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THE IMPACT OF FOREIGN CURRENCY DERIVATIVES ON FIRM MARKET VALUE:

Evidence from Finland in the 2007–2012 financial crisis

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ABSTRACT

This study examines the impact of foreign currency derivatives use on firm market value and stock returns during the financial crisis 2007–2012. The sample consists of nonfinancial firms listed in Nasdaq OMX Helsinki. Thus, the focus of the study is in Finland during a specific and extreme market period. During a financial crisis the predictability of market is even more uncertain and market movements can be enormous. It causes a significant risk in the foreign currency market and a greater need for firms to hedge their currency positions than during a stable market condition. The effects of foreign currency derivatives use may be stronger than found earlier because Finnish firms have more foreign operations than widely studied U.S. firms, and an instable period of financial crisis can multiply the effects of foreign currency hedges.

Firm market value is measured by Tobin's Q. The association between foreign currency derivatives and Tobin's Q is examined with mean and median tests, and univariate and multivariate regressions. The multivariate regression, which includes control variables, is estimated using both pooled OLS and fixed effects regressions. Similar methodology is used to detect the association between foreign currency derivatives and stock returns.

Foreign currency derivatives use is associated with significantly greater market value in a sample of firms without foreign sales. These are exposed to foreign currency risk through import and export competition although they do not have a direct foreign currency exposure. Generally, mean and median tests and some regressions indicate that foreign currency derivatives are associated with lower Tobin's Q during the financial crisis. Contrary, the association between foreign currency derivatives and stock returns is mainly positive but insignificant implying that foreign currency derivatives use does not affect stock returns. However, the fit of these models remains relatively low.

KEYWORDS: foreign currency derivatives, hedging, risk management, firm value, financial crisis

1. INTRODUCTION

The use of derivatives originates already in the Ancient Greece where commodity derivatives were used to manage the price risk of olive corps. However, the importance and volume of derivatives use have increased rapidly only during the last decades. It started in 1972 when active trading with foreign currency futures began in the Chicago Mercantile Exchange. (Puttonen & Valtonen 1996: 227.)

At their best, financial derivatives can be effective tools in risk management and provide great advantages but one should be very careful with them. Warren E. Buffet, The Chairman and CEO of Berkshire Hathaway, stated that "*derivatives are financial weapons of mass destruction*" (Berkshire Hathaway Inc. 2002: 15). His statement reflects the other side of derivatives as they can be extremely harmful when used for wrong purposes or not carefully enough. This was exhibited in the global financial crisis in 2007–2008 when some firms managed to hedge their positions with derivatives, but others' speculations backfired and many corporations drifted into serious difficulties and bankruptcies. This concerned especially financial firms. Derivatives had a remarkable role in the crisis. Afterwards, the regulation of financial derivatives has become an essential issue. As seen, a wide knowledge of appropriate derivatives use is important in order to be able to manage them suitably.

Overall, the research of financial derivatives is wide. Most of the previous studies concentrate on the volume, scope, and purposes of derivatives use. Recently, several studies have researched also the direct impact of derivatives use on firm market value. Nevertheless, the results are somewhat contradictory. For example, the classical Modigliani and Miller paradigm shows that risk management is irrelevant to a firm because shareholders can rather do it by themselves (Modigliani & Miller 1958). However, Allayannis and Weston (2001), who were the first ones to empirically study the direct relationship between derivatives hedging and firm market value, find contrary results. According to their study, risk management and derivatives hedging increases firm market value. Allayannis and Weston (2001) has still remained as an important guideline for later studies.

1.1. Purpose of the study

The purpose of the study is to examine whether hedging with foreign currency derivatives affects firm market value and stock returns during the latest financial crisis 2007–2012 in Finland. The results will give an example how foreign currency derivatives work during an extremely uncertain market condition. However, every crisis is unique and therefore the results cannot be directly extended to other financial crisis, downturns, and currency depreciations. Only few of the earlier studies cover separately derivatives use during this kind of precarious period (Allayannis & Weston 2001; Allayannis, Lel & Miller 2011; Bartram, Brown & Conrad 2011). But, none of them concentrate on a crisis, which is as huge as the 2007–2012 global financial crisis and especially the worst two-year period of 2007–2008.

