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Does hedging with derivatives create firm value?

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Abstract

This paper studies the impact derivative hedging has on firm value and whether the relationship is affected by differences in cash holdings. We use hand-collected data for 171 Swedish firms from various industries during the period 2016-2021 to examine the relationship. Using a multivariate regression approach with Tobin's Q as a proxy for firm value, we find that firms using derivatives are associated with higher firm value. Furthermore, the result shows a positive and significant effect for foreign exchange hedging but negative and insignificant effects for interest rate and commodity hedging. This suggests that the effect of hedging is highly dependent on the risk hedged. Finally, this study finds no evidence for the hypothesis that cash holdings moderate the effect derivative hedging has on firm value. The results obtained in this study contribute both to the previous literature on derivative hedging and the literature about the integrated management of cash holdings and derivatives.

Keywords: Corporate Risk Management, Hedging, Cash Holdings, Derivatives, Firm Value

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1. Introduction

This chapter begins by introducing the background of corporate risk management and the research topic of how derivatives affect firm value. Subsequently, the aim and research question formulated for this thesis is presented. At the end of this chapter, the structure of this thesis is outlined.

1.1 Background

In the last decades, the world has faced both financial and economic crisis that has shed light on the importance of corporate risk management. Mitigation of low-tail outcomes is argued by Stulz (1996) to be the main purpose of risk management. However, more recently it has been suggested that risk management has evolved beyond its traditional focus on risk mitigation into value creation (Ahmed et al., 2014). The prerequisite for risk management to create value is that there exist some market imperfections like external financing costs. Risk management can then increase firm value by reducing the probability of incurring external financing costs.

In a world with perfect capital markets as assumed by Modigliani and Miller (1958), risk management would be irrelevant. Without taxes, transaction costs, bankruptcy costs and external financing costs in place of asymmetric information, using derivatives to hedge financial risk will not add any value to the firm since investors can replicate or undo the firm's risk management decisions at a similar cost. However, in the real world, firms are exposed to a variety of frictions in the market. By relaxing some of the assumptions in the Modigliani and Miller theorem (M&M), the use of hedging strategies can be argued to add firm value. The main motives for risk management being value enhancing relates to financial distress (Smith & Stulz, 1985), tax incentives (Smith & Stulz, 1985; Leland, 1998), and underinvestment problems (Froot, Scharfstein & Stein, 1993). Another motivation for risk management could be agency problems related to management's incentive to hedge (DeMarzo & Duffie, 1995).

The broad notion of risk management can involve tools such as derivatives, precautionary cash, insurance contracts and operational hedges such as geographical diversification. Previous studies on how risk management impact firm value has mostly focused on hedging with derivatives. The empirical evidence of how hedging with derivatives affects firm value is however mixed. For example, studies by Allayannis and Weston (2001), Graham and Rogers (2002), and Carter, Rogers, and Simkins (2006) find evidence that hedging with derivatives has a positive effect on firm value. In contradiction to these studies, Guay and Kothari (2003), Jin and Jorion (2006), and Lookman (2009) find no evidence that hedging with derivatives increases firm value. The mixed evidence showcases the need for further studies regarding the relationship between derivatives and firm value.

As noted earlier derivatives is not the only risk management tool, Bates, Kahle, and Stulz (2009), provide empirical evidence that precautionary cash holdings could be used as a risk management tool. Furthermore, Haushalter, Klasa, and Maxwell (2007) argue that cash holdings could mitigate the problem of underinvestment comparable to the use of derivatives. The description by Bates et al. (2009) and Haushaler et al. (2007) highlights the relevance of studying cash holdings and derivatives simultaneously. The existing empirical studies have focused on the impact derivatives have on corporate cash policies (Opler et al. 1999; Disatnik, Dunchin, & Schmidt, 2014; Sun, Yin, & Zeng 2022). Apart from the empirical studies, Gamba and Triantis (2014) conducted a theoretical study with a dynamic model that incorporated liquidity management and derivative hedging. However, to the best of our knowledge, no empirical studies have examined how cash holdings moderate the effect derivative hedging has on firm value. Hence, this paper contributes to the literature by examining the integrated management of cash holdings and derivatives in relation to firm value.

Furthermore, this study stands apart from the majority of previous studies by categorising the type of risk hedged (foreign exchange rate, interest rate and commodity prices). Categorising the type of risk is of interest since Jin and Jorion (2006) highlight that foreign exchange risk differs from commodity risk exposure. They describe how it is easier for an outside investor to identify and hedge commodity risk relative to foreign exchange risk. Hence, commodity hedging is closer to the setting in the M&M theorem that would make risk management irrelevant for firms. Necessary firm-level data on hedging activities are not easily obtained since it needs to be hand-collected and relies heavily on the accessibility that is determined by country-specific laws. Our data sample consists of 171 Swedish firms listed on the Swedish Stock Exchange over the period 2016-2021. Swedish firms are required to disclose risk exposures and if they use any derivatives to mitigate those risks. This allows us to get detailed information on firms' derivative usage. The data are primarily analysed using a multivariate regression analysis with Tobin's Q as a proxy for firm value. The results from the regression models show that firms using derivatives are associated with higher firm value and that the effect differs between the risk categories.

1.2 Aim and Research Question

This study aims to contribute to the existing literature on how hedging with derivatives affects firm value. The empirical results in previous studies have not been able to reach a consensus about the relationship between derivatives and firm value (Allayannis & Weston, 2001; Jin & Jorion, 2006). The mixed results highlight the need for further research in the field. This study will also aim to extend the knowledge about how cash holdings moderate the effect derivatives have on firm value. The effect derivatives have on cash holdings is a relationship that has received a lot of attention in academia (Opler et al., 1999; Haushalter, Klasa & Maxwell, 2007, Sun, Yin & Zeng, 2022). The integrated management of cash holdings and derivatives has however to a large extent been neglected in earlier studies about how derivatives affect firm value. Based on the aim of this study, the following research question has been formulated.

Does hedging with derivatives create firm value, and is this relationship affected by differences in cash holdings?

1.3 Outline of the Thesis

The remainder of this study is outlined in the following way. Section 2 will present relevant theories and previous literature on how hedging activities could affect firm value. It will also provide the reader with the hypotheses developed for this study. Section 3 will describe the data collection and present the variables used. Furthermore, the section will also cover the empirical models and the econometric approach implemented. Section 4 will present the analysis of the empirical results obtained as well as robustness tests. Lastly, section 5 provides the conclusions of the results and suggestions for future studies.

2. Theories and Literature Review

This chapter aims to provide an overview of the general theories related to the value implications of hedging with derivatives. Beginning with the classic Modigliani and Miller theorem that showcases the irrelevance of hedging under certain assumptions. Theron, the main explanations related to financial distress, tax incentives and underinvestment problems are presented. The theories together with the literature review will lay the foundation for the hypothesis outlined at the end of the chapter.

2.1 The Modigliani and Miller Theorem

The use of derivatives as a risk management tool and how it impacts firm value has been a highly debated topic in the corporate finance literature. The seminal work of Modigliani and Miller (1958) has contributed with a central pillar to this topic. The Modigliani and Miller theorem (M&M) proposes that under certain assumptions related to perfect capital markets, the firm value is not affected by how the firm decides to finance its operations. If the firm uses debt, equity or retained earnings to finance investments holds no relevance to the creation of firm value.

According to Modigliani and Miller (1958), firm value is solely created on the left side of the balance sheet when a firm makes good investments that produce operating cash flow. Thus, the firm's value is independent of the firm's choice of capital structure. In order for the proposition proposed by M&M to hold, it is necessary to assume the existence of perfect capital markets without taxes, transaction costs, bankruptcy costs, or asymmetric information. Moreover, all market participants are assumed to share homogenous expectations, and that atomistic competition exists in the market. This aligns with the findings of Fama (1978), which demonstrate that under these assumptions, the market value of a firm is not affected by its capital structure.

