on firm value using data from Dutch-listed companies. To measure firm value, I will use market-to-book ratio. Previous studies predominantly used Tobin's Q as a proxy for firm value. Tobin's Q, whether used in any specification, is not an accurate measure of firm value, both theoretically and practically. It is important to note that James Tobin did not intend for Q to be used as a tool to evaluate firm value, making its current simplified form not suitable for such a purpose (Barlett and Partnoy, 2018). In this study, price-to-book value is used as a measure of firm value, offering an alternative approach that aligns with prior research (Willim, 2015; Barhraini and Endri, 2021; Ichsani and Izlia, 2021; Nur et al., 2014). Price-to-book ratio compares a company's market value (market capitalization) to its book value. It indicates how much investors are willing to pay for each dollar of book value. A price-to-book ratio greater than 1 suggests that the market values the company's assets and earnings potential more than their historical cost (Sharma et al., 2013). Calculating the price-to-market ratio looks as follows:

$$Price - to - Book\ ratio = \frac{Shareprice}{Book\ value\ per\ share}$$

4.2 Independent variable

Similar to (Ayturk et al., 2016) I will also use different measures for the use of financial derivatives: (i) Derivatives Usage is a dummy variable that equals to 1 if a firm uses any kind of derivative instruments and 0 otherwise. (ii) The Extent of Hedging is an extended

variable measured as the ratio of the total notional value of derivative instruments to the book value of total assets.

4.3 Control variables

As suggested by Frendsidy and Mardhaniaty (2019), I will also control for differences among various industries within the dataset. I anticipate that there are significant differences within a country among different industries. Bartram and Bundesbank (2017) suggest that practically all derivatives used by non-financial companies are employed for hedging; thus, there is no need to compute different variables for derivatives used in hedging and speculation.

Existing studies use variables that might explain the relationship between derivative usage and firm value. These variables are not central in this study but may affect the dependent variable, commonly referred to as control variables. These variables, identified in the literature review, are:

- Firm size ($FS_{i,t}$): Natural logarithm of total assets in year. (Mian, 1996; Minton and Schrand, 1997; Nance et al., 1993).
- ROA ($ROA_{i,t}$): Net profit divided by total assets (Abdullah & Rashid , n.d.; Ayturk et al., 2016; Delen et al., 2013).
- Liquidity ($LQ_{i,t}$): The current ratio of cash and cash correspondent to present liabilities of that year (Ayturk et al., 2016).
- Growth ($GR_{i,t}$): The ratio of capital expenditure to total assets of firm. (Allayannis and Weston, 2001a; Yermack, 1996; Smith & Watts, 1992)
- Age ($AGE_{i,t}$): Logarithm of number of days of which the company has been listed (Clark and Mefteh, 2010).
- Corporate Dividends ($CD_{i,t}$): The dividend policy applied by firm in year t to investor as measured using a dummy variable (Ayturk et al., 2016; Clark and Mefteh, 2010).
- Leverage ($LV_{i,t}$): The leverage of firm long-term debts divided by total assets (Muturi et al., 2018; Abobakr and Elgiziry, 2016).
- Industry (IDi,t): The evaluation of industry effects involves the use of three distinct dummy variables, each taking a value of 1 to denote companies within the raw material, manufacturing, and service industries, and 0 otherwise (Géczy et al., 2007).

4.4 Data

I will utilize data available on the Euronext website, a stock exchange platform where a substantial amount of data, including annual reports, firm characteristics, and company information, can be accessed. Euronext serves as a gateway to the respective company's website where the annual reports are located. The data for this study is collected from January 1 of 2019 - 2022. The reason for this is that new International Financial Reporting Standards related to derivatives were announced in 2014 and took effect on January 1, 2018. Of these 4 years of data, the first 2 years are "normal" or at least untouched by COVID-19, and 2021 and 2022 are influenced by COVID-19. IFRS 9 requires companies to specifically disclose requirements for hedging. The years before COVID-19 form a baseline to which the years after can be compared.

For the distinction of large datasets, most research uses the metrics of Morgan Stanley Capital International (MSCI) world sector stock indices (Energy, Materials, Industrials, Consumer Discretionary, Consumer Staples, Health Care, Financials, Communication Services, Utilities, Real Estate, and Information Technology)[6]. Considering the probability of insufficient data points per industry in this study, I propose an alternative clustering approach. I introduce a dummy variable that assigns a value of 1, 2 and 3 to industries falling within the categories of raw material, manufacturing, and service industries, and 0 otherwise.

To collect data, I chose to search the main body of annual reports for text strings of “derivative”, “hedge”, “forward”, “swap”, “option”, “futures” and “financial risk”. If I find any of these terms in the annual report, there will be a careful examination of how derivatives are used with the company in question.