The study concentrates on Finnish firms, while the previous evidence is mainly from the U.S. market and concerns mostly firm market value measured by Tobin's Q, not stock returns. The Finnish market differs from the U.S. market and therefore the results may be diverse. Compared to the U.S. Finland is much smaller economy, which is more dependent on foreign trade, i.e. on imports and exports. Therefore, the effects may be stronger among Finnish companies, which expose more strongly to the foreign currency risk because of larger amount of foreign trade compared to an average U.S. firm. After Bartram, Brown, and Fehle (2009), the use of foreign currency derivatives is more common in Europe than in the U.S.: 50.9 % of European firms use foreign currency derivatives, while the amount among U.S. firms is only 37.7 %. Aretz and Bartram (2010) suggest that hedging activities vary between countries because of the legal system and the access to derivatives markets.

The Finnish market is a small-sized market, which is part of the Eurozone. The most important export and import countries are Russia, Germany, and Sweden. Hence, the biggest foreign currency exposures are in the Russian rouble and in the Swedish krona. The mutual currency euro eliminates the foreign currency risk within the euro area. Therefore, the foreign trade for example with Germany is as safe as with domestic companies from the currency risk point of view. Other major foreign currency risks for Finnish companies occur in the British sterling, the U.S. dollar, the Japanese yen, the Chinese yuan, the Norwegian krone, the Danish krone, the Swiss franc, and the Polish zloty.

Firms listed in the Nasdaq OMX Helsinki stock exchange are included in the sample because the data are best available for listed firms. It is not appropriate to use any

smaller companies in Finland because they usually do not have foreign trade, or they do not use foreign currency derivatives. For that reason, the sample firms include all nonfinancial firms in the Helsinki stock exchange. All financial firms are excluded because their derivatives use differs significantly from other companies, as they are often market makers in derivatives market.

As Allayannis and Weston (2001) state, foreign currency derivatives are the most used derivatives even though interest rate or commodity derivatives use may have the same effects on firm market value. This study also concentrates on foreign currency derivatives because of the magnitude of their use. While previous studies use almost explicitly Tobin's Q as a measure of firm value, this study extends the measurement to cover both Tobin's Q and stock returns. Thus, it will provide more extensive evidence of the impact of derivatives use. Only Nelson, Moffitt, and Affleck-Graves (2005) have included abnormal stock returns as performance measure in their study of the impacts of foreign currency derivatives use.

1.2. Hypothesis development

Based on the previous studies the first hypothesis is set to assume that hedging with foreign currency derivatives is associated with higher firm market value during the financial crisis. During uncertain times the impact of hedging should be even greater compared to stable market conditions. Even though contradictory results emerge in the previous literature, it seems rational that hedging against foreign exchange risk is remunerative especially during a financial crisis. Also, the effect on stock returns is expected to be positive. Therefore, the explicit hypotheses for derivatives use in Finland are as follows:

Hypothesis 1: *The use of foreign currency derivatives is associated with higher firm market value in a financial crisis.*

Hypothesis 2: *The use of foreign currency derivatives is associated with higher stock returns in a financial crisis.*

These hypotheses are tested with univariate and multivariate tests. The univariate analysis tests the difference in the mean and median Tobin's Q values and stock returns between hedgers and non-hedgers. Univariate regression further estimates the percentual difference in market value and stock returns between hedgers and non-

hedgers. Multivariate test extends the analysis by incorporating different control variables, which may have an impact on the dependent variables. Similar regressions are estimated using separately Tobin's Q and stock returns as dependent variables. Control variables that are likely to affect market value are size, profitability, leverage, growth opportunities, ability to access financial markets, geographical and industrial diversification, credit quality, sector, and time effect. When stock returns are used as the dependent variable, an additional control for beta is used. Both pooled OLS regression and fixed effect regression methods are used to estimate the multivariate regressions.

1.3. Structure of the study

The rest of the paper is organized as follows: Section two provides a theoretical background for foreign currency risk, its management, and financial derivatives explaining the common terms and concepts. Also the incentives and motives for derivatives use are presented. Section three concentrates on the relation between derivatives use and firm market value. It starts with a theoretical concept of firm market value. The core of the section presents the previous studies of derivatives use and firm market value. It is divided into three subsections after the impact of derivatives hedging whether it has been zero, positive or negative. Finally, the last subsection summarizes the previous studies of derivatives use and firm market value.

Empirical part of the study is presented in the section four. First, foreign exchange rate movements during the observation period are analysed. Second, the data part includes the sample formation, explanation for the regression variables, and summary statistics. Third, the methodology covers the univariate and multivariate analyses applied in the study, and the tentative tests for final regressions. Fourth, the empirical results are provided separately for the association between foreign currency derivatives use and Tobin's Q, and foreign currency derivatives use and stock returns. Section five summarizes and concludes the paper. It concentrates on the main findings and limitations, and suggests for further research.