Given that the M&M assumptions hold, no firm would engage in hedging activities, as it would not add any value to the firm. In the context of perfect capital markets, it is possible for investors to replicate a firm's risk management decisions themselves by diversifying their portfolio and hedging their position at a similar cost. This implies that there would be no need for firms to hedge financial risks (Bessler, Conlon, & Huan, 2019). Under perfect capital market assumptions, the net present value of a firm's investment would be unaffected by the inclusion of fairly priced derivatives. Thus, for hedging activities to affect firm value, market imperfections must exist either through taxes, contracting costs, or external financing costs (Smith and Stulz, 1985).

2.2 Financial Distress Costs

Financial distress costs are argued to be one explanation for why hedging could be a value creating activity (Mayers & Smith, 1982; Smith & Stulz, 1985). Hedging can reduce the expected financial distress costs by reducing the variance of the firm value and therefore have a lower probability of encountering financial distress (Nance, Smith & Smithson, 1993). The benefits of hedging can be demonstrated by a simple model presented by Smith and Stulz (1985). First, consider the difference in firm value between a levered and an unlevered firm. Assume there exist S states of the world, where the firm value before taxes V_i is ordered such that if $V_i \leq V_j$ then $i < j$. The state price is denoted P_i, which is the value today of one dollar delivered in state i. The tax rate is $T(V_i)$, given that the firm value before taxes is V_i. The after-tax value of the unlevered firm is $V(0)$. Suppose the levered firm's debt is a zero-coupon bond with face value F. The after-tax value of the levered firm is $V(F)$. Assume that $V_j < F < V_k$, and that bankruptcy costs are given by $C(V_i) \leq V_i$ when $V_i < F$.

$$V(F) - V(0) = \sum_{i=1}^{j} P_i \left(T(V_i)V_i - C(V_i)\right) + \sum_{i=k}^{S} P_i T(V_i) F \quad (1)$$

Equation (1) shows how the value of the levered firm is equal to the unlevered firm plus the present value of the tax shield from debt minus the present value of bankruptcy costs. Hence, lower expected bankruptcy costs will increase the firm value. To see the effect of hedging, suppose that a firm can reduce bankruptcy costs by holding a portfolio of derivatives that have a positive payoff in states where it otherwise would have been in bankruptcy given no hedging. Assume how the firm would have been in bankruptcy in state g without hedging $V_g < F$, but including the hedge portfolio would lead to $V_g + H_g > F$ and $V_m + H_m > 0$. Further assume that the hedge portfolio is self-financed such that $P_g H_g + P_m H_m = 0$, and a constant tax rate T. If $V^H(F)$ is the value of a levered firm that hedges, we then have the effect of hedging given by equation (2).

$$V^H(F) - V(F) = P_g C\left(V_g\right) + P_g T(F - V_g) \quad (2)$$

Equation (2) shows how the hedge reduces the present value of bankruptcy costs and increases the present value of the tax shield. Given the assumptions, the effect of hedging is always positive since $C(V_g) > 0$ and $F > V_g$.

2.3 Tax Incentives for Hedging

Tax incentives are a second theoretical argument for why hedging could increase firm value. Hedging can reduce the expected tax payments if the firm's effective tax schedule is convex (Mayers & Smith, 1982; Smith & Stulz, 1985). With the same notation as previously Smith and Stulz (1985) show how costless hedging increases the firm value. The value of an unlevered firm is given by equation (3).

$$V(0) = \sum_{i=1}^{S} P_i(V_i - T(V_i)V_i) \tag{3}$$

Hedging can reduce expected taxes if there exist two states j and k, such that firm value before-taxes are $V_j < V_k$ and the tax rates are $T(V_j) < T(V_k)$. Assume the firm holds a self-financed hedge portfolio $P_j H_j + P_k H_k = 0$ and that $V_j + H_j = V_k + H_k$. The effect of hedging is given by equation (4).

$$\begin{aligned} V^H(0) - V(0) = {} & P_j\left(T(V_j)V_j - T(V_j + H_j)(V_j + H_j)\right) \\ & + P_k\left(T(V_k)V_k - T(V_k + H_k)(V_k + H_k)\right) > 0 \end{aligned} \tag{4}$$

The positive effect of hedging is implied by Jensen's inequality and that the post-tax firm value is a concave function of the pre-tax firm value since the tax rate increases with firm value. Another implication of taxes is how Leland (1998) shows that hedging could increase the firm's debt capacity, and therefore enable the firm to utilize a larger and more valuable debt tax shield.

2.4 Underinvestment and Cash Holdings

Underinvestment problems are a third theoretical argument for why firms may benefit from hedging (Bessembinder, 1991; Froot et al., 1993). In perfect capital markets such as in Modigliani and Miller (1958), investment decisions are independent of financing decisions such that the Fisher separation theorem holds (Fisher, 1930). However, in reality, firms may face costs associated with external financing due to information asymmetries which can affect their investment decisions. Fazzari et al. (1988) show that external financing is not a perfect substitute for internal finance. A consequence of the costs associated with external financing may be that firms pass up investment opportunities with positive NPV (Myers & Majluf, 1984). Myers (1977) further shows how issuing more senior claims than equity can create incentives for shareholders to underinvest. Froot et al. (1993) describe how hedging can mitigate the underinvestment problem and create value when external financing is more costly than internal finance. The logic is that hedging can redistribute internal funds between different states of nature, in such a way that the cash flow and investment opportunities match better to avoid the need for costly external finance.

Gay and Nam (1998) find support for that firms' use of derivatives is partly driven by avoiding potential underinvestment problems. Haushalter et al. (2007) describe how cash holdings could mitigate underinvestment problems similar to the use of derivatives. How cash holdings moderate the effect derivatives have on firm value is expected to depend on whether cash holdings and derivatives are substitutes or complements. If they are substitutes one would expect that the benefits from hedging with derivatives will be smaller for firms with relatively more cash holdings. Previous studies by Haushalter et al. (2007), Choi et al. (2020) and Sun, Yin and Zeng (2022) find evidence for a substitute relationship between derivatives and cash holdings. In contradiction, the results found by Bolton, Chen, and Wang (2011) and by Opler et al. (1999) suggest that there is a complementary relationship between cash holdings and derivatives usage. The model by Rampini and Viswanathan (2010) can provide a rationale for the complementary relationship. It showed that there exists a trade-off between financing and risk management since both involve future payments that are limited by collateral. Thus, firms that are more financially constrained will hedge less since financing needs override hedging concerns. A positive relationship between cash holdings and derivatives usage may be explained by that firms will need cash for margin requirements when hedging with derivatives. However, Disatnik, Dunchin and Schmidt (2014) found no relationship between overall hedging with derivatives and corporate liquidity policies.

Gamba and Triantis (2014) contribute to the literature with a dynamic model of the interaction between cash holdings and derivatives. The implications of their model show that the incremental value of derivative hedging lies between 0 and 4% of firm value when the firm has cash holdings. The incremental value is however larger when the firm holds no cash, which supports the idea of a substitute relationship between cash holdings and derivatives.

2.5 Literature Review

The empirical evidence of how hedging affects firm value is described to be mixed according to Bachiller et al. (2021). Allayannis and Weston (2001) investigated U.S non-financial firms with exposure to foreign exchange rates during a sample period between 1990-1995 and found an average hedging premium of 4.87%. In addition to this, they found that firms that begin hedging exhibit an increase in firm value relative to firms that do not use derivatives. In the same way, firms that quit hedging are found to exhibit a decrease in firm value, indicating a causal interpretation of the hedging premium. Similar results are reported by Allayannis, Lel and Miller (2012) that emphasise the impact corporate governance has on the hedging premium. Graham and Rogers (2002) argue that increased debt capacity due to hedging adds approximately 1.1% to firm value. Another paper that finds evidence that hedging creates firm value is Carter, Rogers and Simkins (2006), which investigates hedging of jet fuel in the U.S airline industry.