I impose the following screening procedures: (i) the firms must have a financial statement to compute the test variables such as ROA for the period 2019 to 2022 (ii) firms within financial service industry are removed, as this research is concerned with non-financial companies only (iii) firms have stock price information related to the period above, companies that went public within that period of time are also removed from our dataset (iv) the annual report of the firm must be available on the country’s stock exchange website.

[6] The Global Industry Classification Standard. MSCI, (2023). https://www.msci.com/our-solutions/indexes/gics,

4.5 Methods

Similar to the study of Allayannis and Weston (2001) which analyzed the impact of hedging foreign currency on the value of companies, a dataset of a vast number of non-financial firms in the US between the years 1990 to 1995. Additionally, I will employ a univariate analysis, and OLS linear regression, comparing the changes in the effect of derivative usage on firm value.

4.5.1. Univariate analysis

Univariate analysis is a method of statistical analysis that involves examining each variable in a dataset individually, without considering the relationship between variables. It aims to describe the properties and characteristics of a single variable, such as the range of values, the distribution of data, the measures of central tendency (such as mean, median, and mode), and the variability of the data. In other words, univariate analysis focuses on exploring and understanding the characteristics of a single variable, without considering any potential relationships or dependencies with other variables in the dataset (Canova et al., 2017; Groppe et al., 2011). It provides a detailed and comprehensive description of the properties and patterns of variation within the variable, allowing researchers to better understand and interpret the data. One of the main goals of univariate analysis is to identify any outliers or unusual values that may exist within the data, as these can have a significant effect on the results of subsequent analyses. By examining the distribution of the variable, researchers can identify any anomalous values that may be present. To determine whether these are legitimate data points or errors that require correction.

Before proceeding with a multivariate, it is essential to look at the distribution of values for one variable. By examining one variable at a time, I can identify patterns, trends, and distributions in the data. Univariate analysis also helps us identify outliers and missing data, which can be vital for ensuring the quality and accuracy of our analysis[7].

4.5.2 Multivariate analysis

Multivariate analysis is a statistical technique used to analyze data sets that involve multiple variables or factors. In contrast to univariate analysis, which looks at only one

[7] Univariate analysis | Practical Applications of Statistics in the Social Sciences | University of Southampton. (n.d.). https://www.southampton.ac.uk/passs/confidence_in_the_police/univariate_analysis/index.page#:~:text=Univariate%20analysis%20refers%20to%20the,analyses%20we%20should%20carry%20out.

variable at a time, multivariate analysis examines the relationships among multiple variables to identify patterns, associations, and correlations[8].

Researchers can use multivariate analysis to address a broad spectrum of research questions, ranging from exploring the relationship between multiple independent variables and a single dependent variable to examining the interactions among multiple independent variables. (Martin and Maes, 2008). It is often used in fields such as: psychology, sociology, economics, and business to study complex phenomena and make predictions based on multiple factors. There are many different types of multivariate analysis techniques, including multiple regression analysis, factor analysis, cluster analysis, and principal component analysis. These techniques use mathematical models to identify patterns in the data and to explore the relationships between different variables (Haase and Ellis, 1987; Rencher, 2007).

Multivariate analysis can be a powerful tool for uncovering insights and relationships that may not be apparent through univariate analysis. However, it is important to carefully select the appropriate technique based on the research question and the characteristics of the data set. Additionally, multivariate analysis requires careful consideration of the assumptions and limitations of the statistical models used and should be interpreted with caution to avoid overgeneralization or misinterpretation of the results.

In the univariate analysis, I will explore the hypothesis that companies that use derivatives are valued more highly by investors than those that do not. However, in order to establish a causal relationship between derivative usage and firm value, it is important to control for other variables that could also impact firm value. This means I need to conduct a multivariate analysis that considers the effects of other factors such as company size, industry, profitability, and liquidity, among others. By doing so, I can better understand the specific contribution that derivative usage makes to a firm's overall value. In essence, a multivariate analysis allows us to isolate the effect of derivative usage from other potential drivers of firm value, providing a more comprehensive and accurate picture of the relationship between these two variables.

[8] Adobe, D. (n.d.). What Is Multivariate Analysis? | Adobe Basics. https://business.adobe.com/blog/basics/multivariate-analysis#:~:text=The%20main%20advantage%20of%20multivariate,more%20likely%20to%20be%20accurate.

4.5.3 Ordinary Least Squares (OLS)

OLS, a form of regression, applies regression analysis to ascertain the impact of one or more explanatory variables on a dependent variable, such as height, weight, or age on BMI. Often this type of analysis is done to determine the relationship between two variables, predict change in the dependent variable, or predict future value. Not every form of regression is the same, e.g., there is simple regression where the effect of one independent variable on a dependent variable is tested. Such a regression formula looks like this[9]:

$$Y = \alpha + \beta X + u$$

Where α is seen as the starting point and acts as the so-called constant, should the input be 0, some lower bound remains. β is the regression coefficient, and represents the increase in Y when the independent variable increases by x. In this example, researchers use u as the error term, and often, this symbol is presented as ε or another symbol. The error term is a crucial component in a statistical model that represents the unexplained variation between the predicted values of the model and the actual observed results. It's the sum of all the random deviations that can't be accounted for by the explanatory variables in the regression equation. The regression line is used to study the relationship between a single independent variable and a single dependent variable, and the error term quantifies the amount of variability in the dependent variable that remains unexplained by the independent variable (Burton, 2021; Gürünlü Alma, 2011; Mcneish, 2014).