2. FOREIGN CURRENCY RISK MANAGEMENT

Foreign currency risk management is one of the key processes in company performance because of the volatile nature of foreign exchange markets. Therefore, market operators prefer to trade in domestic currency and avoid the risk. This is however often unprofitable or even impossible. Therefore, different risk management strategies are applied to reduce the foreign currency risk. The most common tools in foreign currency risk management are financial derivatives, which include options, forwards, futures, swaps, and exotic derivatives. Only derivatives and their combinations provide a large number of different kinds of hedging instruments. In addition, firms rely on pass-through, operational hedging, and foreign currency debt in financial risk management (Aretz & Bartram 2010).

This section provides theoretical background of foreign currency risk and its management. In addition, it concentrates on the hedging incentives. The primary incentives for hedging are to reduce cash flow or earnings volatility, and to increase shareholder value. Specifically, hedging can reduce financial distress costs, alleviate the underinvestment problem, and decline expected taxes under a convex tax system. In the end of the section, financial derivatives are specifically introduced.

2.1. Foreign currency risk

Exchange rates are determined after a currency system of a country, and they can be either fixed or floating. Under a fixed currency system the domestic currency is tied to a currency of another country or for example to the price of gold. The exchange rate between the two currencies is constant. On the contrary, the value of the euro and other floating currencies is determined after the supply and demand in the markets, but the rates are highly controlled by monetary authorities. Foreign currency risk occurs when the values of currencies fluctuate relative to each other, i.e. when exchange rates change.

There are several reasons that determine the supply and demand of currencies, but the most important factor is the difference in the interest rates of two countries. If real interest rates of two countries, for example Finland and the U.S., differ the Finnish investors with lower real interest rate are willing to exchange currencies and invest them in the U.S. to obtain higher interest. Before investing the currencies need to be

exchanged, which increases the demand of dollars and it appreciates relative to the euro. The purpose is to hedge particularly against real exchange rate changes, not those caused by inflation differences, which are seen as changes in nominal interest rates. But, usually different inflation rates also generate real effects in these two countries. Therefore, also the levels of inflation have an impact on the supply and demand of currencies even though real interest rates are the main driver of the supply and demand. (Taylor 2003; Hillier, Grinblatt & Titman 2012: 705–707.)

Another important factor in the determination of exchange rates is the purchasing power parity (PPP). After the PPP prices should be equal in every country or else an arbitrage opportunity exists. Theoretically, an arbitrage will cause the currency of the country with cheaper goods to appreciate relative to the currency of the other country. PPP moves exchange rates, but it has to be noted that transportation costs and other constraints exist, which distort the PPP-condition. Thus, in reality goods prices are not equal globally. Furthermore, trade imbalances affect exchange rates as a trade deficit between two countries results in an imbalance of currency reserves between these two countries. In addition, monetary policy decisions, such as political decisions and government intervention, and speculator's behaviour have an impact on exchange rates. (Taylor 2003; Hillier et al. 2012: 705–707.)

Currency risk is formed by these changes in the supply and demand of a currency, which move exchange rates. Changes in exchange rates affect primarily corporations, which have foreign sales or operations in different countries. However, they do not only affect these international corporations but also nationally acting, domestic companies because of the international competition. If a currency is overvalued the competitive advantage drops off, as the goods are more expensive only because of the overvalued currency. Changes in exchange rates affect company cash flows and accounting profits but also the market and book values of a company. Therefore, foreign currency risk management is essential for a successful corporation. The importance is widely understood on a firm level, but its measurement and management is rarely implemented effectively. The reason is that in addition to financing decisions currency risk has to be taken into account in many other levels, such as pricing, budgeting, and investment planning. (Allayannis & Weston 2001; Hillier et al. 2012: 703–707.)