Guay and Kothari (2003) question the positive effect of derivatives found by Allayannis and Weston (2001). They argue that potential gains from derivatives are too small to explain the magnitude of the hedging premium claimed by Allayannis and Weston (2001), and that the results might be spurious and driven by operational hedges that correlate with derivative usages. Both Jin and Jorion (2006) and Lookman (2009) investigate oil and gas producers and find no effect of hedging on firm value. Jin and Jorion (2006) highlight that commodity risk is easier to identify and hedge for an outside investor compared to foreign exchange risk. In this manner, commodity hedging is closer to the setting in the Modigliani and Miller theorem (M&M) that would make risk management irrelevant. There also exist papers that find how hedging in the presence of agency problems can decrease firm value (Hagelin et al., 2007; Fauver & Naranjo, 2010). Hagelin et al. (2007) investigate Swedish firms' hedging of foreign exchange exposure between 1997 and 2001. However, the results of Hagelin et al. (2007) show that the overall effect of foreign exchange hedging is positive for firm value.

The findings by Hagelin et al. (2007) are supported by Pramborg (2004) and Jankensgård (2015) that also find a positive effect of foreign exchange hedging for Swedish firms. In contrast, Belghitar, Clark and Mefteh (2013) find no evidence of value creation from foreign exchange hedging in a sample of French firms. For a sample of UK firms, Ahmed et al. (2014)

finds a positive effect on firm value from foreign exchange hedging but a negative effect from interest rate hedging.

2.6 Hypotheses

In the model by Froot et al. (1993), the usage of derivatives to hedge risks is argued to lower the firm's cash flow volatility and in turn preserve the internal capital. The preserved capital could then mitigate the problem of underinvestment. The value of hedging activities then arises when external financing is more expensive than internal financing. Gay and Nam (1998) find support for that firms hedge in response to mitigate the underinvestment problem. In addition to this, the model by Smith and Stulz (1985) provides theoretical arguments for how hedging can increase firm value by reducing financial distress costs and tax payments. A logical implementation of the Froot et al. (1993) and Smith and Stulz (1985) models is thus that we expect a positive relation between derivative hedging and firm value. Hence, the first hypothesis in this study is as follows:

Hypothesis 1. *Firm value is positively related to hedging using derivatives.*

According to Haushalter et al. (2007), cash holdings could mitigate the underinvestment problem similar to derivatives. If cash holdings and derivatives provide the same benefits, they would be substitutes such that firms with more cash would have a lower need for hedging with derivatives. The results by Choi et al. (2020) and Sun et al. (2022) suggest that a substitute relationship exists between derivatives and cash holdings. A substitute relationship would thus intuitively translate into that hedging with derivatives would have a lower effect on firm value for firms with higher cash holdings and vice versa. Thus, the second hypothesis is as follows:

Hypothesis 2. *Higher cash holdings weaken the relation between derivative hedging and firm value.*

3. Data and Methodology

This chapter begins by describing the sample and the data collection process. Thereafter, the definitions of the variables used in the regressions are described. Then the empirical models used for testing the hypothesis are outlined. Lastly, a discussion related to the estimation of the empirical models and corrections for econometric issues is presented.

3.1 Financial Data

Over a sample period from 2016 to 2021, firm-specific derivative usage is obtained for 171 Swedish companies from each firm's annual report. Initially, all 394 firms listed on the OMX Stockholm PI index were collected, thereafter financial service firms were excluded from the sample since the majority of those firms are market makers and consequently their reasons for using derivatives may be different from the reasons for non-financial firms. Following that, firms operating in the utility industry were also excluded from the sample since the utility industry is heavily regulated. The data for the calculation of the dependent and control variables are obtained from Bloomberg and are further described in section 3.2. Firms with incomplete data were excluded from the sample. Leading to a final sample of 171 firms and a total of 1026 firm-year observations. The sample is divided according to the Global Industry Classification Standard (GICS) with 11 industry groups. Since financial and utility firms are excluded from the study and no firm in the sample belongs to the Energy industry, we are left with eight industry groups.

For each year in our sample, we categorise each firm's derivative usage across foreign exchange, interest rate and commodity derivatives. This information is disclosed in the annual reports under the "Financial Instruments" and "Risk Management" sections since Swedish firms are required by law to disclose the usage of derivative instruments. To find the information of interest, we applied a keyword system and searched for the following words "derivatives", "hedge", "forward contract", "future contract", "currency risk", "interest rate risk", "commodity risk", and "swaps". If a firm explicitly disclosed that they do not use any derivatives or that the keyword system did not find any result, the firm is classified as a non-hedger for that year. However, if a keyword was found, the context around the keyword was carefully examined before classifying the firm as a hedger for that year. Moreover, firms that used derivatives also disclosed that they used them for hedging purposes and not for speculative activities. Hence, this indicates that our results are a consequence of hedging activities and not a consequence of speculative usage.

3.2 Definition of Variables

This section begins by describing how the dependent variable *firm value* is constructed, and how the independent variables including derivative usage and cash holdings are measured. To infer the marginal effect of hedging with derivatives on firm value, it is important to control for other factors that could impact firm value. Hence, this section ends by describing the theoretical background of the control variables and how they are measured.

Firm value: This will be estimated using Tobin's Q following the convention of previous studies (Allayannis & Weston, 2001; Jin & Jorion, 2006; Hagelin et al., 2007). Tobin's Q is defined as the market value of assets divided by replacement cost. To operationalise Tobin's Q, we will use the same proxy as Hagelin et al. (2007) and define *Tobin's Q* as:

$$Tobin's\ Q = \frac{(BV\ Total\ Assets - BV\ Equity + MV\ Equity)}{BV\ Total\ Assets} \tag{5}$$

The distribution for our variable *Tobin's Q* is positively skewed. Therefore, we follow the approach of Jankensgård (2015) and log transform *Tobin's Q*. The log transformation also enables us to interpret the coefficients in the regression in percentage terms. Hagelin et al. (2007) argue that the previous study by Allayannis and Weston (2001) has shown that the use of book values as replacement cost does not affect the results compared to more sophisticated estimations.

Hedging: Our variable *Hedging* is a dummy variable that takes the value 1 if the firm uses derivatives to hedge any kind of risk exposure. Measuring hedging activity with a dummy variable is a standard approach in previous studies (Jin & Jorion, 2006; Hagelin et al, 2007; Jankensgård, 2015). The reason for following this convention is that not all firms provide sufficient information to measure hedging activity with a continuous variable.

Foreign exchange hedging: This will be represented by a dummy variable *FXH* that takes the value 1 if the firm use financial derivatives to hedge foreign exchange risk, and 0 otherwise.

Dividing hedging activity into subgroups based on the risk that is hedged can give insight into if the overall effect of hedging is driven by a specific hedging activity. Jin and Jorion (2006) suggest that foreign exchange risk exposure differs from commodity risk exposure.

Interest rate hedging: This will be represented by a dummy variable *IRH* that takes the value 1 if the firm use financial derivatives to hedge interest rate risk, and 0 otherwise.

Commodity hedging: This will be represented by a dummy variable *CMH* that takes the value 1 if the firm use financial derivatives to hedge commodity risk, and 0 otherwise.

Cash holdings: To measure this we use our variable *CashRatio* which is defined as cash and cash equivalents divided by total assets. Cash holdings may have a positive effect on firm value if it reduces costs associated with financial distress and underinvestment. On the other hand, firms that are constrained by low cash holdings may have higher Tobin's Q because they are more likely to primarily invest in positive NPV projects. This argument is related to the free cash flow hypothesis by Jensen (1986) that firms are more likely to invest in negative NPV projects when they have free cash flow in excess. The main interest of cash holdings in this study is the beta coefficient of the interaction variable *Hedging×CashRatio.*

Firm size: Like previous studies by Jin and Jorion (2006) and Hagelin et al. (2007) we use the natural logarithm of total assets as our variable *Firm Size*. Hagelin et al. (2007) describe how the management of hedging programmes are related to substantial economies of scale, which makes large firms more likely to use derivatives to hedge than small firms. Allayannis and Weston (2001) found that larger firms tend to have lower Tobin's Q than small firms.