Multiple regression involves looking at multiple independent variables to predict Y. Such an equation looks like the follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + u$$

For this study, I employ the ordinary least squares method, a commonly used approach that calculates the best-fit line through a set of data points. This involves finding the line that minimizes the sum of squared differences between the observed values and the predicted values. I will compare the regression coefficients of different years to identify potential

[9] Ordinary Least Squares regression (OLS). (n.d.). XLSTAT, Your Data Analysis Solution. https://www.xlstat.com/en/solutions/features/ordinary-least-squares-regression-ols

differences before and after COVID-19. However, before executing a regression analysis, certain prerequisites must be met, primarily related to the data:

- The relationship between the independent and dependent variables is linear, this can be checked via scatter or partial regression plots.
- Constant variance of the error term/uncorrelated error terms implies that the variance in the error term are constant across variables, this is called homoscedastic. In addition, the correlation in the error term is allowed, this can also be checked via a scatterplot.
- The assumption of independence of the error term in OLS can be challenging to assess and is typically evaluated through theoretical reasoning. This involves examining whether the residuals of the regression model exhibit any systematic patterns or correlations that might indicate a violation of the independence assumption.
- The assumption that independent variables are not perfectly expressed as linear combinations of each other (including the constant) is a crucial one in OLS. This assumption is necessary to ensure that the regression coefficients can be estimated uniquely and without undue influence from collinearity between the independent variables (Berry, n.d.; Hayes and Cai, 2007).
- Normality of the error term, assuming that the random errors are normally distributed is important for making accurate inferences and decisions based on the regression model. If the errors do not follow a normal distribution, the estimated coefficients and standard errors may be biased or inefficient, which can lead to incorrect decisions being made[10].

4.5.4 Model construction

To test the hypotheses, I conduct an OLS regression analysis. The ensuing models examine the impact of derivative usage on firm value, considering various control variables. This model deviates from other research in the measurement of the dependent variable. While prior studies commonly used a variant of Tobin's Q, this research introduces a different approach by incorporating the P2B ratio as the dependent variable. Aside from that, the models closely resemble previous research (Ayturk et al., 2016; Clark and Mefteh, 2010). In Model 1, the

[10] Quantitative Research and Business Skills. (n.d.). https://canvas.utwente.nl/courses/10635/pages/additional-material-for-regression-analysis

dummy variable DU represents the independent variable, and in Model 2, the variable NV measures the extent of hedging:

$$\text{Model 1} = P2B_{i,t}: \alpha + \beta_1 DU_{i,t} + \beta_2 FS_{i,t} + \beta_3 ROA_{i,t} + \beta_4 LQ_{i,t} + \beta_5 GR_{i,t} + \beta_6 AGE_{i,t} + \beta_7 CD_{i,t} + \beta_8 LV_{i,t} + \beta_9 ID1\_Dummy_{i,t} + \beta_{10} ID2\_Dummy_{i,t} + \beta_{11} ID3\_Dummy_{i,t} + \beta_{12} DU*COVID + u_{i,t}$$

$$\text{Model 2} = P2B_{i,t}: \alpha + \beta_1 NV_{i,t} + \beta_2 FS_{i,t} + \beta_3 ROA_{i,t} + \beta_4 LQ_{i,t} + \beta_5 GR_{i,t} + \beta_6 AGE_{i,t} + \beta_7 CD_{i,t} + \beta_8 LV_{i,t} + \beta_9 ID1\_Dummy_{i,t} + \beta_{10} ID2\_Dummy_{i,t} + \beta_{11} ID3\_Dummy_{i,t} + \beta_{12} NV*COVID + u_{i,t}$$

As the core of this study is about comparing the different years (pre- and during COVID-19), the models remain constant for either of the hypotheses. However, for the robustness of the study, a different proxy is used for firm value.