2.2. Risk Management

The basis of foreign currency risk management is in risk exposure identification. This is always an approximation, as the future risk cannot be perfectly identified in forehand, which is the most problematic question in the foreign currency risk management. During uncertain economic times it is especially difficult to forecast the risks that a company will face. To facilitate the risk exposure identification the foreign currency risk is generally divided into three categories (Hillier et al. 2012: 703):

- Transaction risk
- Translation risk
- Economic risk

Risk management concentrates most commonly in hedging the *transaction risk*. It occurs because of the changes in exchange rates between the contract and the payment, and thus changes in the company cash flows if they are determined in foreign currency. The transaction risk is associated with individual transactions in foreign currency: imports, exports, foreign assets, and loans. Thus, the risk is easy to observe but still the exchange rate changes are difficult to forecast. By its nature the transaction risk is short-term, usually less than a year. In addition, the profit distribution is symmetric: the profit from foreign currency depreciation equals the loss of foreign currency appreciation. With straightforward hedges the short-term transaction risk can be effectively hedged. It can increase firm value by reducing the variability of cash flows and thereby reducing the expected costs associated with financial distress, taxes, or underinvestment problem. Therefore, a high degree of firms hedge the transaction exposure. However, there are also long-term implications of currency changes that are not hedged when risk management is restricted only to individual transactions. (Hagelin 2003; Hagelin & Pramborg 2004; Hillier et al. 2012: 703–704.)

Translation risk, in turn, arises from the accounting methods when the foreign currency payments are changed into domestic currency in financial statements. The translation risk is typical for an international group company whose subsidiary operates with a different currency than the parent. The income statement and the balance sheet of the subsidiary must be converted into the currency of the parent company for the consolidated financial statement. If the exchange rates vary greatly between the financial statements and the proportion of assets, liabilities, and equity denominated in foreign currency is large, the translation risk is significant. Companies tend to use derivatives to hedge against this risk, but the translation risk management is not

necessarily as effective as hedging the transaction risk (Hagelin 2003). The general recommendation in financial literature is not to worry about the translation risk exposure and thus leave it unhedged. This is because translation gains or losses have only a little impact on firm's cash flows. Secondly, they can be poor estimators of real changes in firm value, and thus managing the translation risk does not reduce the share price exposure. (Hagelin 2003; Hagelin & Pramborg 2004; Hillier et al. 2012: 704.)

Economic risk means the impact of exchange rate changes on firm's competitiveness. While transaction and translation exposures arise from the exchange of foreign currency cash flows into domestic currency, economic exposure also includes the ability to generate those foreign currency cash flows. Economic risk is affected by the location of competitors and their currency distribution, difference between the location of the production facilities and the place of the sale, and also by the determinants of the input prices and the currency they are determined in. Economic risk covers also the situation where a foreign currency risk influences a company that acts only nationally through international competition. For example, if domestic currency is overvalued, competitiveness weakens both in domestic and foreign markets. If a firm has foreign competitors, or if a company imports some of their supplies, foreign goods are cheaper because of the overvalued domestic currency. (Moffett & Karlsen 1994; Hillier et al. 2012: 704–705.)

Economic risk is strategic and therefore it is the most difficult type of risk to manage. However, it has been suggested that the economic risk is the most influential risk exposure and therefore the most important risk to manage. For effective risk management a company should perform a comprehensive competitor analysis and consider the effects of exchange rate changes in the long-run. This requires a prediction of firm's operating and financing cash flows and competitor response in the future. However, these three risk exposures cannot be as clearly separated in practice. They can also affect each other. For example, hedging the translation exposure often affects the economic exposure. (Moffett & Karlsen 1994; Hillier et al. 2012: 704–705.)

After the risk is identified the importance and magnitude should be considered. The magnitude can be measured in various ways. First, a regression model estimates the factor betas as slope coefficients from regressions of historical returns or cash flows on the risk factor. The beta reflects the volatility of a certain factor in comparison to the market and thus gives an indication of the risk exposure. The beta estimation is based on the assumption that past events provide the best estimate of the future so the problem arises when the environment is changing. In some cases the factor betas can be pre-

specified using theoretical background. However, this will usually lead to a worse outcome as theory ignores several real conditions. (Hillier et al. 2012: 715–716.)

Second, a simulation method is forward-looking and based on different scenarios of profits and cash flows that would occur under different events. Its biggest advantage is that simulation method concentrates on future events, while regression model is based on history. The disadvantage is that a manager needs to base the estimate of earnings and cash flows on his or her own forecast, which usually gives somewhat distorted outcome. (Hillier et al. 2012: 716.)

Third and most widely used are the common risk measures. They are used to capture the risk exposure under a single number. The most used measure to determine the risk exposure is value at risk, which is the worst possible loss under normal market conditions for a given time horizon and confidence interval. It captures all market variables under a single number and is therefore more reliable and more used than volatility. After the risk is identified a suitable hedging method should be considered. (Hillier et al. 2012: 717–719.)

