Vaasan yliopisto
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Surviving the bear attack

Did hedgers effectively hedge during the COVID-19 market crash?

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ABSTRACT:

This thesis examines the effect of hedging on firm value during the recent bear market caused by SARS-CoV-2 virus and ultimately its human and economic impact. At the beginning of 2020, the world faced a catastrophe from a disease caused by the virus, called "COVID-19". Its effects spread around the globe, causing severe disruptions to economic and financial activities, including a bear market in the first quarter of 2020. As there has been an explosive growth of COVID-19 research literature, making it the current hot topic, this thesis adds yet a new, unstudied strand to it. Also, as the effect of hedging on firm value is a relatively studied subject, there is not much research of the subject during different economic cycles and none during the most recent bear market.

The purpose of this thesis is to study the effect of hedging on firm value and provide answers regarding whether hedging has a positive effect on firm value; and more specifically, does the possible value premium increase during the bear market. As this thesis contributes to the previous literature with a new unstudied aspect, it also seeks to provide new information regarding whether firms can protect themselves against such market crashes by using derivatives for hedging purposes.

Using a sample of 1318 firm-quarter observations with a 53.2% hedging coverage ratio, this thesis examines the effect of hedging on Tobin's Q (a proxy for firm value) with two different panel data models: (1) a pooled OLS, and (2) a fixed effect model. The sample firms consist of non-financial firms listed in the S&P 500 Index during 2015-2020.

The results show that hedging has a statistically significant positive effect on firm value measured with all the models during the whole sample period. The hedging premium found with the main model suggests that hedging increases firm value by 3.4%. During the bear market, the hedging premium found is even greater. The value-enhancing effect of hedging is found to be 19.6%, suggesting that hedging is more beneficial in terms of firm value during a sharp market decline and that hedging firms succeeded better compared to non-hedgers during that sudden bear market.

KEYWORDS: hedging, derivatives, firm value, COVID-19, bear market

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TIIVISTELMÄ:

Tämä Pro Gradu -tutkielma tarkastelee johdannaisilla suojautumisen vaikutusta yrityksen arvoon koronaviruksen aiheuttaman karhumarkkinan aikana. Vuoden 2020 alku oli poikkeuksellinen, kun maailmaa kohtasi koronaviruksen aiheuttama ennennäkemättömän globaali katastrofi. Nopeasti ympäri maailmaa levinneellä pandemialla oli tuhoisia taloudellisia seurauksia, kuten esimerkiksi sen aiheuttama karhumarkkina vuoden 2020 ensimmäisellä kvartaalilla. Tieteellinen kirjallisuus koronaviruksesta on kasvanut valtavasti viimeisen vuoden aikana, ja tämä tutkielma tuo aiheeseen uuden näkökulman, jota ei ole vielä tutkittu entuudestaan. Kirjallisuudesta löytyy lisäksi paljon tutkimuksia johdannaisilla suojautumisen vaikutuksista yrityksen arvoon, mutta mikään näistä tutkimuksista ei ole tutkinut aihetta tästä näkökulmasta.

Tämän tutkielman tarkoitus on tutkia johdannaisilla suojautumisen vaikutusta yrityksen arvoon ja tarjota vastauksia kysymykseen, onko tällä suojautumisella positiivinen ja arvoa nostava vaikutus yrityksen arvoon, sekä tarkemmin, korostuuko tämä mahdollinen arvonluonti laskumarkkinoiden aikana. Sen lisäksi, että tämä tutkielma tuo aikaisempaan kirjallisuuteen uuden näkökulman, se pyrkii myös tuottamaan uutta informaatiota liittyen siihen, pystyvätkö yritykset suojautumaan yllättäviä markkinaromahduksia vastaan käyttämällä johdannaisia suojautumistarkoituksessa.

Tässä tutkielmassa käytetään otosta, jossa on yhteensä 1318 yritys-kvartaali havaintoa. Otoksen yrityksistä 53.2 % käyttää johdannaisia suojautumistarkoituksessa, ja tämä tutkielma tutkiikin johdannaisilla suojautumisen vaikutusta yrityksen arvoon, mitä mittaamaan käytetään Tobin's Q -suhdelukua. Vaikutusta tutkitaan käyttäen kahta eri paneelidatamallia: pooled OLS ja fixed effect -mallit. Tutkielmassa käytettävät yritykset ovat muita kuin finanssimaailmassa toimivia yrityksiä ja ne kuuluvat osaksi USA:n S&P 500-indeksiä vuosien 2015 ja 2020 välillä.

Tutkimuksen tulokset kertovat, että johdannaisilla suojautumisella on positiivinen vaikutus yrityksen arvoon vuosien 2015 ja 2020 välillä kaikilla tavoilla mitattuna, ja tulokset ovat tilastollisesti merkittäviä. Löydetty vaikutus nostaa yrityksen arvoa 3.4 %. Koronaviruksen aiheuttaman karhumarkkinan aikana löydetty arvonnousuvaikutus on entistä suurempi, 19.6 %, mikä viittaa siihen, että johdannaisilla suojautuminen on hyödyllisempää markkinalaskun aikana ja että yritykset, jotka käyttivät johdannaisia suojautumistarkoituksessa koronaviruksen aiheuttaman karhumarkkinan aikana, pärjäsivät paremmin verrattuna yrityksiin, jotka eivät näitä käyttäneet.

AVAINSANAT: suojautuminen, johdannaiset, yrityksen arvo, koronavirus, karhumarkkinat

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Abbreviations

ATM	At-the-money
CDO	Collateralized debt obligation
CDS	Credit default swap
ITM	In-the-money
MBS	Mortgage-backage security
OTC	Over-the-counter
OTM	Out-of-the-money
P/B	Price-to-book
Q	Tobin’s Q
ROA	Return on assets
VIF	Variance Inflation Factor
VIX	Volatility index
WHO	World Health Organization

1 Introduction

Since the opening of the first derivatives exchange in Chicago in 1848 for farmers to trade grain with merchants, the derivatives market has increased enormously. Today, the total size of notional amounts outstanding for over-the-counter (OTC) derivatives is over $640 trillion (BIS, 2019). A derivative can be defined as a financial security whose value derives from the value of an underlying asset, and the underlying asset can be almost anything today, from stocks and commodities to foreign currencies and weather conditions. Although new types of derivatives enter into the market all the time, the main types of derivatives include forwards, futures, options, and swaps (Hull, 2018, p.1).

Derivatives' role as a risk management tool has become more common in firms over the past few decades. They are widely used by firms for hedging purposes. In other words, they are used to reduce different risks. These risks may include, for example, interest rate risk, foreign currency risk, and commodity price risk. The turbulence in the financial markets over the last years has dramatically highlighted the significance of good firm risk management activities. In order not to be prone to large price volatilities and fluctuation in firm market value, hedging with derivatives has almost become a necessity. In their survey of firms' risk management goals, Bodnar et al. (2011) find that 50% of firms use hedging to avoid large losses from unexpected price movements. 41% of the firms replied that with hedging they wish to increase their firm value.

The firms' hedging behavior and the conditions under which hedging enhances firm value have been widely examined by academics in recent decades. Following Allayannis and Weston's (2001) pioneer study, various research has emerged focusing on different aspects of hedging. While some of the studies examine the value effect in different industries (see e.g., Carter et al., 2006; Gleason et al., 2005) or countries (see e.g., Clark and Judge, 2009; Khediri and Folus, 2009), the others concentrate on value creation by using different derivatives (see e.g., Allayannis et al., 2012; Lookman, 2004). The results, however, remain mixed, with some of the studies finding a positive relationship between hedging activities and firm value (see e.g., Allayannis and Weston, 2001; Carter et al., 2006), while other studies find a negative relationship (see e.g., Lookman, 2004; Naito and Laux, 2011), and some do not find any effect (see e.g., Jin and Jorion, 2006; Khediri and Folus, 2009).

As the effect of hedging on firm value has been widely examined in the literature, one aspect remains relatively unstudied; do economic cycles impact the effect that hedging has on firm value. Therefore, the motivation of this thesis is to investigate whether the effect of hedging on firm value varies during different economic cycles, especially during a bear market. Additionally, the purpose is to examine whether the firms that are engaging in hedging activities succeeded to maintain or increase their value during the market crash compared to non-hedgers. To study this, a recent bear market condition that occurred in the first quarter of 2020 is investigated more deeply.

At the beginning of 2020, the world faced an unforeseen global catastrophe from a disease called COVID-19 caused by a coronavirus. The virus that may have originated in Wuhan, China in December 2019 quickly spread around the world and was declared as a global pandemic on March 11, 2020 by the World Health Organization (WHO). Figure 1 demonstrates the spread of the virus around the world. It reveals how quickly the virus first spread to Europe and later to the Americas. In April, just four months into the outbreak, the global confirmed cases reached 1 million. Just one month later, 5 million cases were confirmed. In October 2020, WHO estimated that COVID-19 had infected 10% of the world’s population (WHO, 2020).

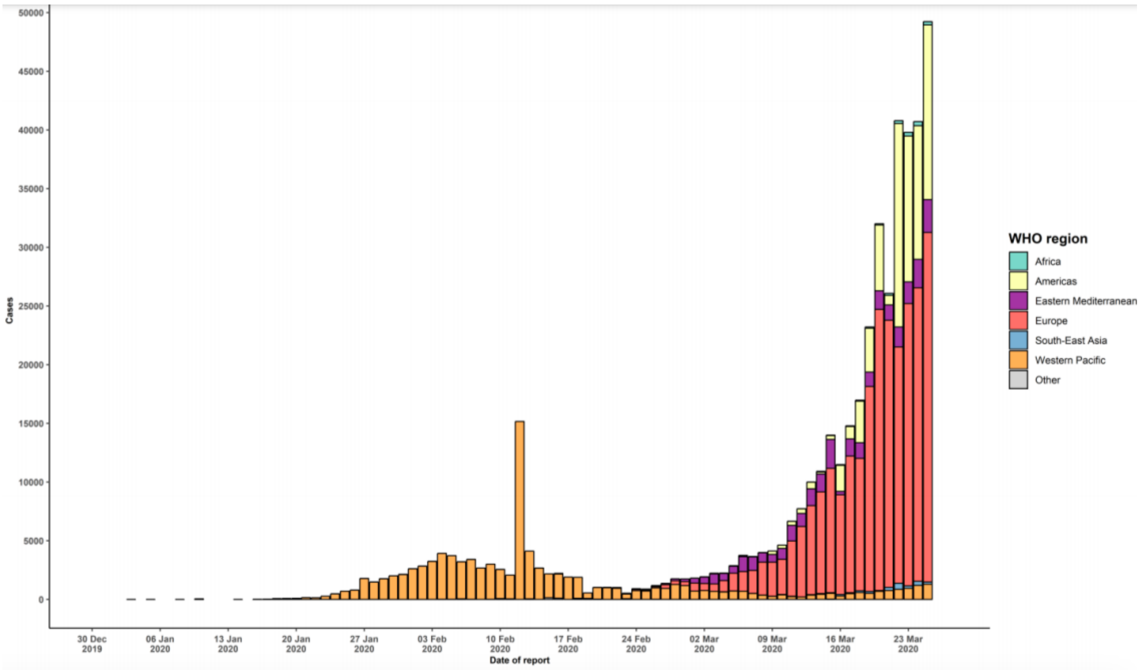

Figure 1. Epidemic curve of confirmed COVID-19 cases by different regions at the beginning of 2020 (WHO, 2020).

The outbreak has already shown massive impacts from short-term effects (such as limited economic activities caused by quarantines and travel restrictions) to long-term effects (such as mass unemployment and business failures). According to the US Bureau of Labor Statistics (2020), the U.S. the unemployment rate increased from 3.5% to 14.7% in just two months, which recorded the highest rate in over 80 years. Altig et al. (2020) add that from the last quarter of 2019, the U.S. GDP fell 11.2% compared to the second quarter of 2020, making it the greatest decline since the Great Depression. To respond to these impacts, the Federal Reserve cut rates to zero and launched a “Quantitative Easing” program to encourage lending and increase the money supply (Federal Reserve, 2020).

The COVID-19 crisis has not only caused enormous economic impacts, but the quick spread of the pandemic has also shaken the global financial markets. Ashraf (2020), when using data covering the first four months of 2020, for example, finds that the more the new confirmed COVID-19 cases increase, the more the stock market declines. Akhtaruzzaman et al. (2020) on the other hand, find that the correlation between U.S.

stock returns increase during the COVID-19 crisis compared to the pre-crisis period, suggesting a reason for the magnitude of the decline. In March 2020, the S&P 500 fell by 35% from its record high, causing a bear market. This drop can clearly be seen from the S&P 500 Index presented in Figure 2.

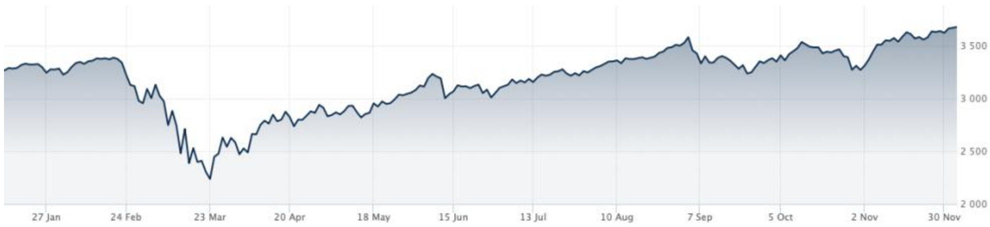

Figure 2. S&P 500 Index in 2020 (WSJ, 2020).

As the figure above shows, the market has seen a V-shaped recovery as the S&P 500 has rebounded from the March crash. However, since most industries still have not achieved the level of market capitalization they had before COVID-19, Mazur et al. (2020) remind us that the recovery is mainly due to the success of technology stocks, and therefore should not be confused with the whole market performing well.

Baker et al. (2020) note that one of the biggest reasons for the sudden market crash was that we live in a service-oriented world in which social distancing and government restrictions have massive negative effects. Therefore, the stock market reacted more powerfully to this pandemic than the previous ones including the Spanish Flu in 1918-1919, the Asian Flu influenza pandemic in 1957-1958, and the Swine Flu in 2009-2010. Figure 3 presents the impact of those pandemics on the S&P 500 Index.

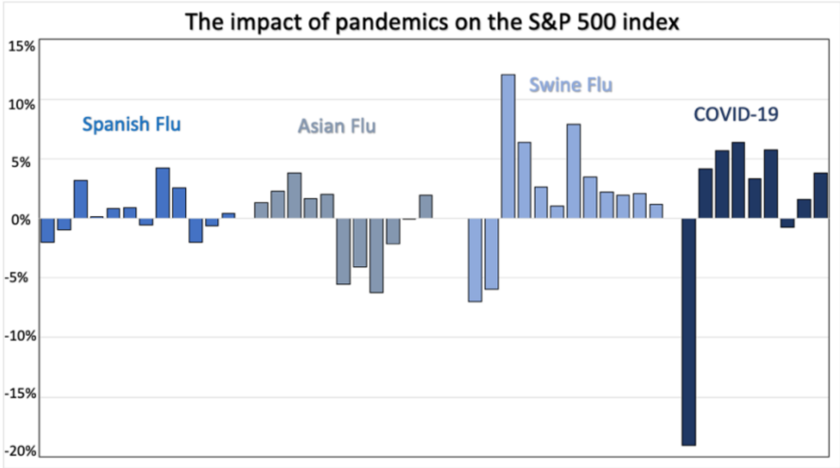

Figure 3. The impact of different pandemics on the S&P 500 Index measured from the starting month of the pandemic until one year forward.