4.5.5 Robustness test

In addition to conducting regression models to test the hypotheses, a robustness test is carried out to investigate the stability of the results. I look at alternative interpretations of the dependent variable, the proxy for firm value, as there are contradictory views stemming from the literature. For this reason, in addition to the book-to-market value, Tobin's Q is used to verify whether the result remains constant, which would align with previous research (Ayturk et al., 2016; Clark and Mefteh, 2010; Ding et al., 2022; Jin and Jorion, 2006; Nguyen and Faff, 2008). Tobin's Q is calculated as follows:

$$\text{Tobin's Q} = [(\text{Market value of equity} + \text{Preferred stocks} + \text{Total debts})/\text{Total assets}].$$

Thus, in this case, the models will have the following appearance:

$$\text{Model 3} = TOBQ_{i,t}: \alpha + \beta_1 DU_{i,t} + \beta_2 FS_{i,t} + \beta_3 ROA_{i,t} + \beta_4 LQ_{i,t} + \beta_5 GR_{i,t} + \beta_6 AGE_{i,t} + \beta_7 CD_{i,t} + \beta_8 LV_{i,t} + \beta_9 ID1\_Dummy_{i,t} + \beta_{10} ID2\_Dummy_{i,t} + \beta_{11} ID3\_Dummy_{i,t} + \beta_{12} DU*COVID + u_{i,t}$$

$$\text{Model 4} = TOBQ_{i,t}: \alpha + \beta_1 NV_{i,t} + \beta_2 FS_{i,t} + \beta_3 ROA_{i,t} + \beta_4 LQ_{i,t} + \beta_5 GR_{i,t} + \beta_6 AGE_{i,t} + \beta_7 CD_{i,t} + \beta_8 LV_{i,t} + \beta_9 ID1\_Dummy_{i,t} + \beta_{10} ID2\_Dummy_{i,t} + \beta_{11} ID3\_Dummy_{i,t} + \beta_{12} NV*COVID + u_{i,t}$$

4.5.6 Outlier elimination

In prior research, scholars commonly used winsorization as a technique for managing outliers. In our application of this method, I identified and replaced outliers beyond the 1st and 99th percentiles for both the price-to-book ratio and Tobin's Q, resulting in the replacement of six data points. Additionally, apart from the winsorization of Tobin's Q and the price-to-book ratio, I eliminated one value of ROA as it significantly deviated from the others, with a value of 2.7. The values of the other variables were more closely aligned, and thus, no further action was deemed necessary here. Applying this method would only result in an unnecessary loss of data.

5. Empirical results

In this chapter, I aim to evaluate the primary hypothesis asserting that companies employing derivatives exhibited higher firm value before the onset of COVID-19. To start our analysis, I will provide a comprehensive overview of the summary statistics for the sampled data. Afterwards, I will present the empirical results derived from multiple regression analyses, elucidating the impact of derivative usage on firm value.

5.1 Descriptive statistics

Tables 1 and 2 provide a comprehensive overview of the summary statistics for both the dependent and independent variables, along with the control variables, divided into two subgroups: non-derivative users and derivative users. Upon careful examination, no anomalies are observable in the mean, standard deviation, and median across the variables. Notably, the price-to-book ratio, serving as the dependent variable, exhibits relatively elevated values, with a mean of 3.49 for non-derivative users and 3.08 for derivative users; P2B is notably higher compared to prior research, where this figure typically hovers around 1. Nevertheless, when evaluating the robustness proxy for firm value through Tobin's Q, the mean value of 1.38 for non-derivative users and 1.33 for derivative users aligns closely with those reported in earlier research factors (Allayannis and Weston, 2001; Ayturk et al., 2016; Fauver and Naranjo, 2010).

Reviewing the independent variable, the data suggests that, on average, the sample is fairly evenly divided. Companies tend to use derivatives about as frequently as they do not, reflected by a mean of 0.45. Additionally, the variable NV demonstrates that derivatives constitute only a minor portion of the companies' overall value, as shown by the max value of only 0.06. Moreover, it appears that derivative users are often characterized by larger size, a longer track record, and are more inclined to pay dividends compared to their non-derivative user counterparts.

Table 3 presents the results of the paired sample t-test, comparing the means of the sample both before and during COVID-19. The pooled sample t-test results reveal significant differences in the variables Growth (GR) (-0.01) and Firm Size (FS) (0.08) between the studied groups, specifically during the periods before and during COVID-19. The significant differences in GR indicate different growth trajectories between entities or conditions during these different periods, with notably lower numbers before COVID-19 than for COVID-19. Meanwhile, the notable difference in firm size (FS) suggests differences in the size or scale of entities compared before and during the pandemic. For growth (GR), the mean difference is

negative, which aligns with prior research by Ishiguro (2022) and Kahle & Stulz (2013) where capital expenditure drastically fell during a crisis. However, Correa-Caro et al. (2021) showed that certain fiscal benefits or governmental stimuli can invert this relationship to a state where a crisis can have a positive impact on capital expenditure due to the governmental stimuli.