Leverage: In line with Jankensgård (2015) we use the ratio of debt to total assets as our variable *Leverage.* The value of a firm may be related to its capital structure. Smith and Stulz (1985) showed that hedging can reduce the expected costs of financial distress. Therefore, we expect a positive relationship between hedging and leverage which makes it important to control for leverage.

Growth opportunities: Firm value may be positively related to growth opportunities. Hagelin et al. (2007) describe how firms are likely to invest more when they have valuable growth opportunities. Froot et al. (1993) describes that hedging can create value if external financing is more costly than internal financing when it ensures that the firm has enough internal funds to undertake its valuable investment opportunities. Hedgers are therefore more likely to have greater investment opportunities. In line with previous studies, we use capital expenditure over total assets as our variable *InvGrowth* (Jin & Jorion, 2006; Hagelin et al., 2007).

Profitability: Firms with high profitability are more likely to have higher firm value. Our variable *Profitability* is defined as return on total assets (ROA) in line with studies of Allayannis and Weston (2001) and Jankensgård (2015).

Access to financial markets: Firms with limited access to financial markets may have higher Tobin's Q since they are constrained to only undertake the investments with the highest NPV. As a proxy for access to financial markets, we follow Jankensgård (2015) and create a dummy variable called *Dividend* that takes the value 1 if the firm pays dividend, and 0 otherwise. The beta coefficient given the interpretation above is expected to be negative. However, dividends may convey information about profitability in the future (expected net cash flow), resulting in a positive beta coefficient (Fama & French, 1998).

Industry effects: In line with previous studies by Allayannis and Weston (2001) and Hagelin et al. (2007) we control for industry effects. Hedgers might have higher firm value if they are concentrated in industries with a higher Tobin's Q, and not because they use derivatives. We control for industry-fixed effects using dummy variables based on the Global Industry Classification Standard (GICS).

Time effects: Hedgers might have higher firm value if their hedging activities are concentrated in years with higher Tobin's Q due to macroeconomic factors, and not because they hedge with derivatives. We follow Allayannis and Weston (2001) and Hagelin et al. (2007) by controlling for time effects using dummy variables for each year.

3.3 Empirical Models

Since the main goal of this study is to evaluate whether hedging with derivatives creates firm value and how differences in cash holdings affect this relationship, we specify various empirical models. The models presented below describe the basic structure of the regression models, where i refers to "firm" and t to "year":

$$Tobin's\ Q_{i,t} = \alpha + \beta_1 Hedging_{i,t} + \beta_2 CashRatio_{i,t} + \beta_3 Hedging \times CashRatio + \beta \boldsymbol{X}'_{i,t} + \varepsilon_{i,t} \tag{6}$$

$$Tobin's\ Q_{i,t} = \alpha + \beta_1 FXH_{i,t} + \beta_2 IRH_{i,t} + \beta_3 CMH_{i,t} + \beta_4 CashRatio_{i,t} + \beta \boldsymbol{X}'_{i,t} + \varepsilon_{i,t} \tag{7}$$

where the dependent variable *Tobin's Q* is the proxy for firm value, α is the constant term and ε is the error term. The first variable in eq. (6) is a dummy variable for overall hedging activities with derivatives, The second variable *CashRatio* captures the influence of cash holdings on firm value. *Hedging x CashRatio* is an interaction variable constructed to capture how cash holdings moderate the effect of hedging on firm value. The last variable $\boldsymbol{X'}$ is a vector of the control variables described in section 3.2. In contrast to eq. (6), hedging activities in eq. (7) are divided by risk category into dummy variables *FXH*, *IRH*, and *CMH.* These three variables are then able to capture if the effect of hedging is driven by any of the risk categories.

3.4 The Econometric Approach

The empirical models presented in section 3.3 will be estimated on panel data since firm observations are collected both cross-sectionally and over time. The simplest way of dealing with panel data is to estimate a pooled regression using OLS and disregarding the time dimension. However, pooling the data implicitly assumes that the average values and relationships between the variables are constant across entities and time (Brooks, 2019). Hence, when using pooled regressions, the benefits of panel data to address entity and time heterogeneity are lost.

To address the problem of heterogeneity, panel data provide the option to use firm and time effects. When applying firm and time effects one can choose between random or fixed effects and the most appropriate one to use depends on the sample. The assumption for random effects requires that all the explanatory variables are uncorrelated with the composite error term (Brooks, 2019). If this assumption does not hold, the estimated parameters will be biased and inconsistent and thus one would prefer using fixed effects over random effects as its coefficients still would be consistent. This assumption is tested with a Hausman specification test and the p-value from the test is 0.000. We thus reject the null hypothesis of using random effects and consequently, this study will use fixed effects. Applying firm-fixed effects implies assigning a unique intercept for each firm that captures cross-sectional differences that are constant over time.

An alternative to firm effects is to employ industry-fixed effects using a least square dummy variable approach in line with previous studies of Allayannis and Weston (2001) and Hagelin, et al. (2007). This approach is also included in this study. Furthermore, to avoid multicollinearity between the intercept and the dummy variables, the intercept is removed from the regression models. A benefit of including fixed effects in the regression models is how it partially can capture effects from omitted variables that cause endogeneity (Roberts & Whited, 2013). The problem of endogeneity arises when the error term is correlated with any of the explanatory variables which results in biased coefficients.

A consequence of using panel data is that the observation may not be independent since we observe the same firms over several years. This could cause biased standard errors. Therefore, in line with Jin and Jorion (2006) and Hagelin, et al. (2007) we apply the Huber-White estimator to all the regressions to produce robust variance estimates. In addition to this, the Huber-White estimator also corrects for heteroscedasticity.

4. Analysis and Results

This chapter begins with analysing the descriptive statistics and the results from the univariate analysis. Thereafter, the results for each multivariate regression model are detailed presented. The findings are then analysed in relation to the previous literature. Lastly, a section with robustness tests is presented to confirm the validity of the results.

4.1 Descriptive Statistics

Table 1 presents descriptive statistics for the full sample of 171 firms listed on the Stockholm Stock Exchange. The firms in the sample have on average a *Tobin's Q* ratio of 2.499, which diverges to a large extent from the median of 1.626. The difference between the mean and median suggests that *Tobin's Q* is positively skewed, which can be confirmed by the high skewness value of 3.986. As mentioned in section 3.2, due to the skewness *Tobin's Q* is log transformed to make the distribution more symmetric. The mean value of 0.636 for the variable *Hedging* tells us that 63.6% of the firm-year observations in the sample belong to derivative users. Looking at the mean values for the *FXH*, *IRH*, *CMH* variables, 53.9% of the firm-year observations use derivatives to hedge foreign exchange risk, 36.7% hedge interest rate risk and 12.5% hedge commodity risk. The findings that foreign exchange hedging with derivatives is the most common and that commodity risk is the least hedged risk are in line with the findings of Ahmed, et al. (2014) for UK firms. For Swedish firms, Jankensgård (2015) found that 58% hedge foreign exchange risk, which is similar to the proportion in this study.