1.1 Purpose, hypotheses and motivation

This thesis focuses on studying the effect of hedging on firm value during the bear market caused by the COVID-19 crisis. The study focuses on non-financial firms in the S&P 500 Index between 2015 and 2020. The index is chosen since it represents a reasonably accurate spread of U.S. firms in different industries. The purpose of this thesis, more specifically, is to examine whether hedging has a positive effect on firm value and whether the firms that used hedging during the market crash succeeded better compared to firms that did not.

According to Modigliani and Miller (1958), in the perfect market a company's value is independent from its capital structure and financing decisions made. Therefore, as hedging has elements of financing decision, normative finance theory suggests that firms do not have any incentive to hedge as it has no effect on firm value. However, different risk management theories suggest that as capital markets are imperfect, the usage of derivatives as a hedging purpose may affect firm value, for example, by reducing taxes (Smith & Stulz, 1985), financial distress and agency costs (Fok et al., 1997), more costly external capital (Froot et al., 1993), and bankruptcy risk and underinvestment problems (Gilje and Taillard, 2017).

Allayannis and Weston (2001) were the first academics to investigate the relationship between hedging and firm value. In their groundbreaking study, they examine a sample of 720 large U.S. non-financial companies that use foreign currency derivatives and find that their usage increases firm value by about 5%. Many other studies have emerged afterward. However, the evidence remains mixed. Similar to the pioneer study, Carter et al. (2006) find a positive value effect while investigating 28 firms operating in the U.S. airline industry. They suggest the value effect to be 10% for hedging firms. Fauver and Naranjo (2010) and Nguyen and Faff (2007), however, find controversial results while examining 1746 firms headquartered in the U.S. and 428 Australian firms, respectively. Fauver and Naranjo find that hedging decreases firm value by 8.4%, while Nguyen and Faff find a hedging discount of 18%. Moreover, Jin and Jorion (2006), with their sample of 119 gas and oil producers operating in the U.S., and Khediri and Folus (2009) with a sample of 320 French non-financial firms, find no effect between firm value and the use of derivatives for hedging purposes. Following the previous literature, I formulate my first hypotheses as follows:

$H^1$0: Hedging has no effect on firm value.
H^1A: Hedging has a positive effect on firm value.

As the sample period of this thesis consists the time period of the bear market caused by COVID-19, the effect of hedging on firm value during that bear market is also examined. There have already been a few studies examining the effect during a bear market but not one yet has investigated during the 2020 bear market caused by COVID-19.

Bartram et al. (2011) study the effect of hedging on firm value during the dot-com bubble at the beginning of the 21st century. With their international sample of 6888 firms, they find that firms that hedged during the bear market had a significant value premium compared to the firms that did not hedge. Ahmed et al. (2020) use a sample of 378 firms to study the effect during the financial crisis and find that firms that hedge foreign currency risk have higher firm value compared to non-hedgers during the crisis. Luo and Wang (2018) also investigate the effect during the financial crisis and find similar results. Following these studies, I formulate the following hypotheses:

$H^2 0$: During the bear market caused by COVID-19 hedging has no effect on firm value.
$H^2 A$: During the bear market caused by COVID-19 hedging has a positive effect on firm value.

From the beginning, the literature has been mixed regarding this subject, and the results vary within industries, countries, risk types hedged, and derivatives used. As the results remain unclear, my motivation for this thesis is to take a new aspect in the field and study the effect of hedging on firm value during the economywide negative shock caused by COVID-19 and see how the change in macroeconomic conditions affects the hedging effect. Also, my motivation is to examine whether hedging has provided shelter against the overall drop in firm value. This aspect is an important addition to previous literature; and this thesis seeks to offer answers regarding the protection against similar, sudden market crashes in the future.

Numerous studies have emerged examining the pandemic from different viewpoints that attempt to explain the unprecedented phenomenon and examine the related impacts. However, none of them has studied the pandemic from the viewpoint offered by this thesis. Therefore, the contribution of this thesis to the previous literature is that it examines the recent bear market from a hedging viewpoint and its impact on firm value. This thesis provides new information regarding whether firms can protect themselves against surprising market crashes by using derivatives for hedging purposes. It also contributes to the previous literature by investigating whether firm value responds to hedging during different macroeconomic conditions. This thesis does not only contribute to the previous literature with the new research aspect but also with this current and trending topic.

1.2 Structure of the thesis

The structure of the thesis is the following: (1) the next three chapters are presented as background, and (2) the last two chapters primarily focus on the empirical analysis and summarization of the results. More specifically, Chapter 2 introduces the derivatives market and the main types of derivatives. Chapter 3 begins by presenting how derivatives can be used as a risk management tool, followed by presenting different incentives to hedge, and ends with presenting financial risk exposures derivatives can be used for. Chapter 4 shows the channels through which hedging activities affect company value. The end of that chapter is the literature review where previous studies, which examine non-financial firms in different markets, are presented.

The empirical part of the thesis is presented in chapter 5. The chapter starts by introducing the data sample used in this thesis. Second, the dependent variable and independent variables are introduced, as well as the summary statistics of the thesis. Third, the methodology used is explained; and finally, the chapter ends with the results from the univariate and multivariate regressions, as well as the results from hedging during the crisis. The final chapter of the thesis, chapter 6, summarizes and concludes the thesis. In that chapter, the main findings are presented as well as the limitations of this thesis. Also, further research ideas are suggested.

2 Derivatives theory

This chapter presents derivatives, their market, and different types of derivatives in more detail. They are presented as it is essential to understand the fundamentals of derivatives and how they can be used for hedging, and ultimately how hedging can affect firm value.

According to Hull (2018, p.1), a derivative is a financial security whose value derives from the value of an underlying asset. In most cases, it is a contract between two or more parties to exchange an asset at a predetermined price on a specified date in the future. The most common underlying assets include securities, currencies, commodities, and interest rates. However, the variable the derivative depends on can be almost anything, for example from orange juice to hurricanes.

Hull (2018, pp. 11-16) notes that derivatives can be used for different purposes. Generally, three different user groups are identified: (1) hedgers, (2) speculators, and (3) arbitrageurs. Hedgers use derivatives for risk reduction. They use them to avoid unfavorable movements in the price of an asset. Speculators use derivatives to bet on or against market movements and profit from that. They can try to get additional leverage from predicting the movements in the price of an asset. They either bet that the price of the asset will increase or decrease in the future and take their position according to that. The third group, arbitrageurs, uses derivatives to earn a riskless profit. They try to utilize the price differences of an asset in different markets by simultaneously entering into both markets and gain from that, for example. Although theory states that hedgers and speculators use derivatives for different purposes, Kuserk (2009, p.54) reminds that reality might be different, as often there is an overlap in the usage between the two groups.

Derivatives are traded in both exchanges and over-the-counter (OTC) markets. Chance and Brooks (2009, pp. 255-261) argue that in the derivative exchange, the contracts are standardized, and they have specific conditions. The exchanges handle everything and also carry the counterparty's credit risk. The first derivatives exchange, The Chicago Board of Trade, was founded in 1848 for farmers to trade grain with merchants. Slightly over a decade later, the first futures were created for speculators to trade grain contracts instead of the underlying asset itself.

Chance and Brooks (2009, pp. 255-261) continue that the other place to trade derivatives, the OTC market, is a market where private contracts are made between two parties directly without involving a clearinghouse. Usually, the parties involved are a company and a financial institution. Unlike in the exchanges, the contracts are not standardized, but the conditions are negotiated between the counterparties themselves. The benefit of these types of arrangements is that they are more flexible, spare money, and allow new types of contracts to be developed rapidly in response to market changes. The drawback, however, is that the credit risk of the other party is higher in these types of trades.

Generally, futures are traded in the exchanges and forwards and swaps in the OTC market. Options, on the other hand, can be traded in both types of markets. The number of trades made in the exchange market per year is bigger than in the OTC market, but yet the average size of transactions is larger in the latter. According to the Bank of International Settlements (BIS, 2020), the total notional amount of OTC derivatives outstanding in 2019 was $640 trillion, whereas the total notional amount of exchange-traded derivatives was $35 trillion. These and the amounts from the previous years are demonstrated in Figure 4.

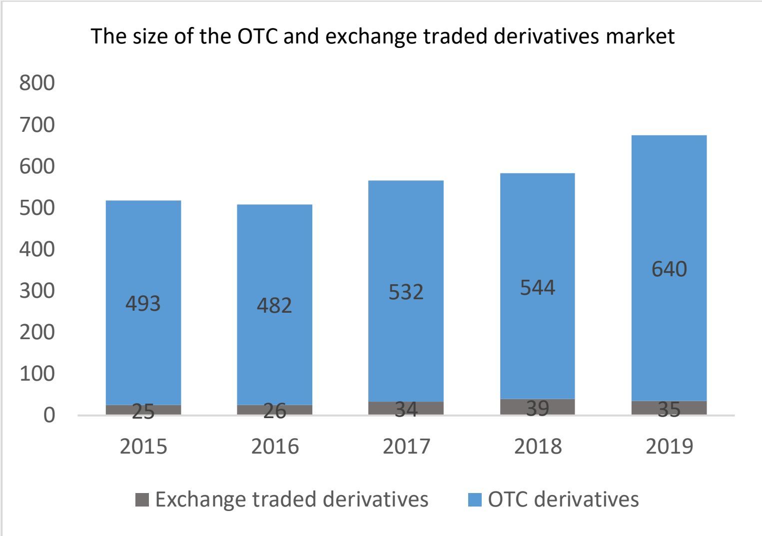

Figure 4. The size of the OTC and exchange-traded derivatives market in 2015-2019 (BIS, 2020).

Due to their involvement in the financial crisis that started in 2007, derivatives have received notable publicity. Bodie et al. (2017, pp. 14-22) and Grosse (2017) note that the effort of encouraging people to buy their own houses in the U.S. and granting mortgages to subprime borrowers led to the development of a housing bubble. Lending banks started to pack those subprime mortgages into derivative instruments and market them as low-risk mortgage-backed securities (MBSs) and collateralized debt obligations (CDOs) to reduce their exposure to risky loans and increase their liquidity. Those securities were then sold forward to investors and other banks. However, when the housing bubble burst, the values of the MBSs and CDOs collapsed resulting in severe losses to many banks. MBSs and CDOs became risky assets. Gradually, due to mistrust, banks started to doubt each other's solvency and stopped lending to each other. This led to the bankruptcy of many major banks and investment banks. Due to the stopping of interbank lending, the crisis that started in the U.S. quickly spread across the world and became global. By 2009 the crisis started to subside, but the consequences, such as the economic downturn and market slowdown, continued for a long time. As a result of the crisis, a number of new, stricter laws and regulations have been developed to control the derivatives market and avoid this from happening again.

2.1 The main types of derivatives

The main types of derivatives are forwards, futures, options, and swaps. The next section gives a brief introduction of these different types of derivatives and presents their similarities and differences.

2.1.1 Forwards

Gottesman (2016, pp. 2-21) states that a *forward contract* is an agreement between a buyer and seller to trade an asset at a predetermined price at a predetermined time in the future. Forwards are traded in the OTC market, and they are private agreements between two parties who themselves negotiate the terms of the contract. The parties are usually either two financial institutions or a financial institution and one of its clients. Due to the contracts' nature, the terms and conditions are not very rigid.

Hull (2018, p.7) states that in the agreement, the party buying the forward contract is entering into a long position and the party selling the forward enters into a short position. The payoff for a long position can be estimated as:

$$S_T - K, \tag{1}$$

where S_T is the spot price of the underlying asset at the time of maturity and K is the delivery price. The value of a forward position is the difference between S_T and K and therefore, the long position benefits from an increase in the price of the underlying asset. Correspondingly, the payoff for a short position can be estimated as:

$$K - S_T, \tag{2}$$

where the short position benefits from a decrease in the price of the underlying asset. Figure 5 demonstrates the payoffs from both positions. Assuming buying or selling a forward contract is costless, the payoff received is directly the gain or loss from the contract.

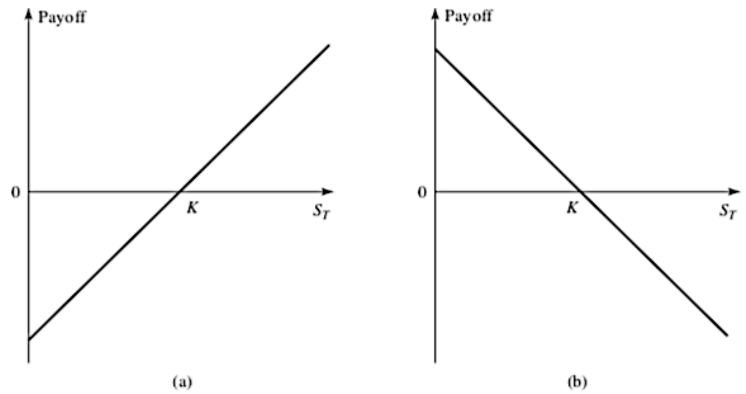

Figure 5. Payoffs from forward contracts: (a) long position, (b) short position. Delivery price = K; price of the asset at contract maturity = S_T (Hull, 2018).

Hull (2018, pp. 110-111) suggests that the price of a forward is the agreed delivery price of the underlying asset by the buyer and seller. For a forward contract in which the underlying asset is tradeable, the price can be derived from the spot price. The pricing formula for a simple forward F_0, assuming it does not pay dividends, can be estimated as follows:

$$F_0 = S_0 e^{rT}, \tag{3}$$

where S_0 is the price of the underlying asset, r is the risk-free rate, and T is the time to maturity.

2.1.2 Futures

According to Chance and Brooks (2009, p.254), a *futures contract* is an agreement similar to a forward contract. It is also an agreement between a buyer and seller to trade an asset at a price agreed upon today for a date in the future. The futures contract has standardized terms and is settled daily.

Despite the similarities between futures and forward contracts, a few things differentiate the two. First, Bodie et al. (2017, p. 756) note that unlike forwards, futures are traded on an exchange. Therefore, the agreements are standardized, and the counterparty risk is carried by the exchange. Second, the timing of the cash flows is different. A forward contract holder receives (pays) the profit (loss) in one large amount at the maturity, whereas a futures contract holder receives (pays/settles) it daily.

Hull (2018, pp. 117-118) notes that in theory, the pricing of futures is usually assumed to be the same as the pricing of forwards demonstrated in the previous chapter. The price of a futures contract is also derived from the spot price of the underlying asset. However, in practice, numerous factors can cause a difference in the pricing of the two, such as taxes, transaction costs, and varying interest rates.

2.1.3 Options

According to Bodie et al. (2017, p. 668), an *option* is a contract between a buyer and seller that gives the buyer the right to purchase the underlying asset at a predetermined price at a predetermined time in the future. Unlike forward and futures contracts, the holder of an option has a right to purchase or sell but they are not obligated to do so. The contract price is referred to as the strike or exercise price, and the date is referred to as the maturity or expiration date. Options are traded on both exchanges and OTC markets.

Brealey et al. (2018, pp. 503-505) note that there are different types of options available in the market. A *call option* gives the holder the right to purchase, and a *put option* the right to sell the underlying asset at a predetermined price at a predetermined date. As with other types of derivatives, the buyers of an option are entering into a long position and sellers into a short position. The options can also be classified by the nature of the contracts. *American options* are options that can be exercised at any time prior to, and including, their maturity date, whereas *European options* can only be exercised on their maturity. Since American options can be exercised at any point during the life of the contract, they are more valuable than European options. An example of an option with unusual exercise dates is called a *Bermudan option*, and it can only be exercised on predetermined dates during its life.