Table 1: Descriptive Statistics non-derivative users

	Construct	Observations	Mean	SD	Min	Max	Median
1	P2B	141	3.49	2.82	.52	11.44	2.45
2	NV	149	.0	.0	.0	.04	.0
3	FS	149	19.91	2.42	14.11	25.27	19.86
4	ROA	149	.01	.15	-.89	.48	.03
5	LQ	149	.39	.26	.0	1.0	.37
6	GR	149	.04	.03	.0	.04	.03
7	AGE	149	8.74	.93	6.59	10.66	8.99
8	CD	149	.52	.50	0	1	1.0
9	LV	147	.19	.16	0	.75	.15
10	TOBQ	148	1.38	.89	.27	4.1	1.09

Table 2: Descriptive Statistics derivative users

	Construct	Observations	Mean	SD	Min	Max	Median
1	P2B	114	3.08	2.58	.50	11.44	2.15
2	NV	123	.0	.0	.0	.06	.0
3	FS	123	22.47	1.84	17.76	26.81	22.37
4	ROA	122	.04	.06	-.24	.24	.04
5	LQ	123	.28	.20	.01	.95	.23
6	GR	123	.03	.03	.0	.23	.03
7	AGE	123	8.97	.91	5.89	10.67	9.16
8	CD	123	.80	.40	.0	1	1.0
9	LV	119	.27	.17	.0	.94	.25
10	TOBQ	123	1.33	.82	.27	4.1	1.15

Table 3: Comparison pre-COVID-19 and during COVID-19

Variables	Observations	Mean(PC)	Mean(C)	Median(PC)	Median(C)	M diff	t-value	df	sig
P2B	266	3.41	3.09	2.44	2.36	-.31	1.81	122	.07
DU	272	.47	.43	.00	.00	-.04	1.39	135	.16
NV	272	.00	.00	.00	.00	.00	-.58	135	.55
FS	272	20.97	21.15	21.17	21.29	.08	-6,52	135	<.001
ROA	272	.02	.04	.03	.05	.02	-1.01	135	.31
LIQ	272	.33	.34	.27	.28	.01	-.55	135	.57
GR	266	.04	.03	.0	.02	-.01	4.13	131	<.001
AGE	272	8.80	8.89	9.01	9.07	.08	-1.64	135	.10
CD	272	.62	.63	1.0	1.0	.01	-1.46	135	.14
LV	266	.22	.23	.19	.22	.08	-.60	131	.54
TOBQ	271	1.33	1.37	1.15	1.08	.04	-.54	134	.58

Note: DF= Degrees of freedom; Sig= Significance level; M Diff= Mean difference between groups; SE Diff= Standard error of group differences; CI 95%= 95% Confidence interval of group differences; PC=Pre-COVID; C=COVID.

5.1.1 Normality test

To assess the normality of our sample, I have used both the Kolmogorov-Smirnov and Shapiro-Wilk tests on the residuals. As presented in Table 3, the results indicate that, with the exception of one variable, all variables exhibit significance in both the Kolmogorov-Smirnov and Shapiro-Wilk tests, with a p-value < 0.001. This implies that the distribution of these variables is not normal. Notably, the variable FS presents a discrepancy in results between the two tests. To be more precise, FS has a p-value of 0.2 in the Kolmogorov-Smirnov test, making it statistically insignificant. In contrast to the Shapiro-Wilk test which yields a p-value of 0.047, implying significance at the 0.05 alpha level. This contradictory outcome for FS implies a nuanced assessment of its normality.

Table 4: Normality Test

Construct	Kolmogorov-Smirnov	Shapiro-Wilk
DU	<.001	<.001
FS	.2	.047
ROA	<.001	<.001
GR	<.001	<.001
NV	<.001	<.001
AGE	<.001	<.001
LV	<.001	<.001
TOBQ	<.001	<.001
LIQ	<.001	<.001
P2B	<.001	<.001

5.1.2 Correlation Analysis

Multicollinearity can arise in multiple regression analysis when two or more independent variables in the model are highly correlated. It becomes a concern when these high correlations lead to issues with the regression coefficients. Table 3 presents the outcomes of the correlation analysis, detailing the correlation values that offer insights into the strength and direction of associations between two separate variables. As a rule of thumb, I categorize correlations below 0.35 as low, those between 0.36 and 0.67 as moderate, and those between 0.68 and 1.0 as high, with values above 0.90 considered exceptionally high (Taylor, 1990).

Analyzing Table 3 reveals the highest significant intervariable correlation, 0.685, observed between TOBQ and P2B, signifying a strong association. However, this is self-

explanatory since these two variables are used to measure the same phenomenon, i.e., firm value. Correlations of this magnitude could cause multicollinearity problems, but since they are not used in the same model, the reliability of the regression analysis will not be compromised.

With the exception highlighted earlier, by Taylor's rule of thumb (1990), no other correlations among different variables are considered "high." However, it is important to highlight the presence of statistically significant, moderate, associations within the dataset. To be more precise, there exists a significant correlation between Corporate Dividends (CD) and Firm Size (FS) with a coefficient of .386**. This correlation suggests that larger firms are more inclined to disburse dividends. Similarly, there is a significant correlation (.392**) between the Use of Derivatives (DU) and Notional Value (NV), indicating that companies utilizing derivatives tend to have a higher notional value in terms of the value of derivatives. Additionally, the correlation of .371** between Firm Size (FS) and Notional Value (NV) suggests that larger firms tend to have a higher ratio of notional value to total assets compared to smaller firms. These correlations balance the boundary between moderate and weak, suggesting that no immediate action is required to address them and mitigate potential multicollinearity issues.