Table 1. Descriptive Statistics

Variable	Mean	Median	Std. dev.	Max.	Min.	Skewness	Kurtosis
Tobin's Q	2.499	1.626	2.509	30.357	0.456	3.986	27.435
Hedging	0.636	1.000	0.481	1.000	0.000	-0.567	1.322
FXH	0.539	1.000	0.499	1.000	0.000	-0.156	1.024
IRH	0.367	0.000	0.482	1.000	0.000	0.550	1.302
CMH	0.125	0.000	0.331	1.000	0.000	2.271	6.158
CashRatio	12.932	7.114	16.855	99.385	0.000	2.609	10.391
Firm Size	2.440	0.475	5.350	52.500	0.004	5.040	37.050
InvGrowth	3.073	1.754	3.825	33.669	0.000	3.015	16.084
Profitability	4.100	6.119	18.565	218.618	-124.089	0.090	30.729
Leverage	22.570	21.624	16.065	89.989	0.000	0.598	3.183
Dividend	0.700	1.000	0.459	1.000	0.000	-0.872	1.760

This table presents descriptive statistics for 171 firms listed on the Stockholm Stock Exchange for the sample period 2016 to 2021. For all variables, the mean, median, standard deviation (Std. dev.), maximum value (Max.), minimum value (Min.), skewness and kurtosis are presented. *Tobin's Q* is the proxy for firm value before being log transformed. *Hedging* represents a dummy variable for firms that use derivatives to hedge, *FXH*, *IRH* and *CMH* are dummy variables for firms that hedge foreign exchange, interest rate and commodity risk respectively. *CashRatio* is the amount of cash and cash equivalent held by firms in relation to total assets, *Firm Size* is the book value of total assets before log transformed, *InvGrowth* is capital expenditure over total assets. *Profitability* represents return on assets and is defined as net income over total assets, *Leverage* is defined as debt divided by total assets and *Dividend* is a dummy variable that takes on the value one if the firm pays dividend and zero otherwise.

In **Table 1** it is also evident that firms on average hold 12.9% of total assets as cash and cash equivalent, with a standard deviation of 16.8%. This highlights that the choice of cash holdings varies between the firms, and the variation could potentially have an influence on the marginal effect of hedging on firm value. The variable *Firm Size* has a similar distribution as *Tobin's Q*, with a larger mean than the median and a high skewness value. In addition to the high skewness value of 5.040, *Firm Size* has a high kurtosis value of 37.050. This suggests that there exist some firms in the sample that have a much larger book value of total assets relative to the majority of the firms. As a consequence of this *Firm Size* is log transformed. In general, when looking at the min. and max. values in the table it is apparent that there exist some outliers in the sample. The outliers will be further addressed in section 4.4.

4.2 Univariate Analysis

In this section, we test if there are significant differences in firm value and firm characteristics between firms that hedge with derivatives and firms that do not. The differences between hedgers and non-hedger are tested both on the mean and median to account for potential non normal distributions. As **Table 2** shows, there are some distinct differences between the two subsamples of hedgers and non-hedgers. There exists a statistically significant difference in *Tobin's Q* between hedgers and non-hedgers. Both the mean and median values are lower for firms that hedge with derivatives compared to firms that do not. This contradicts the hypothesis that firms that hedge with derivatives have a higher firm value. However, the result may be different when controlling for differences in firm characteristics as done in the multivariate analysis. The result that derivative hedging firms have a lower mean value of *Tobin's Q* is comparable to the result of Hagelin et al. (2007) and Fauver and Naranjo (2010). Furthermore, firms that hedge hold a significantly lower amount of cash and cash equivalent compared to non-hedgers, as can be observed by the lower mean and median values of the *CashRatio*. This is consistent with the evidence found in previous literature by Haushalter et al. (2007), Choi et al. (2020), and Sun et al. (2022), that there exists a substitute relationship between derivatives and cash holdings. The mean and median of *Firm Size* are found to be higher for hedgers relative to the values for non-hedgers, which is in line with the stylized fact that larger firms tend to hedge more. In the table, one can also see that firms that use derivatives to hedge have a higher capital expenditure over total assets, a higher return on assets and higher leverage compared to non-hedging firms. These results are consistent with the findings of Fauver and Naranjo (2010). The findings of higher leverage for firms that hedge can be related to Leland (1998) that showed how derivatives can increase debt capacity. Lastly, we can see that 81.9% of hedgers pay dividends relative to 49.1% of non-hedgers, similar to the finding of Hagelin et al. (2007).

Table 2. Summary Statistics over Hedgers and Non-hedgers

	All, N = 1026		Hedgers, N = 653		Non-hedgers, N = 373		Difference tests	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Tobin's Q	2.499	1.626	2.144	1.514	3.120	1.960	-0.976***	-0.446***
CashRatio	12.932	7.114	8.584	5.821	20.544	11.092	-11.961***	-5.271***
Firm size	2.440	0.475	3.680	1.230	0.286	0.098	3.394***	1.132***
InvGrowth	3.073	1.754	3.742	2.378	1.901	0.827	1.841***	1.551***
Profitability	4.100	6.119	6.802	6.326	-0.629	4.531	7.432***	1.796***
Leverage	22.570	21.624	25.719	25.165	17.056	13.100	8.663***	12.064***
Dividend	0.700	1.000	0.819	1.000	0.491	0.000	0.329***	1.000***

This table presents the mean and median of the dependent and firm characteristic variables in a subsample of hedger and non-hedger firms. The second and third columns show the mean and median for all the observations in the sample. The fourth and fifth columns show the values for the subsample of firms that hedge with derivatives, while the sixth and seventh columns present the values for the subsample of non-hedging firms. The last two columns present the difference in mean and median with significance from the difference tests using t-test and Wilcoxon rank-sum test, shown at 1% (***) significance level.

4.3 Multivariate Regression Analysis

In the univariate analysis it appeared that there exists a significant difference in firm value between firms that use derivatives and firms that do not use derivatives to hedge. However, to examine the marginal effect of hedging on firm value it needs to be done in a multivariate setting controlling for other factors that can affect firm value. Hence, the hypotheses in this study are tested with multivariate regression models.

In **Table 3** the results from the multivariate regression models are presented. The first model (M1) examines the effect of hedging on firm value without considering the impact from cash

Table 3. Multivariate Regression Models on Firm Value.

Variable	M1	M2	M3	M4	M5	M6	M7
Hedging	0.053	0.084*	0.075*	0.027	0.084*	0.091*	
	(0.050)	(0.046)	(0.044)	(0.079)	(0.044)	(0.053)	
Firm size	-0.107***	-0.080***	-0.064***	-0.070	-0.069***	-0.069***	-0.063***
	(0.011)	(0.011)	(0.010)	(0.059)	(0.011)	(0.011)	(0.012)
Leverage	-0.011***	-0.004***	-0.003***	-0.001	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
InvGrowth	-0.019***	-0.017***	0.000	-0.002	0.001	0.001	0.002
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Profitability	0.003***	0.006***	0.007***	0.002	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Dividend	0.200***	0.243***	0.288***	0.133***	0.304***	0.304***	0.307***
	(0.045)	(0.044)	(0.045)	(0.039)	(0.045)	(0.045)	(0.045)
CashRatio		0.017***	0.014***	0.004*	0.014***	0.014***	0.014***
		(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Hedging*CashRatio						-0.000	
						(0.002)	
FXH							0.106***
							(0.040)
IRH							-0.061
							(0.040)
CMH							-0.027
							(0.040)
Constant	3.166***	2.117***					
	(0.231)	(0.224)					
Industry effect	No	No	Yes	No	Yes	Yes	Yes
Firm effect	No	No	No	Yes	No	No	No
Time effect	No	No	No	No	Yes	Yes	Yes
Number of obs.	1026	1026	1026	1026	1026	1026	1026
Adjusted R^2	0.273	0.395	0.730	-0.138	0.734	0.730	0.731

This table presents the results from the regression models performed in this study, where the dependent variable *Tobin's Q* is used as a proxy for firm value in all the models. The regression coefficients are reported with the associated standard errors corrected with the Huber-White estimator in brackets below, and shown at 10% (*), 5% (**), and 1% (***) significance levels.

holdings. The coefficient for the variable *Hedging* is positive but not significant. However, when also considering cash holdings in the second model (M2) it appears that the coefficient for *Hedging* becomes larger and significant at the 10% level. This highlights the importance of controlling for other risk management tools such as cash holdings to avoid endogeneity issues.