Bodie et al. (2017, p. 669) suggest that options can be in-the-money (ITM), at-the-money (ATM), or out-of-the-money (OTM). These are called the "moneyness of option". A call option is ITM when the stock price S is higher than the strike price K, $S>K$, and OTM when the stock price is lower than the strike price, $S<K$. The option is ATM when the stock price equals the strike price, $S=K$. On the contrary, a put option is ITM when $S<K$, ATM when $S=K$, and OTM when $S>K$. Table 1 demonstrates these conditions. An option should only be exercised when it is ITM since then a call option holder can buy the security at a lower price than it currently sells in the market, and a put option holder can sell it above its current price in the market. However, this position does not always make a profit due to expenses and commission fees.

Table 1. Moneyness of options (Hull, 2018, p. 216).

	In-the-money	**At-the-money**	**Out-of-the-money**
Call option	$S > K$	$S = K$	$S < K$
Put option	$S < K$	$S = K$	$S > K$

Hull (2018, pp. 212-213) states that a European option is usually used to characterize the payoff of an option due to its simplicity. The payoff from a European call option from a long position is:

$$\max\,(S_T - K, 0), \tag{4}$$

where S_T is the final price of the underlying asset and K is the strike price. If $S_T > K$, the option expires ITM and the option will be exercised. The payout for the holder is $S_T - K$. If $S_T < K$, the option is OTM and will not be exercised. Accordingly, the payoff from a European call option from a short position is:

$$\min\,(K - S_T, 0), \tag{5}$$

the payoff from a European put option from a long position:

$$\max\,(K - S_T, 0), \tag{6}$$

and the payoff from a European put option from a short position:

$$\min\,(S_T - K, 0). \tag{7}$$

The payoffs are visualized in Figure 6.

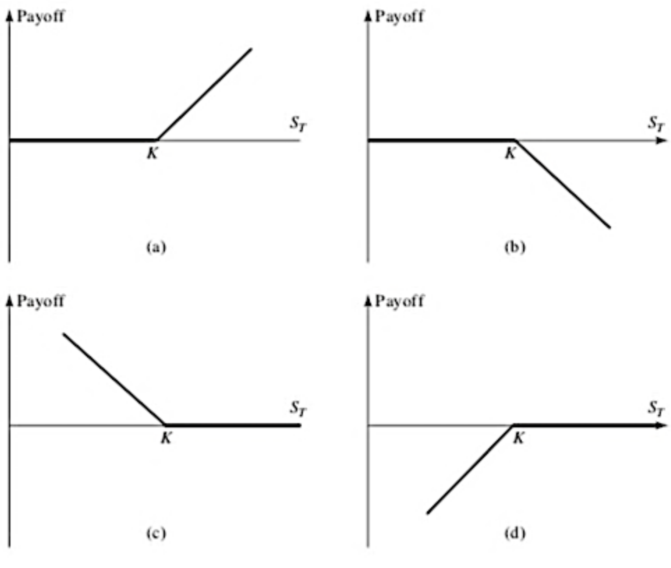

Figure 6. Payoffs from positions in European options: (a) long call; (b) short call; (c) long put; (d) short put. Strike price = K; price of the asset at maturity = S_T (Hull, 2018, p.213).

The first formal model for option pricing was created in 1973, and it is commonly called the Black-Scholes-Merton (BSM) model. The BSM model calculates the theoretical value of European options by using five different indicators: (1) current stock price, (2) strike price, (3) time to expiration, (4) expected interest rate, and (5) expected volatility of the stock price. Obviously, an extension to the original BSM model is to include a sixth input: expected dividends to be paid. According to the BSM model, the formulas to price European call options (c) and put options (p) can be estimated as follows:

$$c = S_0 N(d_1) - Ke^{-rT} N(d_2), \tag{8}$$

$$p = Ke^{-rT} N(-d_2) - S_0 N(-d_1), \tag{9}$$

where

$$d_1 = \frac{ln\frac{S_0}{K} + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{T} \ ,$$

where S_0 is the stock price at time zero, K is the strike price, r is the risk-free interest rate, T is the time to expiration, σ is the stock price volatility, and N is the normal distribution function.

2.1.4 Swaps

According to Hull (2018, pp. 155-156), albeit the forwards, futures, and options constitute the basic set of derivatives instruments, there are multiple variations and combinations in the market. One of the most used of those is an agreement called a *swap*. A swap is a contract between two parties to periodically exchange cash-flows or liabilities of two different financial instruments in the future. The contract specifies certain dates when cash-flows will be paid and the amount that will be swapped. The instruments exchanged can be almost anything, but usually they contain cash-flows based on a notional principal amount. Swaps are traded in the OTC market.

Flavell (2010) notes that the first swap was created in 1981 between IBM and the World Bank. The World Bank was in a position where it needed to borrow German deutsche marks and Swiss francs, but those countries' governments would not support the issuance of the loans. At the time, IBM was in a position where it had those currencies but needed U.S. dollars (of which U.S. interest rates were high). Since they both had what the other party needed, in order to overcome their problems, the two parties decided to "swap" their debts. In this way, IBM got its U.S. dollars and the World Bank received German marks and Swiss francs. Since the creation of the first swap, the swaps market has grown enormously, and new types of swaps have been created.

Bodie et al. (2017, pp. 800-806) suggest that an *interest rate swap* is the most common OTC derivative. Often in an interest rate swap, the two parties agree to exchange cash-flows based on a predetermined fixed interest rate and a floating rate, usually LIBOR, over a predefined period of time. The cash flows are equal to interest calculated from a notional principal amount. Another type of swap, a *currency swap*, is an agreement where two parties exchange both principal payments and interest on debt denominated in different currencies. A third example of swap is a *credit default swap* (CDS). A CDS is a swap that provides a possibility to hedge credit risk. In the agreement, in a case where a borrower of the risky loan defaults, the seller of the CDS pays the lost principal and interest on a loan to the CDS buyer. In addition, it is commonly believed that CDSs were a major cause of the 2008 financial crisis.

3 Hedging with derivatives

This chapter introduces how derivatives can be used for hedging. It is important to present firms' motives to hedge and what kind of risks can be hedged to later understand the effect hedging can have on firm value. The chapter starts by introducing risk management and how derivatives are used as a tool for that. As this thesis focuses on hedging with derivatives, different incentives for using them are then explained. Finally, this chapter ends with an introduction on how different risk exposures can be hedged.

3.1 Risk Management through derivatives

Companies face different risks every day. Hillier et al. (2011 p.757) note that several companies have established risk management departments in their organizations to control those risks. Risk management is a process of identifying, assessing, and controlling different risks to which the company is exposed. Rather than eliminating the risk, the purpose is to effectively manage it. The different risks are managed by the use of financial derivatives, insurance, and other activities. This thesis focuses on the derivatives aspect, with a focus on the value creation hypothesis.

Bodnar et al. (2011) conducted a survey examining the reasons behind firms' risk management activities. 81% of the responders answered that the recent financial crisis made them put more focus on risk management issues. When asking about the goals of their risk management activities, most answers (50%) were "to avoid large losses from unexpected price movements", "to increase firm value" (41%), "to increase expected future cash flows" (39%), and "shareholders expect us to manage risk" (39%).

Hillier et al. (2011, p.758) state that during the past few decades, the use of derivatives as a risk management tool has increased enormously in companies. As of today, most of the largest non-financial companies use derivatives, and it has become a standard part of firms' risk management operations. There are many reasons for the increase in popularity of derivatives use in risk management, such as the increased volatility of interest and exchange rates as well as the growing importance of international companies. It is also possible that simply growing knowledge of derivatives has added to the popularity of their use in risk management.

There are some geographical differences between the use of derivatives as a risk management tool. In their survey, Bodnar et al. (2011) report that 68% of foreign companies use derivatives compared to 56% of companies in North America. Especially in Europe, the use of derivatives is most popular. Brunzell et al. (2011) add that derivatives are more actively used by international firms who have foreign currency exposure. Bartram et al. (2009) find that derivative users, hedgers more precisely, are located in countries with higher GDP per capita, larger markets for derivatives, and belong to OECD countries.

Derivatives usage also differs among sectors. Bodnar et al. (2011) find in their survey that companies operating in the primary products sector such as basic materials, utilities, and transport use derivatives the most (71%), followed by the manufacturing sector (67%). Only 46% of companies operating in the service sector report using derivatives. Brunzell et al. (2011) conclude their study with similar findings.

Several studies have found specific characteristics for companies that use derivatives. For example, Guay and Kothari (2003) find that larger companies are more likely to use derivatives than smaller companies. El-Masry (2006) finds that public firms are more likely to use derivatives than private firms and that the derivatives are used mostly by international firms. Bodnar et al. (2011) find that firms with credit ratings of BB or BBB are more likely to use derivatives than companies in other credit rating classes. Nance et al. (1993) find firms with more growth opportunities to be more likely to use derivatives. Also, a higher market-to-book ratio and higher R&D expenditure seem to lead to a greater usage of derivatives. Similarly, Allayannis and Mozumdar (2000) report companies with high R&D to be more likely to use derivatives. They also add that companies that have sustainable projects are more likely to use them. Lau (2016) find that companies with lower operating income and net profit margins are more prone to derivatives usage.

As explained in chapter 2, derivatives can be used for multiple purposes. This thesis, however, concentrates on the risk reduction aspects of their use. Toward that end, derivatives can provide great risk reduction for investors. Even though derivatives are commonly used for reducing a company's cash flow volatility, they may simultaneously increase a corporation's value. The next section covers different incentives for companies to hedge.

3.2 Hedging incentives

According to Modigliani and Miller (1958), in an efficient market where there are no taxes, transaction costs, and no asymmetric information, the value of a company is independent of its capital structure. Since the firm's value is calculated as the present value of future cash flows, the value solely depends on the good investments that increase operating cash flows, and it is irrelevant how the investments are financed. Hence, the value of an unlevered company equals the value of a levered company, and the value cannot be increased by changing the capital structure. Also, risk management is irrelevant because investors themselves can hedge the risk in a way that is equal to the company's ability to do so; therefore, in theory the company's hedging activities cannot add or subtract value to the company. For example, investors owning stocks of an airline can hedge the risk of an increase in oil price themselves by diversifying their holdings into oil companies (Gulp, 1994).

However, if the markets are inefficient, there might be several reasons for companies to hedge. Hedging can increase the value of a firm by reducing taxes, financial distress, and agency costs. Graham and Rogers (2002) find that companies use derivatives for hedging to increase their debt capacity which results in tax benefits. In their study, measured by their company value, companies had a 1.1% increase in tax benefits. Similarly, Smith and

Stulz (1985) find that hedging decreases taxes, and also might reduce the probability of financial distress and thereby increase the company value. Arnold et al. (2014) conduct a statistical meta-analysis to study companies' incentives to hedge and made similar findings that financial distress is often companies' motive. Fok et al. (1997) also summarize that hedging decreases the probability of financial distress, as well as agency costs, in both debt and equity. Aretz et al. (2007) conclude that reductions in transaction costs might increase a company's value. They find that the reduction in cash flow volatility leads to a lower possibility of default which reduces the anticipated causes of financial distress and bankruptcy. Also, the lower probability of default allows the companies to increase their leverage which helps them to benefit from tax shields.

Hedging can also decrease the firm's risk exposure. Bartram et al. (2011) find companies who use derivatives to have lower cash flow volatility and lower systematic risk. Guay (1999) report a decrease in total risk, unsystematic risk, as well as interest rate risk. Also, Allayannis and Ofek (2001) report that the use of derivatives decreases exposure to exchange rate risk.

Due to a lack of internal capital, hedging can also help with the underinvestment problem in which companies who face growth opportunities need to use the more expensive external capital to finance their investment opportunities. In terms of better planning of future cash flows and the reduction of more costly outside capital, Froot et al. (1993) and Adam (2002) find that hedging can be beneficial.

Managers might also use hedging to maximize personal gain. If their own capital is involved in the company they are managing, Smith and Stulz (1985) argue that risk-averse managers might have personal incentives to hedge. In that case hedging is done if managers find the diversification of risk to be cheaper on a firm-level than executed by themselves on a personal-level.

Hedging may also reduce agency conflicts. Regarding the quality of management and projects of the company, DeMarzo and Duffie (1995) argue that hedging improves the informativeness and therefore reduces the information asymmetry between managers and shareholders. Thus, it can be used as a measure of managerial skill. Regarding the level of risk-taking, Aretz et al. (2007) find that hedging may reduce the differing views of managers and shareholders. Hedging reduces the risk of making losses by stabilizing cash-flows and thus ensuring that investments are profitable, and the risks are worth taking. Aretz et al. also find that hedging may reduce the conflict between shareholders and bondholders by preventing managers from investing below the optimal level or increasing the risk-level of the assets.

Finally, the hedging choices across an industry may affect the incentive to hedge. Adam et al. (2007) argue that companies' hedging choices depend on whether other companies operating in the same industry hedge. Furthermore, in the case where there are many companies hedging, the incentive of an individual company to hedge decreases and vice versa when there are only a few companies hedging the incentive of an individual company to hedge increases.

3.3 Hedging different risk exposures

Companies face different risks related to their operations every day. These include, for example, foreign exchange risk, interest rate risk, commodity price risk, inflation risk, business cycle risk, and industry risk. To reduce these risk exposures, different kinds of derivative tools can be used. As this thesis focuses on hedging foreign exchange risk, interest rate risk, and commodity price risk with derivatives, this section begins by presenting those risks and then shows how to determine the correct derivative to hedge those risk exposures.

Foreign exchange risk, according to Hillier et al. (2011, p.761), is a risk where a company's financial performance is affected by the fluctuation of exchange rates between currencies. In the long run, the most important reason behind the fluctuation of exchange rates is the difference between country inflation. If the inflation rate of a country increases relative to another country, that currency depreciates relative to the other country's currency. Other factors affecting exchange rates can be the country's relative economic performance, capital flows, etc. Foreign exchange risk is an important risk to manage because the fluctuations also affect a company's cash flows, book values, and market values.

Further, Hillier et al. (2011, pp. 761-762) note that the risks related to fluctuations in currency rates can be divided into three categories. First, transaction risk is a risk linked to individual transactions that are denominated in foreign currencies. These include imports, exports, foreign assets, and loans. Due to its simplicity, hedging this type of risk is quite common. The type of risk increases with time.

Second, Hillier et al. (2011, pp. 762-763) state that translation risk is a risk that arises when translating the financial statements of foreign subsidiaries into the currency of the parent company as part of the consolidation of financial statements. The book value of a subsidiary depends on currency value, and if the currency weakens the value of the subsidiary decreases. A motivation to hedge against this type of risk could be, for example, loan covenants that require that the company maintain a debt-to-book-value above a certain level.

Third, Hillier et al. (2011, p.763) state that economic risk is a risk caused by unexpected exchange rate fluctuations that influence a firm's market value. For example, a change in exchange rates can affect the demand for an item in a foreign country which in turn can affect a company's cash flows and thereby its value. Therefore, this risk is associated with the loss of at least one competitive advantage (i.e., pricing in a foreign country), and is a long-term risk for the company affected. Whereas most multinational companies tend to hedge transaction and translation risks, economic risk is more often left unhedged. The reason for this is simply that it is quite complicated to hedge the long-term economic consequences caused by changes in exchange rates, especially since more factors need to be taken into consideration for this type of hedging.