To further investigate multicollinearity, I turn to Variance Inflation Factors (VIFs) for the explanatory variables. VIFs provide insights into the extent of linear relationships between a specific variable and the other independent variables. As a general guideline, VIF values exceeding 10 may raise concerns about multicollinearity (Forthofer et al., 2007; O'Brien, 2007). This statistical approach allows us to assess the degree of interdependence among our variables. Table 2 contains the VIF values, which shows that for none of the variables the VIFs exceed the threshold of 10, thus the probability of multicollinearity-induced errors is negligible, and therefore no variables were removed.

Table 5: Correlation Matrix

	LEV	TOBQ	AGE	CORP_DIV	GR	LIQ	FS	NV	P2B	ROA	DER_U
LV											
TOBQ	-.019										
AGE	.110	.081									
CD	.084	.068	.276**								
GR	.199**	-.032	.025	-.176**							
LIQ	-.071	.203**	-.217**	-.238**	-.057						
FS	.304**	-.033	.225**	.386**	-.096	-.244**					
NV	.182**	-.099	.048	.202**	-.018	-.102	.371**				
P2B	.082	685**	.076	-.030	-.039	.172**	.010	-.131*			
ROA	.032	.064	.252**	.325**	-.034	-.103	.147*	.033	.74		
DER_U	.230**	.123*	.123*	.285**	-.219**	-.219	.508	.392**	-.074	.146*	
VIF	1.175		1.235	1.393	1.120	1.132	1.549	1.094		1.206	1.324

*Note: *= p< 0.1; ** = p<0.05; *** = p<0.01; VIF = Variance Inflation Factors*

5.1.3. Heteroskedasticity test

The Breusch-Pagan test is a way to test for heteroscedasticity. It provides statistical evidence to support or reject the assumption of constant variance of residuals in a regression model. In SPSS, you can conduct the Breusch-Pagan test by squaring the residuals of the dependent variable and using them as dependent variables in a subsequent regression model. A statistically significant result in the ANOVA table implies evidence of heteroscedasticity in the original regression model. If the test indicates heteroscedasticity, it may be necessary to consider alternative modelling approaches. Upon observing Table 6, I can conclude that both p-values of the ANOVA table are higher than 0.05, implying homoskedasticity.

Table 6: Breusch-Pagan test

Variables	ANOVA p-value
P2B	.08
TOBQ	.136

5.2. OLS regression

In the context of Ordinary Least Squares (OLS) regression, I recognize the assumption of normality of errors as one of the classical assumptions. However, I acknowledge that this assumption may not be strictly met in certain cases. One key consideration is the impact of sample size on the validity of this assumption (Mether, 2003).

According to the Central Limit Theorem (CLT), as the sample size increases, the distribution of the sample mean tends to become approximately normal, regardless of the shape of the underlying population distribution. Therefore, in situations where the normality assumption of errors cannot be strictly satisfied, the pragmatic approach according to the CLT ensures that I can still utilize the potential of OLS regression. However, this requires some nuance, as there has been much debate about the sample size before this assumption can be rejected. In an abundance of caution, this study adopted a conservative approach using the upper bound of these studies, which amounts to a minimum sample size of 50 (Allende-Alonso et al., 2019; Hanna & Dempster, 2013; J Pek et al., 2017; Jolynn Pek et al., 2018). With a sample size of 68 distinct companies measured at four different time points, this study satisfies the conditions for invoking the Central Limit Theorem (CLT), allowing us to loosen the assumption of normality.

Table 7 presents the outcomes of Ordinary Least Squares (OLS) regression, examining the impact of derivative usage and notional value on firm value specifically prior and during the COVID-19 period. To assess potential variations in effects during this distinct time frame, I compare the unstandardized coefficients in Table 7.

Table 7 shows that both variables DU (-.155; $p > .05$) and NV (3.6; $p > .05$) are not statistically significant. This implies a lack of detectable effect concerning the relationship between derivative usage (DU) and notional value (NV) on firm value. Moreover, the interaction term, although not significant in both cases, show negative changes in the effect of DU*COVID (-.958; $p > .05$) and NV*COVID (-66.517; $p > .05$) on firm value during COVID-19. Liquidity, however, exhibits a significant positive impact on firm value with values (1.901; $p < .05$) in model 1 and (2.064, $p < .05$) in model 2. Additionally, the R-squared values are relatively low for both models, measuring .083 for Model 1 and .081 for Model 2.