In other words, omitting cash holdings from the regression model will result in a biased coefficient for *Hedging*. This could be explained by that derivatives and cash holdings are correlated as a result of being jointly determined by the firm's risk management policy. The coefficient for *CashRatio* is positive and significant, which indicates that cash holdings would have a positive effect on firm value. One potential explanation for this relationship is that cash holdings can be seen as a risk management tool and have the same theoretical argument for being value adding as hedging activities in general (Froot et al. 1993).

In the third model (M3) industry-fixed effects are applied to the regression. Compared to the M2 regression *Hedging* is still significant at 10% level, but now with a slightly lower coefficient. The inclusion of industry-fixed effects results in a distinct increase in adjusted R^2 from 0.395 to 0.730, indicating how differences in firm value can be explained by which industries the firms belong to. Instead of using industry effects the fourth model (M4) employs firm-fixed effects to account for firm-specific differences that are constant over time that may not be captured by industry-fixed effects. The coefficient for the variable *Hedging* is still positive but no longer significant. The insignificant result could be due to a lack of relationship between hedging and firm value as argued by Jin and Jorion (2006) and Lookman (2009). However, it could also be due to the econometric issue of too little within-firm variation in the sample. As a result, no significant relationship would be found with the firm-fixed effect model even if a relationship exists, as described by Hagelin, et al. (2007). In general, firms' hedging policies are constant over the sample period in this study. In total, 139 of the 171 firms in the sample have a constant hedging policy during the period 2016 to 2021. This suggests that there may be too little within-firm variation for applying fixed effects on firm level.

The main model to test the first hypothesis is the fifth model (M5), which includes both time and industry effects. Incorporating time effects gives similar results and coefficients as the third model. The *Hedging* variable is positive and significant at the 10% level, which is in line with the first hypothesis that firm value is positively related to derivative hedging. This finding is consistent with Allayannis and Weston (2001) and Carter et al. (2006), that both found evidence for a positive relationship between hedging and firm value in the US. However, our result contradicts the findings of Jin and Jorion (2006) and Lookman (2009), that found no relationship between hedging and firm value. One potential explanation could be that they only looked at interest rate and commodity hedging and did not consider foreign exchange hedging. The results from the fifth model suggest that the firms that hedge with derivatives are valued at an 8.4% premium. This hedging premium is higher than the 4.87% reported by Allayannis and Weston (2001), but lower than the 10.2% reported by Carter et al. (2006). However, the interpretation of the magnitude of the hedging premium should be done with caution due to the relatively high standard errors.

To test the second hypothesis of how cash holdings moderate the effect of derivative hedging on firm value, the sixth model (M6) includes the interaction variable *Hedging* × *CashRatio*. The coefficient for the interaction variable is insignificant and close to zero. Thus, we find no evidence for the second hypothesis that higher cash holdings would weaken the relation between derivative hedging and firm value. The result that firms' choice of cash holding level does not affect the hedging premium is puzzling in relation to the previous literature about the close relationship between cash holdings and derivatives (Opler et al., 1999; Choi et al., 2020; Sun et al., 2022). A potential reason for not finding a relationship may be because hedging activity is measured as a binary variable, while the real underlying relationship depends on the magnitude of the hedging activity and should be measured as a continuous variable.

The last model (M7) is constructed to capture if the hedging premium found in the fifth model is driven by any of the risk categories. As described in section 3.2, the three risk categories investigated are foreign exchange rate, interest rate and commodity risk. The coefficient for the variable *FXH* is positive and significant, while the coefficients are negative and insignificant for the variables *IRH* and *CMH*. That foreign exchange hedging has a positive effect on firm value and that interest rate hedging has the most negative effect, is in line with the result found in the UK market by Ahmed et al. (2014). Moreover, the positive effect of foreign exchange hedging for Swedish firms was expected with respect to the previous studies conducted by Hagelin et al. (2007), Pramborg (2004) and Jankensgård (2015). The premium for foreign exchange hedging of 10.6% in this study is lower than the 13.6% found by Jankensgård (2015). The difference may be due to that Jankensgård (2015) only considers the year 2009 as the sample period. Furthermore, as the year 2009 is the aftermath of the 2007/08 financial crisis one intuitively could expect hedging activities to be more valuable during a crisis. In contradiction to our results, Belghitar et al. (2013) found that foreign exchange hedging adds no value to French firms. This contradiction may be due to country-specific differences in the magnitude of foreign exchange risk. As opposed to Sweden, France is part of the European Monetary Union which has reduced the foreign exchange exposure for many firms.

The negative and insignificant coefficient for *CMH* suggests that the effect of commodity hedging differs from foreign exchange hedging as suggested by Jin and Jorion (2006). Commodity risk exposure is more easily identified and hedged by outside investors compared to foreign exchange risk. Hence, commodity hedging is closer compiled with the settings in the M&M theorem that would make hedging irrelevant. Furthermore, the result of a negative and insignificant coefficient for *IRH* may have been influenced by conditioning the sample on non-financial firms. One would for example expect that interest rate risk matters more for financial firms than for non-financial firms.

The included control variables are all significant and have consistent signs across the models except the variable *InvGrowth* which becomes insignificant with a positive sign when industry effects are included. The coefficient for *Firm Size* shows that larger firms have lower firm value consistent with findings in previous studies by Allayannis and Weston (2001) and Jankensgård (2015). *Leverage* has a negative effect on firm value which is reasonable given the finding that *CashRatio* has a positive coefficient and cash holdings sometimes are inferred as negative debt. The coefficients for *Profitability* are as expected positive since firms that are more profitable tend to have a higher valuation. As a final remark, *Dividend* have a positive effect on firm value that potentially could be explained by the argument of Fama and French (1998), that dividends can convey information about future profitability.

4.4 Robustness Tests

In this section, robustness tests are performed to check the validity of the results found in the multivariate section. The descriptive statistics in **Table 1** showed that there exist some outliers in the data. Hence, one concern is that the results potentially are driven by outliers that could cause misleading conclusions. To address this, outliers are identified and removed from the sample. The regression models used in the multivariate section are then re-estimated using the sample that is cleaned from the most extreme outliers. **Table 4** presents the re-estimated models, which show that the results are not sensitive to outliers. The re-estimated coefficients for the variable *Hedging* tend to be slightly more positive and significant than the previous coefficients. Moreover, the re-estimated coefficients for the control variables are not significantly affected by the re-estimation. All this suggests that the direction of the results found in the multivariate section is robust in relation to the concern of outliers.

Table 4. Robustness Tests of the Multivariate Regression Models on Firm Value

Variable	M1	M2	M3	M4	M5	M6	M7
Hedging	0.080	0.103**	0.091**	0.041	0.098**	0.112**	
	(0.050)	(0.044)	(0.043)	(0.078)	(0.043)	(0.052)	
Firm size	-0.105***	-0.074***	-0.059***	-0.085	-0.063***	-0.064***	-0.058***
	(0.011)	(0.010)	(0.010)	(0.057)	(0.010)	(0.011)	(0.012)
Leverage	-0.011***	-0.004***	-0.003***	-0.001	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
InvGrowth	-0.019***	-0.015***	0.000	-0.002	0.001	0.001	0.003
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Profitability	0.003**	0.008***	0.008***	0.003	0.008***	0.008***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Dividend	0.180***	0.192***	0.232***	0.129***	0.245***	0.244***	0.249***
	(0.047)	(0.044)	(0.043)	(0.039)	(0.043)	(0.043)	(0.043)
CashRatio		0.019***	0.016***	0.004	0.016***	0.016***	0.016***
		(0.001)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Hedging*CashRatio						-0.001	
						(0.003)	
FXH							0.116***
							(0.039)
IRH							-0.052
							(0.039)
CMH							-0.029
							(0.039)
Constant	3.103***	1.973***					
	(0.231)	(0.222)					
Industry effect	No	No	Yes	No	Yes	Yes	Yes
Firm effect	No	No	No	Yes	No	No	No
Time effect	No	No	No	No	Yes	Yes	Yes
Number of obs.	1013	1013	1013	1013	1013	1013	1013
Adjusted R^2	0.270	0.407	0.739	0.060	0.743	0.742	0.743

This table presents the results from the regression models performed with robustness checks for outliers, where the dependent variable *Tobin's Q* is used as a proxy for firm value in all the models. The regression coefficients are reported with the associated standard error errors corrected with the Huber-White estimator in brackets below, and shown at 10% (*), 5% (**), and 1% (***) significance levels.