Interest rate risk occurs, according to Bodie et al. (2017, pp. 508-510), when interest rates change and thereby change the value of an investment. The change in interest rates affects the value of bonds and other fixed-income securities. For example, an increase in interest rates decreases the value of a bond, and vice versa. In addition to affecting future cash flows, due to their role in discounting, interest rates also affect the present value of cash flows. Also, while foreign exchange rates can change throughout the day, interest rates can remain the same for long periods.

Commodity price risk is (Hull, 2018, pp. 772-775) a risk occurring from changes in commodity prices. Commodities can be categorized as agricultural (e.g., wheat, corn, cocoa, etc.), metal (e.g., gold, silver, platinum, etc.), or energy (e.g., oil, gas, electricity, etc.) commodities. Fluctuations in these prices can be harmful to companies largely due to their impact on production costs, product pricing, earnings, and credit availability.

Determining the right derivative to hedge risk exposures is important. In their study, regarding the question of whether it matters which derivative is used for hedging a risk exposure, Ahmed et al. (2020) state that the literature mixed. However, they note that in practice many of the non-financial firms use derivatives that are also used by others and which are popular. In their study, the authors present the most common derivative tools for each risk category. For hedging foreign currency risk and commodity price risk, forwards are found to be the most popular tool. For hedging interest rate risk, swaps are the most popular derivative.

Furthermore, Ahmed et al. (2020) present the percentage of each derivative tool used among each risk category. First, for foreign currency risk, forwards are the most popular tool (66.9%), followed by swaps (32%), options (7.9%), and futures (less than 1%). Second, for interest rate risk, swaps are the most popular tool (61.4%), followed by options (7.1%), forwards (4.4%), and futures (less than 1%). Third, for commodity price risk, forwards are used the most (9.1%), followed by swaps (8%), options (5.5%), and futures (4.1%). These findings are presented in Figure 7.

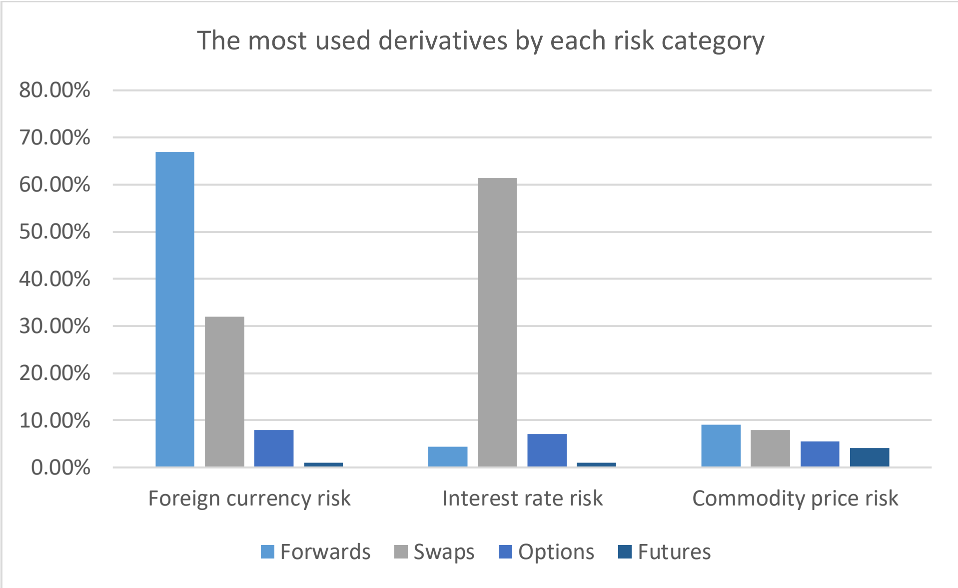

Figure 7. The most used derivatives by each risk category, according to Ahmed et al. (2020).

After presenting the most popular derivative tools used for each risk, Ahmed et al. (2020) examine the effect of each exposure on firm value between hedgers and non-hedgers. The results suggest the following: for firms with foreign currency risk exposure, hedgers have a higher firm value than non-hedgers by 4.3% at a 1% significance level. Similarly for firms exposed to commodity price risk, commodity risk hedgers have a higher firm value compared to non-hedgers by 7.6% at a 1% significance level. Regarding interest rate risk, non-hedgers have a higher firm value than hedgers by 3.9% also at a 1% significance level.

Ahmed et al. (2020) then continue by comparing how each derivative impact firm value when used for offsetting different risks. When used to offset foreign currency exposure, they find that the usage of forwards, options, and swaps all have a positive and significant effect on firm value. When used to offset commodity price exposure, the use of futures has a positive and significant effect on firm value. The effect of options use is also positive but insignificant. When using forwards and swaps the effect on firm value is negative and significant. Finally, when used to offset interest rate exposure, the use of swaps has a positive and significant effect on firm value. The same applies for forwards, although the results are not significant. With options, the effect on firm value is negative and significant.

4 The effect of hedging on firm value

To be able to measure the effect that hedging has on firm value, firm value must be presented. This chapter begins by presenting firm value and how it is measured, followed by introducing what affects firm value. Next the effect that hedging has on firm value is presented. This chapter ends with presenting previous studies and their results regarding the effect that hedging has on firm value.

Noted by Brealey et al. (2007, pp. 52-54), firm value should reflect the accurate value of the company and there are two ways to present it: (1) book value and (2) market value. Book value reflects the accounts in the financial statements, whereas market value reflects how the firm is valued by the "market". As the price of the stock affects the market value of the firm, a decrease in the share price decreases the value of the firm. This is what happened to many firms during the market crash caused by COVID-19 at the beginning of 2020. To avoid these types of value decreases, many firms try to prevent this type of risk by hedging.

Other than stock price movements, there are also different factors affecting firm value in both ways, positively and negatively. For example, firm size can affect firm value in both ways, positively (e.g., Dang et al., 2019) and negatively (e.g., Hirdinis, 2019). Profitability (Allayannis and Weston, 2001), R&D (Ahmed et al., 2020), and capital expenditures (Myers, 1977) have a value-increasing effect on the firm value, whereas dividend yield has a negative effect on it (Jin and Jorion, 2006), for example.

There are multiple ways to measure firm value, such as the price-to-book ("P/B") ratio. Following previous literature in the field (see e.g., Allayannis and Weston, 2001 and Luo and Wang, 2018), this thesis uses Tobin's Q as a proxy for firm value. Also, due to its future-oriented view, Hoyt and Liebenberg (2008) note that Tobin's Q is a good measure of firm value (which is useful in terms of hedging). Tobin's Q is a ratio where the market value of the firm is divided by the replacement value of its assets. A more precise introduction of this measure is done in the next chapter. This chapter continues by showing the different ways hedging affects firm value. While the corporate hedging theory suggests that hedging increases firm value, the empirical evidence is mixed. The different effects are presented at the end of this chapter.

While the previous chapter discussed companies' incentives to hedge, this chapter addresses the channels through which hedging activities impact the value of the company. First, direct effects are introduced followed by indirect effects. In their forerunner article, Allayannis and Weston (2001) argue that corporate hedging itself has a direct effect on firm value. Lookman (2004) note that the value premium might be due to hedging secondary risk through the use of financial derivatives. Shareholders reward good management with higher value. Adam and Fernando (2006) point out that hedging activities also create significant cash flow advantages, which have a positive impact on company value. Smith and Stulz (1985) suggest that managers might hedge company risks if their own personal wealth is dependent on the company's value and the risk hedging is cheaper for them on a company level than on a personal level. By doing that, they might want more compensation for the non-diversifiable risks or hedge the risks at the company level, but as long as the hedging costs are smaller than the reduction in extra compensation, the company's value will increase.

Hedging also has some indirect effects on firm value. According to Leland (1998), hedging has a positive effect on the leverage ratio because hedging increases a company's debt capacities, which, due to the higher interest deductions, results in tax benefits. Those savings increase a company's value. Also, firms are not expected to entirely exploit the additional debt capacity, which lowers companies' distress costs and increases their value. Graham and Rogers (2002) add that the saved money can also be allocated to profitable investments and R&D activities that also increase firm value. Campello et al. (2011) state that hedgers are more likely to get loan arrangements with lower rates and are less likely to have covenants that limit their investments. Both of these effects have an increasing value effect on firms. Froot et al. (1993) note that hedging helps to avoid more costly external financing. When internal capital is cheaper than external, hedging helps to use more of the internal ones which lowers earnings volatility and thus helps the company to make profitable investments. Gilje and Taillard (2017) note that hedging reduces bankruptcy risk and underinvestment problems which both add value to the company. Contrary to these effects, Jensen and Meckling (1976) find that hedging has a negative impact on the leverage ratio.

The leverage ratio also has a direct impact on firm value. Cheng and Tzeng (2011) find that leverage has a positive impact on firm value, while Chen and Chen (2011) find, due to increasing agency and bankruptcy costs, leverage to have a negative impact. The different determinants affecting firm value are demonstrated in Figure 8.

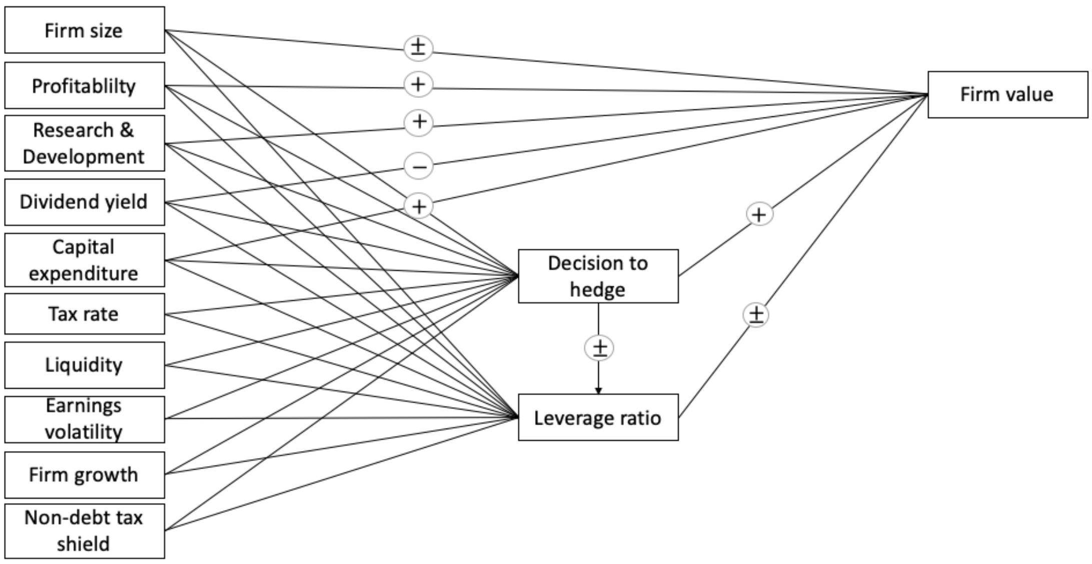

Figure 8. Determinants of firm value.

The next subchapters present previous literature on the effects that hedging has on firm value. First, the studies that find hedging to be value enhancing are presented. Second, studies that find hedging to be value destroying are introduced. Third, studies that find hedging to have no effect on firm value are then showcased. This chapter ends with a review of the few available studies directly addressing the effect of hedging on firm value during an economic downturn. The literature regarding this is limited, but the studies are presented as these are the closest to the one examined in this thesis. All of the previous studies presented in this chapter examine non-financial firms, and therefore, the results are comparable to this thesis.

4.1 Hedging increases firm value

Allayannis and Weston (2001) were the pioneer researchers to study the effect of hedging on firm market value. In their study of 720 large U.S. non-financial companies, they examine the potential value effect of using foreign currency derivatives on company value. They find a positive relationship between the usage of foreign currency derivative and firm value of an average of 4.87%. The results are statistically and economically significant. After this study was published, many others find a positive effect as well.

Gleason et al. (2005) examine U.S. high-tech companies using a sample of 216 companies in 1998. Their results are statistically significant at the 5% level, and they find hedging to be positively related to firm value (a value effect of 5.6%). Carter et al. (2006) investigate the U.S. airline industry between 1992 and 2003 and examine a sample of 28 companies in the industry. Their results suggest that hedging has a positive effect on company value within that industry, and they propose the hedging value effect might be as high as 10%. Mackay and Moeller (2007) conduct a study of 34 U.S. oil refiners in the years between 1985 and 2004. They find positive and significant results between hedging and firm value (a value effect of 4.4%).

While most of the studies investigate companies in the U.S., many studies have been made concerning companies operating in other countries. Allayannis et al. (2012) perform an international study with a sample of 372 non-financial firms using currency derivatives from 39 countries. They find significant evidence that the usage of currency derivatives increases company value for firms that have strong firm-level and country-level governance. The value effect found is as high as 10.7%. Vivel Búa et al. (2015) examine the Spanish market with a sample of 100 non-financial companies between

2004 and 2007. They find that hedging provides firms with an average 1.53% value premium. Clark and Judge (2009) study 412 non-financial companies from the U.K. in 1995. They find that foreign currency hedging positively affects firm value. The hedging premium found is 12.3% and is statistically significant at the 5% level. Finally, Brunzell et al. (2011) investigate non-financial Nordic listed firms. Their sample consists of 112 firms in 2006. They find weak support that hedging has a value increasing effect.

Geyer-Klingeberg et al. (2020) conclude a meta-analysis of 71 studies that find a hedging value premium. They find a relationship between the value premium and the quality of the journal where the study is published. The value premium found is, on average, 2% lower for studies published in higher-ranked journals. They also find that the value premium is systematically higher for those hedging foreign exchange exposure and lower for interest rate and commodity price hedgers. The econometric model also matters. Studies that omit controls for fixed effects and endogeneity have a strong upward bias in their hedging premium results. Also, studies that control for operational hedging in their regressions have a larger value premium. The results also suggest that hedging premiums differ across countries and world regions. Value creation is determined by the country's market access to financial derivatives as well as the country's tax rate level. Overall, by finding the best practice among the studies and utilizing that, they find that the average value premium for foreign currency hedgers is 1.8%, for interest rate hedgers -0.8%, and for commodity hedgers -0.6%.

4.2 Hedging decreases firm value

To study the impact of derivative use on firm value, Fauver and Naranjo (2010) examine a sample of 1746 non-financial firms that have a headquarter in the US. They use a time period from 1991 to 2000 and find that for firms with greater agency and monitoring problems derivative usage has a negative impact on firm value. The results are economically significant with an effect of -8.4%. Lookman (2004) examine oil and gas producing firms and use a sample of 125 firm observations between 1992 and 2000. The results suggest that for firms hedging their primary risk, firm value is lower than for firms that do not engage in hedging activities.

Naito and Laux (2011) study how hedging affects firm value using a sample of 434 non-financial firms that are included in the S&P 500 Index in February 2011. Thus, the sample consists of large firms from all industries. Their results suggest that the relationship between firm value and hedging is negative and statistically significant at the 1% level. Therefore, derivatives use decreases firm value.

Nguyen and Faff (2007) investigate different derivatives' effects on firm value with a sample of 428 non-financial Australian firms between 1999 and 2000. They suggest that the usage of derivatives, and especially the usage of interest rate derivatives, has a negative and significant effect on firm value with an 18% hedging discount. Lau (2016) study the effect of derivatives use on firm value in Malaysia. The sample used covers 680 Malaysian non-financial firms from 2003 to 2012. The results suggest that the use of derivatives yields a negative and significant effect on firm value for hedgers. More specifically, derivatives users have, on average, 51% lower firm value than non-users. The enormous negative coefficient compared to other studies is explained by the fact that that study is conducted in a developing country.

4.3 Hedging has no effect on firm value

The proposition by Modigliani and Miller (1958) states that the value of a firm is independent of hedging choice. Therefore, the decision of whether to hedge or not to hedge should not have any effect on firm value. There are a few examples of this in the literature that seem to support this theory.