Variables	*B(Model 1)*	*B(Model 2)*
Constant	-2.315	-2.342
	(-.988)	(-1.008)
DU*COVID	-.958*	-
	(1.932)	
NV*COVID	-	66.517
		(-1.541)
DU	-.155	-
	(.351)	
NV	-	3.600
		(.098)
FS	.145*	.140*
	(1.708)	(1.711)
ROA	1.518	1.310
	(.986)	(.851)
LQ	1.901**	2.064***
	(2.599)	(2.831)
GR	-4.155	-3.034
	(-.860)	(-.630)
AGE	.204	.191
	(1.028)	(.951)
CD	-.064	-.069
	(-.156)	(-.170)
LV	2.071*	1.988*
	(1.911)	(1.833)
R^2	.083	.081
N	246	246

5.3 Robustness test

In order to ensure the robustness and reliability of our findings, I conduct a comprehensive robustness test by employing Tobin's Q as an alternative measure for firm value. Tobin's Q, a ratio of a firm's market value to its replacement cost, offers a nuanced perspective on firm valuation. This alternative metric allows us to examine the consistency of our results, providing a more comprehensive evaluation of the impact of various factors on firm value.

Table 8 reveals the linear regression results with Tobin’s Q as proxy for firm value, table 8 shows non-significant values for DU (-.011; $p > .05$) and NV (-11.630; $p > .05$). The interaction term, although not significant, shows contradicting effects as DU*COVID (-.090; $p > .05$) and NV*COVID (.197; $p > .05$) have a both negative and positive changes in the effect on firm value during COVID-19. Moreover, similar to the first two models, liquidity continues to show a positive effect on firm value in both Model 3 with values of (.908; $p < .05$) and Model 4 (.906; $p < .05$), this time assessed using TOBQ. Furthermore, in Table 8, there are no other coefficients with significant values. The R-squared values are relatively for the robustness test, measuring .075 for Model 3 and .083 for Model 4.

Variables	*B(Model 3)*	*B(Model 4)*
Constant	.488	.465
	(.691)	(.672)
DU*COVID	-.090	-
	(-.592)	
NV*COVID	-	.197
		(.015)
DU	-.011	-
	(-.081)	
NV	-	-11.630
		(-1.032)
FS	.000*	.006
	(.016)	(.244)
ROA	.149	.153
	(.329)	(.339)
LQ	.908***	.906***
	(4.128)	(4.150)
GR	.173	.276
	(.116)	(.187)
AGE	.046	.036
	(.766)	(.584)
CD	203	.199
	(1.636)	(1.612)
LV	-.011	.020
	(-.034)	(.061)
R^2	.075	.083
N	259	259

5.4 Interpretation of the results

In this section, the results of the regression models are linked to the hypotheses, and they are subsequently either accepted or rejected as necessary.

Hypothesis 1 (H1): Companies using derivatives have higher firm value prior to COVID-19

The outcomes of the Ordinary Least Squares (OLS) regression analyses reveal a statistically non-significant negative association between firm value (P2B) and the use of derivatives (DU, NV) model 1. Model 2 showed a non-significant relationship between NV and firm value. The empirical pattern of Model 1 persists through a robustness test in which Tobin's Q replaces P2B. However, lacking statistical significance in both instances results in the rejection of H1. These findings correspond with some prior research, e.g., research from Pakistan and Greece, indicating that no significant correlation can be identified between these two variables (Bashir and Sultan, 2019; Kapitsinas, 2008). However, there is also research indicating an inverse or positive relationship, evidently, this depends on numerous factors (Allayannis and Weston, 2001; Ayturk et al., 2016; Fauver and Naranjo, 2010).

In addition, to the empirical evidence, various theoretical frameworks provide insights into the relationship between derivative usage and firm value. Contrary to the Capital Structure Irrelevance Theory, the empirical evidence suggests that, in practical scenarios, risk management endeavours have a positive influence on firm value (Alti, 2006; Ardalan, 2017; Luigi and Sorin, 2009). The Operational Risk Theory and Market Volatility Theory suggest that during periods of heightened market volatility or increased operational risk within a sector, firms reap the benefits from derivative usage due to the increased stability (Chernobai et al., n.d.; Juan De Witt, 2013; van Mieghem, 2011). Additionally, the Financial Distress Theory illustrates that derivates afford certain tax advantages, indirectly contributing to an augmented firm value (Myers, 1993, 1984, 1977). These theories cannot be confirmed or denied given the lack of statistical evidence.

Hypothesis 2 (H2): The positive effect of derivative usage on firm value prior to COVID-19 becomes stronger during COVID-19.

The results of the regression analysis indicate that the supposed strengthened positive impact of derivatives on firm value during COVID-19 is statistically insignificant. Therefore, I reject H2, and this inconsistency can be observed consistently in both the regular and

robustness tests. This contradicts the Financial Distress Theory, which asserts that during times of crisis, companies benefit from derivative usage as it mitigates the risk of bankruptcy, where costs are predominantly disproportionately distributed (Nance et al., 1993; Altman, 1984). Additionally, most empirical evidence was contradicting as it indicated that during times of crisis, the use of derivatives can have a significant positive/negative or neutral effect on firm value than before the crisis (Alam et al., 2018; Butt et al., 2022; Rokola et al., 2023).