In addition to outliers, a further concern is that the positive relationship between derivative hedging and firm value could be caused by reversed causality. For example, it can be argued that firms with a higher Tobin's Q have a greater incentive to hedge since a higher Tobin's Q may reflect that the firm has more profitable investment opportunities. Hence, higher firm value for derivative users may reflect their incentive to hedge, and not that hedging causes higher firm value. To address this, we perform the reverse causality test as done by Allayannis and Weston (2001). In order to conduct this test, all the observations are classified into four separate categories. The first category consists of firms that do not hedge in the current period and remain unhedged in the next period (N_t, N_{t+1}). The second category considers firms that do hedge in the current period but quit hedging in the following period (H_t, N_{t+1}), while the third category considers firms that begin hedging in the next period (N_t, H_{t+1}). The last category includes firms that continue to hedge in the next period (H_t, H_{t+1}). The first three categories are constructed as dummy variables and included the following cross-sectional regression:

$$Tobin's\ Q_t = \alpha + \beta_1(N_t, N_{t+1}) + \beta_2(H_t, N_{t+1}) + \beta_3(N_t, H_{t+1}) + \beta \boldsymbol{X}_t' + \varepsilon_t \qquad (8)$$

where the last variable $\boldsymbol{X}_t'$ is a vector of the control variables described in section 3.2, and ε_t is the error term. The first hypothesis to be tested is that hedging adds no firm value, where the null hypothesis is that $\beta_1 = 0$. We expect firms that remain unhedged to have a lower Tobin's Q and therefore $\beta_1 < 0$. The second hypothesis is that the size of Tobin's Q does not influence the decision to begin hedging, with a null hypothesis that $\beta_3 = \beta_1$. If firms with a high Tobin's Q decide to hedge, it should mean that firms that begin hedging in the next period should have a higher Tobin's Q than firms that remains unhedged ($\beta_3 > \beta_1$). The last hypothesis is that the size of Tobin's Q does not influence the decision to quit hedging, such that $\beta_2 = 0$. If firms conversely quit hedging in response to low values of Tobin's Q, the firms that quit hedging in the next period are expected to have lower Tobin's Q than the firm that continues hedging ($\beta_2 < 0$). The three hypotheses are tested with a Wald test.

Table 5. Reverse Causality Test

Variable	Number of obs.	Dep. var: Tobin's Q
Firms that remain unhedged (N_t, N_{t+1})	280	-0.120***
		(0.046)
Firms that quit hedging (H_t, N_{t+1})	20	0.054
		(0.109)
Firms that begin hedging (N_t, H_{t+1})	19	-0.126
		(0.146)

Wald tests	p-value
Hypothesis 1: NN = 0	0.010
Hypothesis 2: NH = NN	0.965
Hypothesis 3: HN = 0	0.619
Joint test of hypothesis 2 and 3	0.883

This table presents the results from the reverse causality test for analysis of how changes in hedging policy affect firm value. The dependent variable is *Tobin's Q* as a proxy for firm value, and the regression includes the control variables *Firm Size*, *Leverage*, *InvGrowth*, *Profitability*, *Dividend* and *CashRatio,* and industry-fixed effects for a more detailed description of the control variables, see section 3.2. The regression coefficients are reported with the associated standard error in brackets below, and significance levels are shown at 10% (*), 5% (**), and 1% (***) significance levels.

The first hypothesis that hedging adds no firm value is rejected at 1% significance level. In **Table 5**, one can see that the coefficient for firms that remains unhedged is negative (-0.120), which is consistent with the previous findings that hedging with derivatives creates firm value. Furthermore, the second hypothesis cannot be rejected meaning that we find no evidence that the size of Tobin's Q affects the decision to begin hedging. Similarly, the third hypothesis cannot be rejected and suggests no evidence that the size of Tobin's Q would affect the decision to quit hedging. In addition to this, no evidence of reverse causality is neither found when testing hypotheses 2 and 3 jointly. However, it should also be noted that this test is applied to a sample with relatively few changes in hedging policy. Therefore, the inference of no reverse causality should only be interpreted as an indication that there exists no reverse causality.

5. Conclusion

In this study, we test the hypothesis that hedging with derivatives creates firm value and investigate if this relationship is affected by differences in cash holdings. For the analysis, detailed data were hand-collected for 171 Swedish firms for the period 2016 to 2021. Tobin's Q is used in the multivariate regression analysis to measure how firm value is affected by derivatives usage. To further explore the relationship, we categorise derivative usage into three categories: foreign exchange, interest rate and commodity derivatives.

The empirical findings show that hedging with derivatives is associated with higher firm value when controlling for firm characteristics. The positive relationship between derivatives and firm value is indicated to be driven by foreign exchange hedging, given the results when investigating the three categories of derivative usage. The effects from interest rate and commodity hedging are both negative but insignificant, suggesting that the effect from hedging is highly dependent on the risk hedged. Finally, this study finds no evidence that cash holdings moderate the effect derivative hedging has on firm value.

Our results are consistent with the theories that hedging can increase firm value in the presence of market imperfections. The inference that cash holdings do not affect the relationship gives rise to a need for a further and better theoretical understanding of the integrated relationship between cash holdings and derivative hedging. The results of this study have practical implications that are relevant to firms' risk management practices and policies. Swedish firms with a value maximisation purpose that have exposure to foreign exchange risks, should consider engaging in hedging activities with derivatives.

Further research on this topic should consider how hedging activities are measured. A limitation of using discrete hedging variables is that it may be harder to capture if cash holding affects the hedging premium. Hence, using a continuous variable as an alternative may give a better insight into the relationship. Another limitation is that cash holdings and derivatives are not the only factors affecting a firm's ability to meet cash flow volatility. Future research should also incorporate a firm's ability to liquidate assets and its real flexibility to scale up and down operations.

References

Ahmed, H., Azevedo, A., & Guney, Y. (2014). The Effect of Hedging on Firm Value and Performance: Evidence from the Nonfinancial UK Firms, *European Financial Management 2014 Annual Conference*, Available online: https://hull-repository.worktribe.com/output/1788287 [Accessed 21 February 2023]

Allayannis, G., & Weston, J.P. (2001). The Use of Foreign Currency Derivatives and Firm Market Value, *The Review of Financial Studies,* vol. 14, no. 1, pp.243-276, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 23 February 2023]

Allayannis, G., Lel, U., & Miller, D.P. (2012). The use of foreign currency derivatives, corporate governance, and firm value around the world, *Journal of International Economics,* vol. 87, no. 1, pp.65-79, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 23 February 2023]

Bachiller, P., Boubaker, S., & Mefteh-Wali, S. (2021). Financial derivatives and firm value: What have we learned?, *Finance Research Letters,* vol. 39, pp.1-9, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 26 March 2023]

Bates, T.W., Kahle, K.M., & Stulz, R.M. (2009). Why Do U.S. Firms Hold So Much More Cash than They Used To?, *The Journal of Finance,* vol. 64, no. 5, pp.1985-2021, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 2 April 2023]