2.3. Incentives to hedge

Allayannis and Ofek (2001) examine the purposes for which derivatives are used and find that they are primarily used for hedging rather than for speculation. Hence, the main target is to reduce uncertainty in foreign exchange rates, not to obtain additional profits. Similar results are found also by Brunzell, Hansson, and Liljeblom (2011). There are three primary reasons for hedging with derivatives: to reduce the cash flow volatility, to reduce the earnings volatility, and to increase the shareholder value. Whether a firm chooses to stabilize its earnings or cash flow volatility will lead to different results than if it chooses to hedge its value. Allayannis and Weston (2003) suggest that reducing the earnings or cash flow volatility is more important than increasing the firm value because reducing the volatility itself already affects the value. Further, they find that hedging the earnings volatility has a greater impact than hedging the cash flow volatility. Bartram et al. (2011) find that firms reduce at least cash flow risk, total risk, and systematic risk through financial risk management and derivatives. Thus, it seems that reducing earnings or cash flow volatility is the main interest of firms. (Hillier et al. 2012: 697.)

Different incentives occur on the background for the need to stabilize the cash flow or earnings volatility and to increase the firm value. The specified motivation helps to determine the most suitable hedging strategy and the appropriate level of hedging. Theories of hedging suggest that the benefits emerge because hedging reduces financial distress costs, alleviates the underinvestment problem, and declines the expected taxes under a convex tax system. However, the evidence for these hypotheses is mixed although the issue is widely studied (e.g. Smith & Stulz 1985; Nance, Smith & Smithson 1993; Mian 1996; Tufano 1996; Géczy, Minton & Schrand 1997; Gay & Nam 1999; Graham & Rogers 1999; Haushalter 2000; Allayannis & Ofek 2001; Lel 2012). The results seem to be largely sample-specific.

2.3.1. Financial distress costs

Financial distress costs are costs that are associated with difficulties in the financial condition of a firm, such as bankruptcy costs and costs related to reorganizations, debt obligations, and liquidity issues. Further, financial distress can cause conflicts between debt holders and equity holders, and reluctance to operate with a firm with financial difficulties for the most important stakeholders, such as customers and suppliers (Hillier et al. 2012: 689–692). Therefore, the financial distress is costly for a firm but can be reduced by hedging. However, the evidence for this hypothesis is diverse.

Nance et al. (1993) examine all kinds of derivatives use within a sample of Fortune500 firms in 1986. Similarly, Géczy et al. (1997) use a sample of Fortune500 firms in 1991 but examine only foreign currency derivatives. Both Nance et al. (1993) and Géczy et al. (1997) find that firms with tighter financial constraints are more likely to hedge than others. By hedging they can reduce the cash flow and earnings volatility, which enhances the investment planning and enables a cheaper access to capital markets and lower cost of external capital. Thus, a firm can invest in valuable growth opportunities. These findings provide evidence for the financial distress cost hypothesis.

Smith and Stulz (1985) argue that hedging the variability in earnings can reduce the probability of the distress and thus increase firm value. Haushalter (2000) examines commodity hedging policy within oil and gas firms and finds evidence consistent with the financial distress hypothesis. Similarly, Graham and Rogers (1999) and Lel (2009) find support for the hypothesis. If the motivation for hedging is to avoid the financial distress costs, the hedging strategy should both increase the firm value and stabilize the

cash flows. However, several other studies find no evidence for the hypothesis (Allayannis & Ofek 2001; Brunzell et al. 2011). Also, further results from Nance et al. (1993) and Géczy et al. (1997) provide mixed evidence for the financial distress cost hypothesis.

2.3.2. Underinvestment problem

Bessembinder (1991) and Froot, Scharfstein & Stein (1993) suggest hedging as a solution to the underinvestment problem. Investment planning has to be done in advance and the investment delays and alternatives are often costly. Because internal capital is cheaper than external, a firm usually invests correspondingly to its internal cash flows. The future cash flows can vary greatly, and therefore hedging allows firms to plan better for their future capital needs as it stabilizes the cash flows and reduces the need of outside capital markets. Underinvestment can also cause agency problems between company shareholders and debt holders. Specifically, a company refuses to invest in low-risk projects in order to maximize the firm value because low-risk investments do not accumulate shareholder value similarly to risky projects. However, low-risk projects are more secure for the company's debt holders as they are more likely to receive the payment streams from the company in time. Hedging creates value because it reduces incentives to underinvest. This is because it reduces agency costs and improves contracting terms, and reduces the variability of cash flows (Bessembinder 1991).