6. Conclusion

This research study aimed to investigate the correlation between the use of derivatives and firm value during the COVID-19 pandemic. The study involved constructing a literature-based model and using a sample of 68 identical non-financial companies listed on the Dutch stock exchange between the years 2019-2022 to explore this phenomenon. Firm value was measured using both P2B and Tobin's Q, while derivative usage was measured through a dummy variable and the ratio of notional value to book value. Eight control variables were considered to account for any potential relationships.

Previous studies have yielded mixed results, indicating both positive/negative and no significant relationship between the two variables. The outcome of this research aligns with studies where no statistically significant relationship could be identified. In this context, it can be concluded that for Dutch listed companies, there was neither an advantage nor a disadvantage in the use of derivatives and its impact on firm value.

Furthermore, this study did not yield significant results for the better part of the control variables. This contradicts the majority of other studies where significant results were found. In these studies, the control variables were measured in the same way but produced different results. However, this discrepancy might be attributed to the relatively small sample size and the duration of the study. Previous research often incorporated a larger number of data points, considering not only a greater number of companies but also a longer timeframe than the four years covered in this study.

6.1 Contributions

This study contributes to existing studies on the relationship between the use of derivatives and firm value. The results indicate that, for Dutch non-financial companies, there is no statistically significant relationship in this regard. Additionally, the novel context of Dutch companies during the health crisis, COVID-19, provides new insights into whether crises may have a potential impact on this relationship.

This study also adds valuable insights by specifically examining the Dutch context during the COVID-19 crisis. While prior research has explored the general relationship between derivatives and firm value, the focus on the Dutch non-financial sector during a crisis enriches the understanding of how economic uncertainties and disruptions, may influence this dynamic. The findings suggest that the conventional knowledge regarding the relationship between derivatives and firm value might not universally apply in the context of a health crisis, emphasizing the importance of considering unique contextual factors. Moreover, this

study underlines the need for more nuanced and context-specific analyses in the study of financial derivatives and their impact on firm value. By delving into a specific crisis period and geographical context, the research contributes to the broader understanding of risk management strategies and financial decision-making during unprecedented events.

6.2 Limitations

This study has several limitations that have to be taken into consideration. First, the sample size of 68 Dutch non-financial companies over a four-year period might limit the generalizability of the findings to a broader population. The relatively short duration of the study may not capture longer-term trends or delayed effects, necessitating caution in extending conclusions beyond the observed timeframe.

The focus on the COVID-19 crisis introduces a specific economic context, potentially influencing the observed relationships in ways that may not be representative for financial or other kinds of crisis. Additionally,

Efforts were made to align variable measurements with previous studies, but subtle differences might exist, contributing to variations in results. Furthermore, the non-significant results for control variables contradict findings from other studies, highlighting a potential discrepancy that may be attributed to the study's specific context, sample size, or other unexplored factors. Additionally, the study's timeframe may not encompass all relevant market conditions, and changes in market dynamics over time could influence the observed relationships.

Lastly, the omitted variables not accounted for in the study may also influence the results, as the value of R-squared was relatively low. And while efforts were made to meet regression analysis assumptions, violations in normality may exist, affecting the accuracy of the results and warrant the need for careful interpretation of the study's robustness.

Future research should expand by including longitudinal studies with extended timelines as they are essential for long-term trends and provide a broader perspective. As well as, incorporating an industry-specific analyses which can uncover more nuanced dynamics, while exploring the impact of derivatives during various crisis periods provides insights into companies' adaptability. Furthermore, researchers should explore alternative metrics beyond simply using a dummy variable to measure derivatives. This approach falls short in distinguishing between various types of derivatives.

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Appendix

Appendix 1

Appendix 1: Tickers of sample companies

ASMI.AS
ASML.AS
AVTX.AS
BSGR.AS
BAMN.AS
BFIT.AS
BESI.AS
BRIL.AS
BRUN.AS
CMCOM.AS
KO
CORB.AS
CTAN.AS
ENVI.AS
FAGRO.AS
FFARM.AS
FUGR.AS
GLPG.AS
HEIJ.AS
HEIN.AS
HOLCO.AS
HYDRA.AS
IMCD.AS
TKWY.AS
KENDR.AS
KPN.AS
BOLS.AS
MARL.AS
NEDAP.AS
OCI.AS
ORDI.AS
PHARM.AS
PHIA.AS
PRCF.AS
PNL.AS
RAND.AS
REN.AS
RWI.AS

ROOD.AS
SGO.AS
SBMO.AS
SHELL.AS
SIFG.AS
LIGHT.AS
SLIGR.AS
TITAN.AS
TWEKA.AS
TOM2.AS
ULVR.AS
VASN.AS
VEON.AS
VVY.AS
VOPA.AS
WKL.AS