Jin and Jorion (2006) examine the relationship between hedging and firm value using a sample of 119 U.S. oil and gas producers between the years 1998 and 2001. They find that hedging reduces stock price sensitivity but does not affect market value.

Khediri and Folus (2009) investigate 320 French non-financial firms in 2001. They find hedging to have no effect on firm value; and they propose that that effect might be due to the different characteristics of French and U.S. firms and/or their respective financial markets. Similarly, dos Santos et al. (2017) analyze 282 Brazilian non-financial firms between 2006 and 2014 to study the value effect of hedging by Brazilian non-financial companies. They find hedging not adding any value for those firms and suggest that their motivation to hedge is the cash flow management, not the value-adding.

4.4 The effect of hedging during a bear market

As the empirical part of this thesis examines the effect of hedging on firm value during a bear market caused by COVID-19, several studies investigating the effect of hedging during recent bear markets are now reviewed prior to empirical analysis. A bear market is defined as a 20% or more decline in a stock index from its recent high (Mishkin and White, 2002). The most recent bear markets prior to the one caused by COVID-19 are the two caused by the "financial crisis" in 2007-2009 and the "dot-com bubble" in 2000-2002.

Bartram et al. (2011) use a sample of 6888 non-financial firms from 47 countries between 2000 and 2001. The countries examined in their sample represent 99% of global market capitalization during the years of study. They find that firms using derivatives have a positive and weakly statistically significant value-enhancing effect on firm value. However, as their time period includes a major decline in the economy in the majority of countries, with some experiencing a recession in both years examined, the effect of derivatives use on firm value during a sharp market decline is also investigated. To study this, the time period is lengthened to 1998-2003. The results show that derivative users outperformed the non-users in 2001 as they had a 4.3% higher mean value (i.e., as measured by Tobin's Q). The result is statistically significant at the 10% level. The users also have significantly higher alphas in every year but 1998 with the highest premium in 2000. These findings support the derivative use/hedging value creation hypothesis during a market downturn.

Ahmed et al. (2020) study different risk exposures and hedging around financial crises. They use a sample of 378 non-financial firms listed in the FTSE All Share Index during 2005-2017. Their results suggest that hedging foreign currency risk is beneficial during pre-crisis, crisis, post-crisis, and non-crisis time periods (i.e., they find a positive and significant effect on firm value of 10.5%, 3.1%, 1.2%, and 7.1%, respectively). All the results are statistically significant at least at the 10% level. Across all time periods hedging interest rate risk, however, yields a lower firm value compared to non-hedgers. The findings are significant. Hedging commodity price risk has a positive and significant effect on firm value during the non-crisis period of 6.3% but a negative effect during pre-crisis, during-crisis, and post-crisis periods. Most importantly the results suggest that during the crisis, firm value is higher for hedgers compared to non-hedgers, but only for those hedging foreign currency risk. Therefore, when investigating whether hedging increases firm value during a bear market period, they propose that the type of risk hedged matters.

Luo and Wang (2018) use a sample of almost 70 000 firm-quarter observations from Chinese non-financial firms during 2000-2013. Their results show that there is a positive and statistically significant relationship at the 1% level between the use of derivatives and firm value. Hedgers have a 31.4% higher firm value than non-hedgers. As their time-period consists of the financial crisis in 2008-2009, they examine the effect during the crisis period. They find that the increase in value weakens during the financial crisis.

Panaretou (2014) examine the effect of hedging on firm value with a sample of 1372 firm-year observations. The sample period is from 2003 to 2010 and consist of large non-financial U.K. firms. The results suggest that hedging with currency derivatives creates value (16.3%, and statistically significant at the 5% level). The results of hedging with other derivatives are insignificant. As the sample period includes the years of the financial crisis, the hedging premium is examined for those as well. The results for currency hedgers are statistically significant at the 5% level but suggest that during 2007-2008 the premium decreases as the benefits from under-investment and tax costs are lost. As the costs of hedging offset the benefits, the results for interest rate hedgers suggest a negative hedging premium for the time-period of 2008-2010.

As the previous section shows, and excluding FX hedging, the literature regarding the subject remains mixed. Also, recent studies' results are probably more robust because heteroskedasticity is controlled for in most of those studies. The studies presented in this section are listed in Table 2.

Table 2. List of the studies and the effect they find mentioned in the chapter.

Authors	Year(s)	Derivative type	Sample	Value premium
Ahmed et al. (2020)	2005-2017	GEN	378 non-financial firms	Differs
Allayannis and Weston (2001)	1990-1995	FCD	720 large U.S. non-financial companies	Positive
Allayannis et al. (2012)	1990-1995	FCD	372 non-financial firms from 39 countries	Positive
Bartram et al. (2011)	2000-2001	GEN	6888 non-financial firms from 47 countries	Positive
Vivel Búa et al. (2013)	2004-2007	FCD	100 Spanish non-financial firms	Positive
Brunzell et al. (2011)	2006	GEN	112 Nordic non-financial firms	Positive
Carter et al. (2006)	1992-2003	COM	28 U.S. airline companies	Positive
Clarke and Judge (2009)	1995	FCD	412 UK non-financial firms firms	Positive
Fauver and Naranjo (2010)	1991-2000	GEN	1746 non-financial firms headquartered in the U.S.	Negative
Gleason et al. (2005)	1998	FCD	216 U.S. high-tech frims	Positive
Jin and Jorion (2006)	1998-2001	COM	119 U.S. oil and gas producers	No effect
Lau (2016)	2003-2012	GEN	680 Malaysian non-financial firms	Negative
Lookman (2004)	1992-2000	COM	125 oil and gas producers	Negative
Luo and Wang (2018)	2000-2103	FCD	70,000 firm-quarter obs. from Chinese firms	Positive
Mackay and Moeller (2007)	1985-2004	COM	34 U.S. oil refiners	Positive
Naito and Laux (2011)	2011	GEN	434 U.S. Non-financial firms listed in S&P 500	Negative
Nguyen and Faff (2007)	1999-2000	GEN	428 Australian non-financial firms	Negative
Panaretou (2014)	2003-2010	GEN	The non-financial firms in the FTSE 350	Positive

5 Empirical part

The empirical part begins by introducing the data sample used in this thesis. Next, the dependent variable and independent variables are introduced. Later, the methodology section introduces the univariate and multivariate regressions run. Finally, the results are presented.

5.1 Data

This thesis examines the effect of hedging on firm value of U.S. non-financial firms between 2015 and 2020. The five-year time period chosen captures the effect of the recent bear market and gives a reasonable time period prior to the market crash. The data of the thesis consist of the non-financial firms listed in the S&P 500 Index. The sample is chosen because it represents a comprehensive sample of U.S. firms operating in different sectors, and accounts for almost 80% of available U.S. market capitalization. Also, the index is chosen because it is one of the most followed equity indices and the effect of the recent bear market can clearly be seen from its returns. The U.S. market has been widely examined in this research area, yet there are no examinations done regarding the subject during the recent economic downturn caused by COVID-19. Thus, this thesis contributes to previous studies. All data are gathered from the Thomson Reuters Datastream database.

The sample consists of non-financial firms listed in the S&P 500 Index. The total number of firms listed in the index is 505 since 5 of the firms have two different share classes of stock. As this thesis focuses on non-financial firms, the financial firms (SIC = 6000-6999) [1] are excluded from the sample. This is done because financial firms' motive to use

[1] According to Standard Industrial Code (SIC) system, all firms are classified into one of the 10 industries. The industries are the followings: agriculture (0100-0999), mining (1000-1499), construction (1500-1799), manufacturing (2000-3999), transportation and public utilities (4000-4999), wholesale trade (5000-5199), retail trade (5200-5999), finance, insurance, and real estate (6000-6799), services (7000-8999), and public administration (9100-9999).

derivatives may differ significantly from their use by non-financial firms (Fauver and Naranjo, 2010). After eliminating the financial firms from the sample, the total number of firms in the sample is 411.

Based on the previous literature, different accounting variables are used as independent variables. However, some of the independent variables used in the thesis have a very low coverage ratio. For example, growth, R&D, and geographical diversification are missing 61.6%, 62.9%, and 14.4% of their values, respectively. To get balanced data, the rows that have missing values are dropped, which limits the number of the observations in the data remarkably. After removing the missing values, the final sample consists of 1318 quarterly observations.

The sample period is from Q1 2015 to Q3 2020. Quarterly observations are used to examine hedging efficiency during the recent bear market. The sample period includes the year 2020, when COVID-19 started spreading from the Chinese city of Wuhan, which caused a market crash in the first quarter of the year. During the COVID-19 crisis, the S&P 500 Index fell by 35% from its record high of 3386.15 on February 19 to 2237.40 on March 23 (S&P Dow Jones Indices, 2021). At the same time, the volatility index (VIX), often called as the “fear index”, rose from 14.38 on February 19 to 61.59 on March 23 peaking at 82.69 during the time period (Fred, 2021). This time period is identified as a bear market and it marks the most rapid bear market in history (Haase and Neuenkirch, 2021). The movements of the S&P 500 Index and the VIX are illustrated in Figure 9.

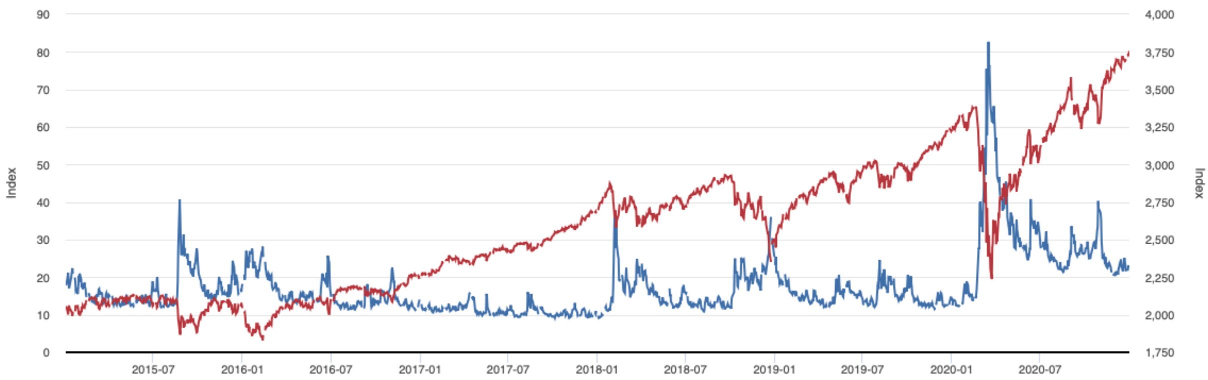

Figure 9. S&P 500 and VIX index 2015-2020 (S&P Dow Jones Indices, 2021; Chicago Board Options Exchange, 2021).

As the drop in the S&P 500 Index and rise in the VIX occurred during Q1 2020, and as quarterly data is used, the crisis period in this thesis is defined as Q1 2020. This period consists a total of 28 firm-quarter observations. As the number of observations during the crisis in the sample is relatively low, this is a limitation of this thesis.

Following Ayturk et al. (2016), each quarter the firms in the sample are divided into hedgers and non-hedgers. Accordingly, firms' quarterly financial statements are examined, and if any value has been found on either current derivative assets, non-current derivative assets, current derivative liabilities, or non-current derivative liabilities accounts, the firm is classified as a hedger. If there is no open value found on any of those accounts, the firm is classified as a non-hedger. As this thesis only makes the comparison between hedgers and non-hedgers, no further diversification between different derivatives types used is made here. Although it acknowledges that they can be used for speculative or arbitrage purposes as well, this thesis also straightforwardly assumes that all the derivatives are used for hedging purposes.

The method of classifying firms as hedgers and non-hedgers based on their derivative accounting data allows to make the classification between the hedgers and non-hedgers without having to manually search for the hedging information from the firms' financial statements. However, it is acknowledged that this method may lose the accuracy between the classification as all the firms using derivatives are assumed to be using them for hedging purposes and thus some firms might accidentally be categorized into the wrong group.

5.1.1 Dependent variable

In line with previous literature (see e.g., Allayannis and Weston, 2001 and Luo and Wang, 2018), Tobin's Q (“Q”) is used as a proxy for firm value. The ratio is calculated as the market value of a firm over its replacement cost of assets. Luo and Wang (2018) note that if Tobin's Q value is greater than 1, it means that the firm's market value is higher than the cost to replace its assets suggesting that the stock of the firm is overpriced. Accordingly, if the value is 1, the market value reflects the firm's recorded assets and is priced correctly. Conversely, if the value is between 0 and 1, as the market value is lower than the replacement cost of assets, the stock is underpriced.

Previous literature shows that there are different ways to calculate Tobin's Q. However, this thesis uses the simplified method to calculate the ratio as the more advanced calculations require more data and as Allayannis and Weston (2001) show, the correlation between the advanced and simplified Tobin's Q ratio is as high as 0.93. Therefore, the method used to calculate Q does not generally change financial analysis that uses a simpler versus a more complex version. The simplified Tobin's Q ratio is calculated as the market value of equity plus the book value of total liabilities divided by the book value of total assets. The formula is:

$$Tobin's\ Q = \frac{MV\ of\ Equity + Total\ Liabilities}{Total\ Assets} \tag{10}$$

The market value of equity is the total number of preferred shares outstanding multiplied by the market price of the shares. The values are calculated quarterly by using the quarter-end stock prices. Total liabilities and total assets represent the quarterly book values of total liabilities and total assets, respectively. Tobin's Q values are calculated separately for each firm and each quarter.

There are several benefits of using Tobin's Q as the measure of firm value. Hoyt and Liebenberg (2011) note that Tobin's Q ratio does not require risk adjustments or standardization. Lindenberg and Ross (1981) add that the ratio cannot be manipulated by the management. Hoyt and Liebenberg (2008) continue that Tobin's Q is a future-looking measure that is important in risk management because the benefits are expected to be gained in the future rather than now. The use of Tobin's Q as a measure of firm value also has some limitations. Lindenberg and Ross (1981) note that the ratio ignores the intangible costs and therefore the value for firms with large intangible assets may be erroneous. Bartlett and Partnoy (2020) argue that the simplified Q is likely to generate biased estimates as the ratio has omitted assets (e.g., intangibles) and firm-specific characters that might alter the ratio (e.g., the level of current assets).

Wernerfelt and Montgomery (1988) note that Tobin's Q may be highly affected by the industry in which the firm operates. Thus, some industries might have naturally higher Tobin's Q values. To avoid the possibility that the potential hedging premium is only due to industry effects and not due to the use of derivatives, as suggested by Allayannis and Weston (2001), industry-adjusted Tobin's Q is also used. Industry adjusted Tobin's Q is calculated as follows:

$$Industry - adjusted\ Tobin's\ Q = Q - Industry\ median\ of\ \ Q \qquad (11)$$

5.1.2 Independent variables

There are several firm characteristics that have been shown to have an effect on firm value (i.e., Q), and these are used as independent variables in this examination. The independent variables used are based on the previous literature in the field (Allayannis and Weston, 2001, Jin and Jorion, 2006, and Luo and Wang, 2018) and they include control variables and dummy variables. The variables and their theoretical justifications follow.

Hedger (HEDGER) is a dummy variable that shows whether the firm is engaging in hedging activities in the current quarter. The dummy takes a value of 1 if the firm has an open derivative position in any derivative account (current derivative assets, non-current derivative assets, current derivative liabilities, non-current derivative liabilities) and a value of 0 if it does not have any value. Hedging has shown to have a positive effect on firm value in both the theoretical (see e.g., Campello et al., 2011; Gilje and Taillard, 2017) and empirical literature (Allayannis and Weston, 2001; Carter et al., 2006).