Belghitar, Y., Ephraim, C., & Mefteh, S. (2013). Foreign currency derivative use and shareholder value, *International Review of Financial Analysis,* vol. 29, pp.283-293, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 26 March 2023]

Bessembinder, H. (1991). Forward Contracts and Firm Value: Investment Incentive and Contracting Effects, *The Journal of Financial and Quantitative Analysis,* vol. 26, no. 4, pp.519-532, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 3 April 2023]

Bessler, W., Conlon, T., & Huan, X. (2019). Does corporate hedging enhance shareholder value? A meta-analysis, *International Review of Financial Analysis,* vol. 61, pp.222-232, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 26 March 2023]

Bolton, P., Chen, H., & Wang, N. (2011). A Unified Theory of Tobin's q, Corporate Investment, Financing, and Risk Management, *The Journal of Finance,* vol. 66, no. 5, pp.1545-1578, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 15 April 2023]

Brooks, C. (2019). Introductory Econometrics for Finance, 4th edn, Cambridge: Cambridge University Press

Carter, D.A., Rogers, D.A., & Simkins, B.J. (2006). Does Hedging Affect Firm Value? Evidence from the US Airline Industry, *Financial Management,* vol. 35, no. 1, pp.53-86, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 21 March 2023]

Choi, S., Jang, H., Kim, D., & Seo, B.K. (2020). Derivatives use and the value of cash holdings: Evidence from the U.S. oil and gas industry, *The Journal of Futures Markets,* vol. 41, no. 3, pp.361-383, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 26 March 2023]

DeMarco, P.M., & Duffie, D. (1995). Corporate Incentives for Hedging and Hedge Accounting, *The Review of Financial Studies,* vol. 8, no. 3, pp.743-771, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 12 April 2023]

Disatnik, D., Dunchin, R., & Schmidt, B. (2014). Cash Flow Hedging and Liquidity Choices, *Review of Finance,* vol. 18, no. 2, pp.715-748, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 26 March 2023]

Fama, E.F., & French, K.R. (1998). Taxes, Financing Decisions, and Firm Value, *The Journal of Finance,* vol. 53, no. 3, pp.819-843, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 21 March 2023]

Fama, E.F. (1978). The Effects of a Firm's Investment and Financing Decisions on the Welfare of Its Security Holders, *The American Economic Review,* vol. 68, no. 3, pp.272-284, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 21 March 2023]

Fauver, L., & Naranjo, A. (2010). Derivative usage and firm value: The influence of agency costs and monitoring problems, *Journal of Corporate Finance,* vol. 16, no. 5, pp.719-735, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 28 March 2023]

Fazzari, S.M., Hubbard, R.G., Petersen, B.C., Blinder, A.S., & Poterba, J.M. (1988). Financing Constraints and Corporate Investment, *Brookings Papers on Economic Activity,* vol. 1988, no. 1, pp.141-206, Available online: https://www.jstor.org/stable/2534426 [Accessed 14 April 2023]

Fisher, Irving. (1930). The Theory of Interest, New York: The Macmillan Company

Froot, K.A., Scharfstein, D.S., & Stein, J.C. (1993). Risk Management: Coordinating Corporate Investment and Financing Policies, *The Journal of Finance,* vol. 48, no. 5, pp.1629-1658, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 21 March 2023]

Gamba, A., & Triantis, A.J. (2014). Corporate Risk Management: Integrated Liquidity, Hedging, and Operating Policies, *Management Science,* vol. 60, no. 1, pp.246-264, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 12 April 2023]

Gay, G.D., & Nam, J. (1998). The Underinvestment Problem and Corporate Derivatives Use, *Financial Management,* vol. 27, no. 4, pp.53-69, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 21 March 2023]

Graham, J.R., & Rogers, D.A. (2002). Do Firms Hedge in Response to Tax Incentives?, *The Journal of Finance,* vol. 57, no. 2, pp.815-839, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 15 April 2023]

Guay, W., & Kothari, S.P. (2003). How much do firms hedge with derivatives?, *Journal of Financial Economics,* vol. 70, no. 3, pp.423-461, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 17 April 2023]

Hagelin, N., Holmén, M., Knopf, J.D., & Pramborg, B. (2007). Managerial Stock Options and the Hedging Premium, *European Financial Management,* vol. 13, no. 4, pp.721-741, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 29 March 2023]

Haushalter, D., Klasa, S., & Maxwell, W.F. (2007). The influence of product market dynamics on a firm's cash holdings and hedging behavior, *Journal of Financial Economics,* vol. 84, no. 3, pp.797-825, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 12 April 2023]

Jankensgård, H. (2015). Does Centralisation of FX Derivative Usage Impact Firm Value?, *European Financial Management,* vol. 21, no. 2, pp.309-332, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 21 March 2023]

Jensen, M.C. (1986). Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers, *The American Economic Review,* vol. 76, no. 2, pp.323-329, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 30 March 2023]

Jin, Y., & Jorion, P. (2006). Firm Value and Hedging: Evidence from U.S. Oil and Gas Producers, *The Journal of Finance,* vol. 61, no. 2, pp.893-919, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 21 March 2023]

Leland, H.E. (1998). Agency Costs, Risk Management, and Capital Structure, *The Journal of Finance,* vol. 53, no. 4, pp.1213-1243, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 28 March 2023]

Lookman, A.A. (2009). Does Hedging Increase Firm Value? Comparing Premia for Hedging 'Big' Versus 'Small' Risks, *EFA 2004 Maastricht Meetings Paper,* no. 5174, Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=501182 [Accessed 28 March 2023]

Mayers, D., & Smith, C.W. (1982). On the Corporate Demand for Insurance, *The Journal of Business,* vol. 55, no. 2, pp.281-296, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 16 April 2023]

Modigliani, F., & Miller, M.H. (1958). The Cost of Capital, Corporation Finance and the Theory of Investment, *The American Economic Review,* vol. 48, no. 3, pp.261-297, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 21 March 2023]

Myers, S.C., & Majluf, N.S. (1984). Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics,* vol. 13, no. 2, pp.187-221, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 16 April 2023]

Myers, S.C. (1977). Determinants of corporate borrowing, *Journal of Financial Economics,* vol. 5, no. 2, pp.147-175, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 16 April 2023]

Nance, D.R., Smith, C.W., & Smithson, C.W. (1993). On the Determinants of Corporate Hedging, *The Journal of Finance,* vol. 48, no. 1, pp.267-284, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 30 March 2023]

Opler, T., Pinkowitz, L., Stulz, R.M., & Williamson, R. (1999). The determinants and implications of corporate cash holdings, *Journal of Financial Economics,* vol. 52, no. 1, pp.3-46, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 18 April 2023]

Pramborg, B. (2004). Derivatives hedging, geographical diversification, and firm market value, *Journal of Multinational Financial Management,* vol. 14, no. 2, pp.117-133, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 29 March 2023]

Rampini, A.A., & Viswanathan, S. (2010). Collateral, Risk Management, and the Distribution of Debt Capacity, *The Jouranal of Finance,* vol. 65, no. 6, pp.2293-2322, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 18 April 2023]

Roberts, M.R., & Whited, T.M. (2013). Chapter 7 – Endogeneity in Empirical Corporate Finance, *Handbook of the Economics of Finance, 2*.

Smith, C.W., & Stulz, R.M. (1985). The Determinants of Firms' Hedging Policies, *The Journal of Financial and Quantitative Analysis,* vol. 20, no. 4, pp.391-405, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 25 March 2023]

Stulz, R.M. (1996). Rethinking Risk Management, *Journal of Applied Corporate Finance,* vol. 9, no. 3, pp.8-25, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 25 March 2023]

Sun, W., Yin, C., & Zeng, Y. (2022). Financial Hedging, Corporate Cash Policy, and the Value of Cash, *British Journal of Management,* vol. 33, no. 3, pp.1271-1303, Available through: LUSEM Library website https://www.lusem.lu.se/library [Accessed 3 April 2023]