Firm size (SIZE) has been shown to affect firm value and is included as an independent variable. Larger firms have higher accounting profits, and the larger size often leads to greater efficiency (Peltzman, 1977). Thus, size is expected to have a positive relationship with firm value. In addition, larger firms are more likely to use hedging (Graham and Rogers, 2002). Firm size is measured as the natural logarithm of total assets, and calculating the logarithm is intended to control the size effect.

Leverage (LEV) reflects the firm's capital structure and is shown to have an effect on firm value. It is measured as the ratio of the book value of long-term debt to total assets. Although increasing the debt level has certain benefits, such as tax reductions and better management commitment (Leland, 1998), high leverage tends to result in higher risk and increases agency and bankruptcy costs (Chen and Chen, 2011). Thus, leverage is expected to negatively affect firm value.

Profitability (PROF) is measured with the return on assets (ROA) ratio, which is calculated by dividing net income by total assets. ROA reflects the efficiency of creating income with assets, and the higher the ROA, the more profitable the firm. Allayannis and Weston (2001) show that profitable firms will be more likely to be valued higher, and therefore have higher firm value.

Growth (GROWTH) is measured as the ratio of capital expenditures to total sales. As capital expenditures are investments that will turn into future profits, investment growth is shown to have a positive effect on firm value (Myers, 1977). Also, firms that hedge have better investment opportunities than firms that do not hedge, which affects positively firm value (Géczy et al., 1997).

R&D (R&D) is another measure for investment growth opportunities. It also represents the firm’s know-how and knowledge. R&D is measured as the ratio of R&D expenditures to total sales and is expected to have a positive relationship with firm value (Ahmed et al., 2020).

Geographic diversification (GEOG) is measured by the ratio of foreign sales to total sales. Firms with foreign sales are multinational firms; and multinationality tends to create value. Thus, geographic diversification is expected to increase firm value (Bodnar and Weintrop, 1997).

Dividend (DIV) is a dummy variable that takes a value of 1 if the firm paid dividends in the current quarter and a value of 0 if it did not pay dividends. A dividend dummy is included as it reflects the firm’s access to financial markets. Firms with restricted access to financial markets can only accept projects with the highest net present values, which may be seen with a higher firm value. Thus, the dividend payment is expected to have a negative impact on firm value. (Jin and Jorion, 2006.)

Crisis (CRISIS) dummy is a dummy variable that identifies the COVID-19 bear market as the crisis period and thus separates it from the whole period. The dummy takes a value of 1 in Q1 2020 and 0 otherwise. Crisis is expected to negatively affect firm value.

In addition, time and industry effects are controlled for in the regressions. *Industry effect* (INDUSTRY) dummy is used as some industries have naturally higher firm values than others, and if the firm is operating in such an industry, it will be falsely seen to have a higher firm value due to the wrong reasons (Allayannis and Weston, 2001). Therefore, a dummy is used for different industries to control this effect and is based on the two-digit SIC code. Year effects (TIME) are also controlled by using yearly dummies. Table 3 presents a summary of these variables.

Table 3. Summary of variables.

Variables	Predicted sign	Definition
Tobin's Q		(MV of equity+BV of total liabilities)/BV of total assets
Hedger	+	Dummy variable for derivatives usage
Firm size	+	Natural logarithm of total assets
Leverage	-	BV of long-term debt/Total assets
Profitability	+	Net income/Total assets (ROA)
Growth	+	Capex/Total sales
R&D	+	R&D expenditures/Total sales
Geog. Diver.	+	Foreign sales/Total sales
Dividend	-	Dummy variable for dividend payments
Crisis	-	Dummy variable for crisis period

5.1.3 Descriptive analysis

The descriptive analysis includes all the main variables that are being used in the empirical research. The statistics of the sample firms are presented in Table 4 that follows. Panel A presents the summary statistics of the whole sample and consists of 1318 firm-quarter observations. Panel B shows the statistics for hedgers, and it contains 702 firm-quarter observations. Therefore, hedger firms are the majority of this sample. Panel C highlights the figures for non-hedgers, and it includes 616 firm-quarter observations. As the median Q (0.556) of all firms is smaller than the mean of Q (0.559), panel A shows the distribution of Tobin's Q is skewed. Therefore, the natural logarithm of Tobin's Q is henceforth used to measure firm value to make the distribution more symmetric.

Panel A also shows that the mean and median values of Tobin's Q for all firms are less than 1, which indicates the market value being lower than the replacement cost of assets. The values for the natural logarithm of Tobin's Q as well as for the industry-adjusted natural logarithm of Tobin's Q are also presented here, with the latter taking higher values. As the mean and median values of leverage are 0.557 and 0.552, respectively, most of the firms in the sample seem to have more debt than equity. Also, over half of their sales come from foreign sales, indicating that the majority of firms in the sample are multinational firms. In addition, as the mean value for dividend payment is 0.642 and the median is 1, most of the firms seem to be dividend payers.

The mean value of hedgers establishes that 53.2% of the firms in the sample are hedgers. This amount is similar to the findings of Bodnar et al. (2011), who find that 56% of the firms in North America use derivatives. Also, different studies on the use of derivatives in the U.S. markets find different levels of their use. The most similar hedger percentage is found by Fauver and Naranjo (2010), who find that 49.2% of the firms in their sample of 1746 firms headquartered in the U.S between 1991 and 2000 use derivatives. Naito and Laux (2011) find that 75.6% of the firms they analyze use derivatives (based on a sample of 434 firms in the S&P 500 in 2011). The differentiation in the percentage of hedgers in the studies may be due to the fact that the data collection processes have been different. Studies that use hand-collected information on hedging usually have a higher hedging coverage ratio.

Panel B and C show the specific qualities for hedgers and non-hedgers. Both Tobin's Q and the industry-adjusted Tobin's Q values are higher for firms that hedge. This is in line with the theory that hedging increases firm value.[2] Hedger firms also appear to be a bit bigger, have more leverage, be more profitable, have better growth opportunities, have higher foreign sales, and pay more dividends than non-hedging firms. These results are

[2] See e.g., Campello et al. (2011), who find that the better loan terms given to hedgers have an increasing effect on the firm value, or Gilje and Taillard (2017), who find that hedging reduces bankruptcy risk as well as underinvestment problems, both leading to a higher firm value.

in line with Fauver and Naranjo (2010). Interestingly, non-hedging firms use more money for R&D than hedging firms.

Table 4. Summary statistics.

Variable	N	Mean	Median	Std. Dev.	Min	Max
Panel A: All firms						
Tobin's Q	1318	0.559	0.556	0.226	0.009	1.793
Ln (Q)	1318	-0.683	-0.586	0.504	-4.701	0.584
Industry-adjusted Q	1318	-0.110	0.011	0.562	-3.981	0.936
Hedger	1318	0.532	1.000	0.499	0.000	1.000
Firm size	1318	16.414	16.366	1.351	12.151	19.823
Leverage	1318	0.557	0.552	0.227	-0.004	1.781
Profitability	1318	0.021	0.020	0.028	-0.301	0.308
Growth	1318	0.056	0.041	0.050	0.000	0.377
R&D	1318	0.115	0.098	0.092	0.000	1.556
Geographical diversification	1318	0.550	0.534	0.238	0.000	1.098
Dividend	1318	0.643	1.000	0.479	0.000	1.000
Crisis	1318	0.021	0.000	0.144	0.000	1.000
Panel B: Hedgers						
Tobin's Q	702	0.586	0.576	0.215	0.078	1.242
Ln (Q)	702	-0.608	-0.550	0.408	-2.542	0.217
Industry-adjusted Q	702	-0.017	0.034	0.487	-1.823	0.936
Hedger	702	1.000	1.000	1.000	1.000	1.000
Firm size	702	16.756	16.653	1.302	14.173	19.496
Leverage	702	0.584	0.574	0.215	0.069	45292
Profitability	702	0.022	0.021	0.024	-0.095	0.308
Growth	702	0.057	0.042	0.051	0.000	0.377
R&D	702	0.105	0.088	0.074	0.000	0.484
Geographical diversification	702	0.561	0.535	0.211	0.000	1.001
Dividend	702	0.717	1.000	0.450	0.000	1.000
Crisis	702	0.017	0.000	0.129	0.000	1.000
Panel C: Non-hedgers						
Tobin's Q	616	0.529	0.515	0.235	0.009	1.793
Ln (Q)	616	-0.767	-0.662	0.583	-4.701	0.584
Industry-adjusted Q	616	-0.215	0.002	0.620	-3.981	0.875
Hedger	616	0.000	0.000	0.000	0.000	0.000
Firm size	616	16.024	15.862	1.299	12.151	19.823
Leverage	616	0.526	0.513	0.235	-0.004	1.781
Profitability	616	0.019	0.019	0.033	-0.301	0.228
Growth	616	0.055	0.039	0.048	0.000	0.372
R&D	616	0.127	0.103	0.108	0.000	1.556
Geographical diversification	616	0.537	0.525	0.266	0.000	1.098
Dividend	616	0.558	1.000	0.496	0.000	1.000
Crisis	616	0.025	0.000	0.159	0.000	1.000

Table 5 showcases the different variables during the crisis and the whole sample periods. Surprisingly, Tobin's Q is higher in terms of mean and median values during the crisis indicating that firms were valuated higher during the market downturn. Also, in terms of mean values during the crisis, the industry-adjusted Tobin's Q is higher. During the whole time period, the mean and median values of hedgers are higher. This suggests that firms decreased their hedging positions during the crisis and hedged less.

During the crisis period, leverage was higher compared to the whole period suggesting that firms had more debt during the crisis. In terms of mean values of total assets during that period, the increased amount of debt during the crisis led to larger firm sizes. In addition, during the whole time period, firms were using more money for capital expenditures. During the crisis period, firms were using more money for R&D. Firms' foreign sales were reduced during the crisis period. Finally, during the crisis period, firms increased their dividend payments.

Table 5. Comparison of variables between the crisis and the whole sample periods.

	Crisis *N = 28*		***Whole period*** *N = 1318*	
Variable	**Mean**	**Median**	**Mean**	**Median**
Q	-0.629	-0.466	-0.684	-0.590
Industry-adjusted Q	-0.049	0.089	-0.111	0.010
Hedger	0.428	0.000	0.534	1.000
Firm size	16.542	16.358	16.411	16.366
Leverage	0.590	0.624	0.556	0.551
Profitability	0.027	0.018	0.021	0.020
Growth	0.053	0.036	0.056	0.041
R&D	0.120	0.125	0.115	0.097
Geographical diversification	0.534	0.502	0.550	0.535
Dividend	0.821	1.000	0.639	1.000

5.2 Methodology

The following methodology portion of the thesis consists of data testing as well as univariate and multivariate analyses. First, the data are tested for multicollinearity. Next, the univariate analysis section examines the effect of hedging on Tobin's Q (which is used as the measure of firm value). The univariate regression section uses only one variable, hedger, to examine the effect on firm value (i.e., Q). However, the variables that were excluded in the univariate analysis also have an effect on firm value and therefore, cannot be fully ignored. Therefore, this thesis also uses multivariate analysis to include those variables and examine their effect on firm value. The regression models are formed based on the hypothesis of this thesis and previous literature (see e.g., Allayannis and Weston (2001)).

5.2.1 Multicollinearity tests

Before presenting the univariate and multivariate tests, the data are tested for multicollinearity. Woolridge (2016, pp. 83-86) explains that to derive unbiased estimates from econometric models, the amount of multicollinearity in the regression variables should be examined, and the amounts should be low. Multicollinearity intrinsically indicates that an independent variable in the regression is collinear with another independent variable in the model, meaning that the variables are not truly independent but influencing each other.

The Variance Inflation Factor ("VIF") test is used to measure multicollinearity. The value for VIF ranges from 1 up. And, as it indicates a lower correlation among variables, the smaller the VIF, the better. There has not been a single VIF value proposed in the literature that would suggest how high the value would have to be to cause problems. Woolridge (2016, p.98) notes that any value under 10 implies that there is no significant multicollinearity in the estimation. The results of the VIF test are presented in Table 6. A constant is added to the VIF test, but it is not included in the table. The values for the variables range between 1.008 and 1.407; and the values do not imply that there is multicollinearity in the variables.

Table 6. VIF test**.**

	VIF
Hedger	1.110
Firm size	1.222
Leverage	1.267
Profitability	1.054
Growth	1.276
R&D	1.224
Geographical diversification	1.407
Dividend	1.107
Crisis	1.008
Mean VIF	1.186

The pair-wise correlation of the variables is examined using Pearson correlation coefficients. Woolridge (2016, pp. 659-660) notes that the correlation analysis measures the linear relationship between the variables. The value ranges from -1 to +1. A value of -1 indicates a complete negative correlation, while a value of +1 indicates a complete positive correlation. A value of 0 implies that there is no correlation between the variables.

Table 7 presents the Pearson correlation for variables that are used in the multivariate regression as well as the p-values for those pairs of variables. The correlations range from -0.35 to 0.92 (both correlations are statistically significant at the 1% significance level). The highest correlation occurs between Tobin's Q and leverage; and the value of 0.92 suggests that there is a strong linear relationship between the pair of variables. Also, if a strong correlation exists between the dependent and independent variables, multicollinearity does not create problems here either and can largely be ignored.

Table 7. Pearson correlation coefficient matrix.

	Q	HEDGER	SIZE	LEVERAGE	PROFITABILITY	GROWTH	R&D	GEOG.DIV.	DIVIDEND	CRISIS
Q	1 ***									
HEDGER	0.156 ***	1 ***								
SIZE	0.103 ***	0.270 ***	1 ***							
LEVERAGE	0.922 ***	0.127 ***	0.074 ***	1 ***						
PROFITABILITY	-0.182 ***	0.054 **	0.012	-0.133 ***	1 ***					
GROWTH	-0.372 ***	0.013	0.176 ***	-0.351 ***	-0.001	1 ***				
R&D	-0.227 ***	-0.122 ***	-0.145 ***	-0.231 ***	-0.069 **	0.057 **	1 ***			
GEOG. DIVERSIFICATION	-0.001	0.052 *	0.071 ***	-0.036	0.115 ***	0.015	0.017	1 ***		
DIVIDEND	0.236 ***	0.166 ***	0.267 ***	0.167 ***	0.014	-0.201 ***	-0.351 ***	0.252 ***	1 ***	
CRISIS	0.015	-0.03	0.014	0.021	0.033	-0.009	0.007	-0.009	0.054 **	1 ***

***, **, and * indicate statistically significance at the 1%, 5% and 10% levels, respectively.

Table 7 also shows the following: at the 1% level, Tobin's Q has a significant correlation with every variable but geographical diversification and crisis. The correlation with hedgers, firm size, leverage, and dividend is positive and relatively low, except for leverage which has the highest correlation. At the 1% level, Tobin's Q also has a significant correlation with profitability, growth, and R&D, but the correlations are negative, implying lower firm valuations. It should be noted that these negative correlations are not in line with the literature suggestions.

Hedging has a positive and significant correlation with size, leverage, profitability, geographical diversification, and dividend. This suggests that bigger firms, firms with high leverage, firms that are profitable, multinational firms, and firms that pay dividends are more likely to hedge. Surprisingly, firms with high R&D tend to hedge less. It is also noteworthy to mention that there is a higher negative correlation between leverage and growth, as well as R&D and dividend. Those correlations are both significant at 1% level, and this suggests that firms that are more significantly levered may have fewer growth opportunities, and firms that have higher R&D may not pay as high dividends as those that have lower R&D.

After showing that the detected multicollinearity can be safely ignored according to both of the previous tests, univariate and multivariate tests can be performed. Those are presented in the following subsections.

5.2.2 Univariate analysis

In univariate analysis, the regression is conducted using only one explanatory variable, hedger. Other variables are excluded from this regression except for industry and time dummies that control the industry and time effect, respectively. As the regression only includes the main variable of the thesis, it allows examining the direct effect of hedging on Tobin's Q without taking the impact of other variables into account. In terms of firm value, this way it is easy to compare how hedgers succeeded compared to the non-hedgers. The formula used for the univariate regression is:

$$\ln(Q) = \beta_0 + \beta_1 HEDGER_{it} + u \tag{12}$$

As just noted, some industries may naturally have higher Tobin's Q values than others. Therefore, the univariate regression is also estimated for the industry-adjusted Tobin's Q. By constructing this test, it can be determined whether the hedging premium documented is due to derivatives use or industry specification. The industry-adjusted Tobin's Q is used according to the methodology described above, and the results are presented in Table 8 below.

5.2.3 Multivariate analysis

While the univariate analysis simply examines whether hedgers have higher firm value than non-hedgers, the multivariate analysis examines the relationship between hedging and firm value with other variables added to the regression and controlled for. These variables are size, leverage, profitability, investment growth, geographical diversification, and access to financial markets. The presentation of these variables is showcased in Table 3.

The data used in this thesis is balanced panel data. According to Woolridge (2016, p. 9), panel data uses the same cross-sectional units observed over multiple points in time. The main three types of panel data regressions are: (1) pooled OLS, (2) fixed effect, and (3) random effect models. As it is the simplest method to analyze balanced panel data, pooled OLS regression is first used in this thesis following Allayannis and Weston (2001). A pooled OLS is an OLS regression that pools the observations and ignores the panel data structure. This allows the sample to vary between the quarters, which is a good property with a sample with many cross-sectional units and relatively short time periods.

The regression model for pooled OLS regression is presented next. This regression examines the first hypothesis of this thesis. Similarly to the univariate regression, the dependent variable used is the natural logarithm of Tobin's Q, β_0 is the intercept, and u is the error term. In addition to the common explanatory variables previously detailed, industry effect and time effect dummies are added to the pooled OLS regressions. The regression is estimated for both the Tobin's Q and the industry-adjusted Tobin's Q.

$$\ln(Q)_{i,t} = \beta_0 + \beta_1 HEDGER_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 PROF_{i,t} + \beta_5 GROWTH_{i,t} + \beta_6 R\&D_{i,t} + \beta_7 GEOG_{i,t} + \beta_8 DIV_{i,t} + \beta_9 INDUSTRY + \beta_{10} TIME + u \tag{13}$$

The regression results are estimated with firm-level clustered robust standard errors. This improves the models but does not change the coefficient estimates. Woolridge (2016, pp. 320-321) notes that a limitation, however, with pooled OLS regression models often is that they might be autocorrelated. Autocorrelation can be controlled if the pooled OLS model is a long panel data that has a small number of cross-sectional units and a large number of time periods. However, the data sample of this thesis is a short panel data that consists of a large number of cross-sectional units and a quite small number of time periods, and therefore, autocorrelation may exist. To correct the autocorrelation problem and to strengthen the robustness of the thesis, a fixed effect regression is also conducted.

Woolridge (2016, pp. 436-439) also reminds that in addition to fixing the autocorrelation problem, the fixed effect model can correct multicollinearity and heteroskedasticity. The model is also a better fit for a sample with many cross-sectional units and a small number of time periods. The fixed effect model can capture time-constant unobserved factors that may affect the dependent variable, and thus the error term of the model only represents errors that vary across times. To capture those factors, all the variables need to be time-invariant and therefore industry effect dummy is excluded from this regression. Besides the removed industry effect dummy, the fixed effect model uses the same regression as the pooled OLS models. The results from the fixed effect model are presented in Table 10 below and are estimated for both of the dependent variables.

To examine the second hypothesis, where hedgers are hypothesized to perform better during the crisis time, all the variables are multiplied with a crisis dummy. This gives a chance to study the effect of hedging during the crisis period. The regression model for this is the same as the one presented above but only the observations during the crisis time are included. The regression is again estimated for Tobin's Q as well as for industry-adjusted Tobin's Q, and the results for pooled OLS and fixed effect regressions are presented in Table 11.

5.3 Results

This section starts by presenting the results from the univariate pooled OLS regression that only includes one variable in the regression, hedger. Later in the multivariate results part, control and dummy variables are added to the regression. First, the pooled OLS regression is estimated using both Tobin's Q and industry-adjusted Tobin's Q as the dependent variable. Later, the same dependent variables are estimated for the fixed effects model regression. This section ends with the results of hedging on firm value during the crisis. The results from these regressions are estimated using both dependent variables and both regression models.

5.3.1 Univariate results

The results from the univariate pooled OLS regression are presented below in Table 8. As a reminder, for model 1, the dependent variable is Tobin's Q, and for model 2, the dependent variable is industry-adjusted Tobin's Q; and the significance levels of the variables are denoted after the coefficients (and t-statistics are presented in parenthesis).

Table 8. Univariate pooled OLS regression results.

Variables	Tobin's Q (1)	Industry-adjusted Tobin's Q (2)
Constant	-0.740***	0.245***
	(-15.718)	*(5.158)*
Hedger	0.148***	0.142***
	(5.199)	*(4.955)*
Industry dummies	Yes	Yes
Time dummies	Yes	Yes
N	1318	1318
R^2	0.036	0.209

***, **, and * indicate statistically significance at the 1%, 5% and 10% levels, respectively.

Consisting with the value-increasing theory, in which the firms that hedge have a higher firm value measured by Tobin's Q, the results from the univariate pooled OLS regression show that hedgers have a positive and significant connection between hedging and Tobin's Q. In fact, hedgers have a 14.8% higher firm value compared to non-hedgers. Similar results apply when using the industry-adjusted Tobin's Q as the measure for firm value. Measured in this way, hedgers are rewarded with a 14.2% higher firm value than non-hedgers. This supports the notion that the hedging premium is real and not only due to a higher industry value. However, the R^2 s in the models are very low and therefore these models do not explain the effect too well. The R^2 values, however, seem to be low in other similar studies in terms of univariate analysis. For example, Luo and Wang (2018) find the R^2 to be 1.1% in their univariate analysis where Tobin's Q is the dependent variable. Regarding the R^2, the results from the multivariate regressions are expected to yield better results.

5.3.2 Multivariate results

Table 9 presents the results from the multivariate pooled OLS regression. Model 1 uses Tobin's Q as the dependent variable and is consistent with the thesis' hypothesis. The results show that hedging increases firm value by 3.4%. The results are statistically significant at a 1% level. This finding is consistent with, for example, the findings of Bartram et al. (2011), who find that hedging with derivatives increases firm value by 4.3%. The effect of firm size on firm value is low and the results are not significant. On the contrary, profitability and growth are both statistically significant at a 1% level, but, in turn, decrease the firm value. Predictably, leverage has a very large positive and significant effect on firm value as increasing the debt increases firm value. Dividend payment, against expectations, is found to positively affect firm value.

As the model explains 86.6% of the variation, the R^2 from this model, which is the model's goodness of fit measure, is very good compared to other similar studies. For example, Luo and Wang (2018) find the R^2 value in their model to be only 20.6% and Allayannis and Weston (2001) 73%.

Table 9. Multivariate pooled OLS regression results.

Variables	Tobin's Q (1)		Industry-adjusted Tobin's Q (2)	
Constant	-1.915	***	-0.917	***
	(-15.442)		(-7.404)	
Hedger	0.034	***	0.025	***
	(-3.927)		(-2.669)	
Size	0.006		0.004	
	(-1.183)		(-0.762)	
Leverage	1.946	***	1.920	***
	(34.797)		(-34.485)	
Profitability	-1.281	***	-1.487	***
	(-3.992)		(-4.512)	
Growth	-0.576	***	-0.571	***
	(-4.427)		(-4.308)	
R&D	0.016		-0.118	*
	(-0.331)		(-1.767)	
Geog. Diver.	0.047		0.082	**
	(-1.351)		(2.301)	
Dividend	0.074	***	0.106	***
	(-6.041)		(7.887)	
Industry dummies	Yes		Yes	
Time dummies	Yes		Yes	
N	1318		1318	
R^2	0.866		0.881	

***, **, and * indicate statistically significance at the 1%, 5% and 10% levels, respectively.

While the results above are controlled for from the industry effects with the use of industry dummies, that are based on the two-digit SIC code, a regression based on the use of industry-adjusted Tobin's Q as a dependent variable is also run to control for the possible value premium caused by certain industries. The results from this regression are presented in model 2 and are pretty similar to the previous results from model 1 (with the difference being that model 2 has more significant coefficients than model 1). According to these results, hedgers are rewarded with a 2.5% higher firm value compared to non-hedgers. This is slightly lower compared to the previous model. This might be because the industry-adjusted Tobin's Q captures only the pure effect of firm-specific factors and ignores the industry effect that might cause an increase in the value if a firm operates in a high-value industry. The only notable difference between the two models is that in model 2, profitability decreases the firm value slightly more and the sign of the R&D coefficient is negative as well as significant in this model. The R^2 in this model is also fractionally better (88.1%) and a lot higher compared to the value found by Allayannis and Weston (2001) regarding the use of industry-adjusted Tobin's Q as the dependent value (25%).

Although the main variable in the regression has the expected effect on firm value, many other independent variables seem to differ from the expected signs. The signs of the leverage, profitability, growth, and dividend coefficients in both models (and R&D in model 2) differ from the expectations presented in Table 3 and from the theory presented in previous literature.

The results from the fixed effect model regressions are presented in Table 10. Model 1 again shows the results with having Tobin's Q as the dependent variable and model 2 with having the industry-adjusted Tobin's Q as the dependent variable. The coefficient in model 1 regarding hedgers is similar to the one found with the pooled OLS regressions results. The positive and significant coefficient suggests that hedgers are rewarded with a 3.2% higher firm value compared to non-hedgers and thus hedging is value-enhancing. The other coefficients in this model are also similar to the ones estimated with the pooled OLS regression. Regarding Tobin's Q, these findings suggest that the model used, as even the R^2s in the models are almost identical, does not have a remarkable impact on the results.

Table 10. Multivariate Fixed effects model regression results.

Variables	Tobin's Q (1)		Industry-adjusted Tobin's Q (2)	
Constant	-1.916	***	-0.875	***
	(-15.310)		(-6.559)	
Hedger	0.032	***	0.062	***
	(-3.753)		(-4.642)	
Size	0.007		-0.031	***
	(-1.338)		(-4.447)	
Leverage	1.947	***	1.913	***
	-34.757		(31.198)	
Profitability	-1.286	***	-1.370	***
	(-4.007)		(-3.899)	
Growth	-0.568	***	-0.754	***
	(-4.314)		(-4.090)	
R&D	0.023		-0.275	**
	(-0.461)		(-2.080)	
Geographical diversification	0.040		0.234	***
	(-1.266)		(6.193)	
Dividend	0.068	***	0.246	***
	(-6.151)		(13.870)	
Industry dummies	No		No	
Time dummies	Yes		Yes	
N	1318		1318	
R^2	0.865		0.804	

***, **, and * indicate statistically significance at the 1%, 5% and 10% levels, respectively.

Regarding the industry-adjusted Tobin's Q results, the fixed effect regression is estimated in model 2. As the coefficient is found to increase the value by 6.2%, this model gives the highest firm value for hedgers and the result is statistically significant at a 1% level. Compared to other models, the coefficients estimated with this model have the highest significance levels as all of the variable estimates in the model are significant (and all are significant at the 1% level, except for R&D being significant at the 5% level). This model also continues the pattern of constants being statistically significant. However, even with the model having the best values in terms of statistical significance, it has the lowest R^2 value of all the multivariate models. Yet, it must be noted that the R^2 value is remarkably better compared to other similar studies. For example, Luo and

Wang (2018) find the R^2 to be only 22.3% or Allayannis and Weston (2001) find it to be as low as 4%.

The other notable difference of this model compared to the others is that the signs of the coefficients all differ from the expected signs, except for the geographical diversification variable, which matches the predicted value. Although all the models have had difficulties matching the coefficient signs with the expected signs, none of them differ from those as much as this model does. The coefficient signs that differ in this model compared to most of the others are size and R&D. In this model, size has a negative coefficient, suggesting that the larger the firm, the more it decreases firm value. Also, R&D is found to have a negative sign implying that the more a firm invests in R&D, the more the firm value suffers. This indicates that, on average, the R&D investments are not profitable. Regarding the industry-adjusted Tobin's Q, this finding is in line with the one found from the pooled OLS regression.

The effect of hedging on firm value is estimated in four different ways above (two different dependent variables and two different regression models). All of the results imply that hedging has a positive effect on firm value at 1% significance level. The hedging premium found ranges between 2.5%-6.2% depending on the model. Thus, the results suggest that the alternative hypothesis is accepted as hedging has a positive effect on firm value.

5.3.3 Value-effect during the bear market

As the primary question of this thesis relates to the value effect of hedging during the bear market caused by COVID-19 (also noted as the "crisis period"), this subsection showcases the results from this analysis. First, the results of the effect of hedging on firm value (*Q*) with the use of pooled OLS regression are presented. Second, the results from the same examination with the use of fixed effect model are shown. Third, the results from pooled OLS regression examining the effect with the use of industry-adjusted Tobin's Q as the dependent variable are presented. Finally, the previous examination is conducted with the use of fixed effect model.

The results from the effect of hedging on firm value (Q) during the crisis with the use of pooled OLS model are presented in Table 11. Model 1 presents the results during the crisis time which is the main focus of this examination. Model 2 shows the results from the previous section and the results are presented as a reference to be able to highlight the value effect during the crisis time. Model 3 presents the differences between the results.

Model 1 shows that during the crisis period, hedging increases firm value by 19.6%. The value-enhancing effect of hedging is economically significant and implies that during the bear market, firms that are engaging in hedging activities are protected against the value drop and survive better compared to the non-hedgers. Also, the effect is considerably higher during the crisis period compared to the whole period. The value-enhancing effect of hedging is 16.2 percentage points ("p.p.") higher during the crisis than the whole period suggesting that hedging is especially beneficial during a market downturn. However, the results are not statistically significant during the crisis period, and therefore the alternative hypothesis is rejected.

Table 11. Results from the effect of hedging on Tobin's Q during the crisis with the use of pooled OLS regression.

	Crisis	Whole period	
	Tobin's Q	**Tobin's Q**	**Difference**
Variables	(1)	(2)	(3) = (1)-(2)
Constant	-0.003	-1.915 ***	1.912
	(-1.609)	(-15.442)	
Hedger	0.196	0.034 ***	0.162
	(1.575)	(-3.927)	
Size	-0.124 ***	0.006	-0.130
	(-5.039)	(-1.183)	
Leverage	2.071 ***	1.946 ***	0.125
	(6.478)	(34.797)	
Profitability	-2.935	-1.281 ***	-1.654
	(-1.454)	(-3.992)	
Growth	0.150	-0.576 ***	0.726
	(0.256)	(-4.427)	
R&D	-0.012	0.016	-0.028
	(-0.021)	(-0.331)	
Geographical diversification	0.198 *	0.047	0.151
	(1.893)	(-1.351)	
Dividend	0.225	0.074 ***	0.151
	(1.402)	(-6.041)	
Industry dummies	Yes	Yes	
Time dummies	Yes	Yes	
N	28	1318	
R^2	0.907	0.866	

***, **, and * indicate statistically significance at the 1%, 5% and 10% levels, respectively.

Table 11 also shows that during the crisis period, firm size, profitability, and R&D have a negative effect on firm value. These findings differ from the results of the whole period as during the whole time period, only profitability has a negative effect on firm value of those three. The magnitude of profitability's decrease during the crisis period is significant and the difference in the decline is also enormous when compared to the whole period as the decline is 165.4 p.p. larger during the crisis. Conversely, leverage, growth, geographical diversification, and dividend payments have a positive effect on firm value during the crisis period. These findings are in line with the results from the whole period except for growth which is found to effect positively on firm value during crisis and negatively during the whole time period.

Table 12 introduces the results from the same examination but uses fixed effect regression model to estimate the results. With the use of this model, the effect of hedging during the crisis period increases firm value the same amount as it does in the previous model. However, when comparing the crisis period to the whole period, the effect of hedging during the crisis is higher in this model due to the lower value of hedging during the whole period. The results confirm the benefits of hedging during crisis. As the results in this model also suggest that hedging may have saved the firms from the value drop that occurred in the first quarter of 2020, the results regarding hedging during the crisis are not statistically significant here either. This might be due to the limitation of the data regarding the number of observations during the crisis period. Therefore, further studies with a potentially higher number of observations are needed to verify the findings.

The results regarding the other variables in this model are similar to the previous model in terms of signs and magnitudes of coefficients. Also in this model, size, leverage, and geographical diversification remain the only independent variables that are statistically significant at some level. Also, the R^2 in this model is almost identical to the previous model. The same applies to the differences in coefficients during the crisis and whole time periods. These findings suggest that the model used to examine the effect of hedging during the crisis period does not matter.

The R^2 values in both regression models examining the effect of hedging on Tobin's Q during the crisis are really high (90.7% and 90.6%). They are also significantly high when compared to the other studies that examine the effect during different crises. For example, Luo and Wang (2018) find an R^2 value to be 22.4% in their study of the effect of currency derivatives on firm value during the financial crisis. Similarly, Panaretou (2014) finds an R^2 of 26.2% in the study of currency derivatives during the financial crisis.

Table 12. Results from the effect of hedging on Tobin's Q during the crisis with the use of fixed effect regression.

Variables	Crisis Tobin's Q (1)		Whole period Tobin's Q (2)		Difference (3) = (1)-(2)
Constant	0.000	***	-1.916	***	1.916
	(-34.570)		(-15.310)		
Hedger	0.196		0.032	***	0.164
	(1.572)		(-3.753)		
Size	-0.124	***	0.007		-0.131
	(-5.035)		(-1.338)		
Leverage	2.069	***	1.947	***	0.122
	(6.476)		-34.757		
Profitability	-2.948		-1.286	***	-1.662
	(-1.456)		(-4.007)		
Growth	0.141		-0.568	***	0.709
	(0.242)		(-4.314)		
R&D	-0.004		0.023		-0.027
	(-0.007)		(-0.461)		
Geographical diversification	0.196	*	0.040		0.156
	(1.879)		(-1.266)		
Dividend	0.224		0.068	***	0.156
	(1.398)		(-6.151)		
Industry dummies	No		No		
Time dummies	Yes		Yes		
N	28		1318		
R^2	0.906		0.865		

***, **, and * indicate statistically significance at the 1%, 5% and 10% levels, respectively.

Table 13 presents the results of hedging on firm value by using industry-adjusted Tobin's Q as the dependent variable (which controls the possible value premium caused by certain industries). The table continues the similar pattern where model 1 presents the results during the crisis period, model 2 during the whole period for comparison, and model 3 highlights the differences between the coefficients.

Model 1 in Table 13 shows that firms that use hedging during the bear market caused by COVID-19 are rewarded with 15.2% higher firm value compared to non-hedgers. The value premium is lower compared to the previous models where Tobin's Q was used as the dependent variable. This might be due to the controlling of the possible industry value premium as in this model, the value is purely due to hedging and the industry in which the firm operates does not affect the value of the firm. The results also suggest that hedging is less beneficial during the crisis compared to whole period, but still, the benefit is quite large (12.7 p.p.).

Table 13. Results from the effect of hedging on industry-adjusted Tobin's Q during the crisis with the use of pooled OLS regression.

	Crisis		Whole period		
	Industry-adjusted Q		**Industry-adjusted Q**		**Difference**
Variables	(1)		(2)		(3) = (1)-(2)
Constant	0.003		-0.917	***	0.92
	(-1.454)		(-7.404)		
Hedger	0.152		0.025	***	0.127
	-(1.465)		(-2.669)		
Size	-0.105	***	0.004		-0.109
	(-5.578)		(-0.762)		
Leverage	2.203	***	1.920	***	0.283
	(8.627)		(-34.485)		
Profitability	-1.590		-1.487	***	-0.103
	(-0.942)		(-4.512)		
Growth	1.040	*	-0.571	***	1.611
	(1.880)		(-4.308)		
R&D	-1.038	*	-0.118	*	-0.92
	(-1.838)		(-1.767)		
Geographical diversification	0.449	***	0.082	**	0.367
	(3.939)		(2.301)		
Dividend	0.300	**	0.106	***	0.194
	(2.003)		(7.887)		
Industry dummies	Yes		Yes		
Time dummies	Yes		Yes		
N	28		1318		
R^2	0.860		0.881		

***, **, and * indicate statistically significance at the 1%, 5% and 10% levels, respectively.

The signs of the coefficients in this model are similar to the signs in the previous models, but the magnitudes of the coefficients differ in this model compared to the previous ones. For example, profitability has a lower negative effect on firm value in this model where the industry-adjusted Tobin's Q is used as the dependent variable and also, the difference between the crisis and whole time period is smaller. Growth has a remarkably higher effect on firm value during the crisis in this model and the difference enlarges in this model as well. R&D has a higher negative effect on firm value in this model and the difference is notable between the crisis and whole periods as well. Lastly, geographical diversification has a higher positive effect on firm value in this model compared to the previous models and the gap between the different time periods is also higher.

Another notable thing regarding this model is that there are more statistically significant coefficients in this model. Whereas in the previous models, only size, leverage, and geographical diversification are statistically significant, here also growth, R&D, and dividend have statistically significant coefficients. However, similar to the previous results, hedging is not statistically significant in this model either and therefore, the second alternative hypothesis is still rejected.

Finally, Table 14 presents the results of hedging on firm value using industry-adjusted Tobin's Q as the dependent variable and fixed effect model as the regression model. Model 1 shows that hedging increases firm value by 15.2% which is consistent with the results of the previous model. However, the value premium during the crisis is smaller when compared to the whole period in this model. This is due to the higher effect of hedging on firm value during the whole time period. The result in this model regarding the value premium of hedging is not statistically significant either, confirming that more studies are needed to verify the value-enhancing effect of hedging on firm value during a crisis.

The signs and magnitudes of the coefficients in this model are similar to the previous model. Also, there is no remarkable disparity between this model's and the previous model's differences between the crisis and whole time periods. In addition, the R^2s in the models are identical. These findings confirm again that the model chosen does not affect the results.

Table 14. Results from the effect of hedging on industry-adjusted Tobin's Q during the crisis with the use of fixed effect model regression.

Variables	Crisis **Industry-adjusted Q** (1)	Whole period **Industry-adjusted Q** (2)	**Difference** (3) = (1)-(2)
Constant	-0.000 ***	-0.875 ***	0.875
	(-29.728)	(-6.559)	
Hedger	0.152	0.062 ***	0.090
	(1.463)	(-4.642)	
Size	-0.105 ***	-0.031 ***	-0.074
	(-5.599)	(-4.447)	
Leverage	2.205 ***	1.913 ***	0.292
	(8.651)	(31.198)	
Profitability	-1.579	-1.370 ***	-0.209
	(-0.935)	(-3.899)	
Growth	1.047 *	-0.754 ***	1.801
	(1.897)	(-4.090)	
R&D	-1.045 *	-0.275 **	-0.770
	(-1.842)	(-2.080)	
Geographical diversification	0.450 ***	0.234 ***	0.216
	(3.954)	(6.193)	
Dividend	0.300 **	0.246 ***	0.054
	(2.006)	(13.870)	
Industry dummies	No	No	
Time dummies	Yes	Yes	
N	28	1318	
R^2	0.860	0.804	

***, **, and * indicate statistically significance at the 1%, 5% and 10% levels, respectively.

The effect of hedging on firm value during the bear market caused by COVID-19 is examined above using four different methods. The results suggest that during the market crash, hedging increased firm value and helped the hedging firms to protect against the market decline. The hedging premium found is 19.6% when measured with Tobin's Q as the dependent variable and 15.2% with industry-adjusted Tobin's Q as the dependent variable. These results are in line with the findings of Bartram et al. (2011), Ahmed et al. (2020), and Luo and Wang (2018), who find hedging to be beneficial during market downturns.

The results also show that the hedging premium found is remarkably bigger during the bear market, suggesting that hedging is especially beneficial then. These results should be considered in the future in terms of protection against sudden market declines. However, even as the results suggest such a high value premium, the results regarding any of the four models are not significant, and therefore the alternative hypothesis is rejected.

6 Conclusions

This thesis examines the effect of hedging on firm value. To study this, a sample of 1318 firm-quarter observations of U.S. non-financial firms listed in the S&P 500 Index between 2015 and 2020 is used. The main purpose of this thesis is to examine the effect of hedging on firm value during the recent bear market and provide answers regarding whether hedgers are rewarded with a higher firm value during the market decline, and whether hedging offered a shelter against the sudden market crash.

Since Allayannis and Weston's (2001) pioneer study of the topic, many other studies have emerged with different research focuses (e.g., examining the effect in different industries, countries, or with different derivatives). However, as hedging is found to affect firm value positively, negatively, and not at all, the results remain mixed. Interestingly, the topic area has been widely examined yet one aspect remains relatively unstudied: does the economic cycle affect hedging results? Therefore, the motivation of this thesis is to bring a new aspect to the literature and examine the effect during the bear market caused by COVID-19.

Using Tobin's Q as a proxy for firm value, this study is conducted using a pooled OLS regression model to analyze panel data. In addition, an alternative measure for firm value (industry-adjusted Tobin's Q) and an alternative econometric method (fixed effect regression model) are adopted to check the robustness of the results. Following Allayannis and Weston (2001), to get the direct effect from hedging, the results are first examined with univariate analysis and then with multivariate analysis, where other independent variables are added to the regression.

First, the results from the univariate analysis reveal that hedging increases Tobin's Q by 14.8%. In addition, the hedging premium is found to be 14.2% when measured by an industry-adjusted Tobin's Q. Both results are statistically significant at the 1% level. However, even as the univariate analysis suggests that hedgers have a higher firm value compared to non-hedgers, it provides a very simplified view. Therefore, a multivariate analysis is conducted to confirm the effect and provide more reliable results.

In the multivariate analysis other independent variables that also affect firm value are added to the regression. These variables include size, leverage, profitability, growth, R&D, geographical diversification, and dividend. The multivariate results also support the first alternative hypothesis in which hedging increases firm value. The results suggest that hedging increases firm value by 3.4%. As the hedging premium varies between 2.5% and 6.2% when measured using industry-adjusted Tobin’s Q (i.e., as the proxy for firm value) and with the other regression model (the fixed effect model), the result is also robust to the other measures of the effect; and those results are statistically significant at a 1% level. Furthermore, the results are in line with the theory that suggests hedging to be value-enhancing. The results are also in line, e.g., with Carter et al. (2006), who find a positive value effect using a sample of U.S. airline companies that hedge commodity risk and contrast with the findings of Naito and Laux (2011), who use a similar sample as this thesis but perform their analysis on an earlier time-period (i.e., during 2011).

The main focus of the thesis is to examine the effect of hedging on firm value during the bear market caused by COVID-19, and to do that, a crisis dummy is added to the regressions to measure the effect during the crisis time. The results imply that hedgers have a higher firm value compared to non-hedgers by 19.6% (i.e., when measured by using Tobin’s Q as a proxy for firm value). When using industry-adjusted Tobin’s Q as a proxy for firm value, the hedgers are rewarded with a 15.2% higher firm value compared to non-hedgers. As it removes the value effect that some industries naturally have, this premium is a bit smaller. Regarding each of the dependent variables, both of the regression models (i.e., the pooled OLS and fixed effect models) provide the same results. This implies that the regression model used does not matter. The value-increasing effect found for hedgers during the crisis period is significantly higher compared to the value premium found for hedgers during the entire sample period. This suggests that hedging is found to be beneficial in terms of firm value during the whole sample period and the effect is emphasized during the economywide decline. The results are also in line with e.g., the findings of Bartram et al. (2011) who find a value-enhancing effect for hedging during the dot-com bubble, although the value premium found is lower than found in this thesis.

The results during the COVID-19 crisis are economically significant. This suggests that during the crisis hedging is beneficial as hedgers, in terms of firm value, succeed more compared to non-hedgers. Also, hedging can provide shelter against sudden market value drops. This is important information for firm managers who are considering using derivatives for hedging and looking to increase their firm value. However, none of the results during the crisis are statistically significant, and therefore, these findings should be interpreted with caution and more studies with possibly a larger data set are needed to confirm the findings. Also, as the results lack in statistical significance, the second alternative hypothesis is rejected (i.e., although the result was positive, it cannot with confidence be concluded that hedging during the recent bear market had a positive effect on firm value).

This thesis examines the effect of hedging on firm value during the recent bear market caused by COVID-19. To my knowledge, this is the first study that examines that effect during this crisis and therefore contributes to the literature for the following two topics: (1) the effect of hedging on firm value, and (2) research regarding COVID-19 (which is the current hot topic in the literature). In addition to being a current and trending topic, this thesis contributes to the previous literature by providing answers regarding whether hedging can increase firm value and protect against sudden market crashes in the future. Additionally, this thesis provides important information for firm managers and policymakers regarding the benefits of the use of derivatives for hedging.

The thesis has some limitations. First, the classification between hedgers and non-hedgers is based on hedging accounts instead of hand collecting that information. This method might reduce the accuracy of classification as well as the correctness of defining derivative users as hedgers (i.e., whereas the firms could be using the derivatives for speculative or arbitrageur purposes instead). Second, as three independent variables (growth, R&D, and geographical diversification) have many missing observations, many rows are dropped to balance the data. This reduces the number of firm-quarter observations remarkably. Third, none of the crisis regression results are statistically significant, so the value-enhancing effect is not fully confirmed. This is most probably related to the second limitation (i.e., as reducing the rows drops the number of observations during the crisis from 411 to 28).

Finally, for future research, there are several aspects that could be examined. First, it would be interesting to examine what level of hedging generates the value effect. Whereas this thesis only studies the effect between hedgers and non-hedgers, and does not include the amount that is hedged, it would be fascinating to find out the exact level that generates the effect. Second, the post-crisis period could be examined to find whether hedging increases firm value then. Third, it would be interesting to study whether the recent bear market has changed the firms' hedging behavior. Fourth, the value effect of hedging could be examined by comparing the effect in different industries. As COVID-19 has had a negative impact for most of the industries, a few industries have clearly benefitted from the crisis. Thus, a comparison between hedging in different industries could be executed. Finally, as Ahmed et al. (2020) find during the financial crisis, hedging is only beneficial when hedging foreign currency risk; it could be examined whether the same results hold during the COVID-19 crisis, and additionally whether the risk hedged or the derivative type used matters during that period.

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