Gay and Nam (1999) concentrate solely on the underinvestment problem and find support for the hypothesis using several different variables as a measure. The hypothesis is also supported by Géczy et al. (1997), Allayannis and Ofek (2001), and Lel (2009), who all study foreign currency derivatives. They find that highly leveraged growth firms have a greater incentive to hedge. If the main purpose is to improve the planning and decision-making, the hedging strategy should primarily concentrate on hedging the earnings and cash flows rather than the value. Studies such as Nance et al. (1993) and Mian (1996), which cover also other types of derivatives, provide mixed evidence for the underinvestment problem. Specifically, Mian (1996) examines all types of derivatives use for a large sample of firms in 1992 and finds that hedging activities exhibit economies of scale.

2.3.3. Tax convexity

Smith and Stulz (1985) determine how firms can decrease the expected tax liability with derivatives. After Smith and Stulz (1985) hedging can decrease firm's expected tax payments because of the asymmetry of the tax treatment between gains and losses. Since under progressive tax system the tax rate increases along with the income, stabilizing the pre-tax income will lower the overall tax liability. This is especially the case if the income varies greatly over time. (Hillier et al. 2012: 689–690.)

After the hypothesis derivatives are used to reduce the variability in taxable income and thereby to reduce the expected taxes. As a result, the gains from lower tax payments increase the value of a firm. Even though Nance et al. (1993) and Mian (1996) find support for the tax convexity hypothesis, Géczy et al. (1997) and Allayannis and Ofek (2001) find no evidence for the hypothesis when foreign currency derivatives are used.

2.4. Derivatives

A derivative is a financial instrument created for the needs of risk management. Its value depends on the underlying asset, which can be almost anything, for example a stock, an interest rate, an index, a currency, a commodity, or weather. Firms' and investors' growing conscious of the risks and the possibility to control them has resulted as a boom in the derivatives use since 1970–1980. In addition to options, forwards, futures, and swaps, derivatives include also the so-called exotic derivatives, which are more complex and uncommon derivatives and therefore not defined as specifically in this study. They are still included in the empirical part if a firm has used exotic derivatives during the observation period. However, if a firm uses exotic derivatives, it usually uses also the simple ones. (Hillier et al. 2012: 201; Hull 2012: 1–2.)

Derivatives are traded in specialized derivatives exchanges, other exchanges, or alternatively over-the-counter (OTC). Exchange traded derivatives have standardized contracts which means that the exchange defines the content of the contract increasing the liquidity and transparency of the trade. However, the majority of derivatives trading occurs in the OTC-market which is a network formed by derivative brokers, financial institutions, and large corporations. Contracts are not standardized but can be defined by the parties of the trade and therefore include larger risk. (Hull 2012: 2–4.)

Derivatives markets have seduced a wide range of traders. They can be divided into three categories after their demeanour and goals. First, a hedger's aim is to reduce risk that arises from future movements in market variables, which in the case of foreign currency risk are exchange rates. A hedger uses derivatives ethically and for the explicit purposes that derivatives were generated in the first place. Second group of derivatives users, speculators, take substantial risks to make quick and large profits by betting on the future direction of the exchange rate. Thus, they are a contradiction to hedgers. While hedgers try to avoid the risk exposure, speculators wish to take position in the market trusting that the exchange rate moves as they expect. Third group, arbitrageurs, lock a riskless profit by taking two or more offsetting positions. Arbitrage opportunities may momentarily exist in volatile and active markets but the supply and demand set the prices equal very quickly, and the arbitrage opportunity vanishes. (Hull 2012: 9–16.)

A hedger also needs to consider the amount of coverage he or she is willing to attain. Full coverage is not usually the best option and neither is the opposite: leaving the position naked and accepting all the risk. Alternative way is a stop-loss strategy where the loss is eliminated as soon as it occurs. This is however a costly strategy and requires vigilance and active trading. Generally, the most favoured hedging strategy is considered to be delta hedging. Delta is defined as the rate of change of the option price with the respect to the price of the underlying asset. Thus, it represents the slope of the curve that relates the option price to the underlying asset price. For example, if a delta equals 0.7, the option price changes about 70 % times the amount of stock price change. Delta hedging is however a more sophisticated hedging strategy, which is mostly implemented by institutional and professional investors. After all, the company management decides which strategy to follow and how much of the risk exposure is necessary to cover. The hedging method depends also largely on the source of foreign currency exposure and the level of financial risk. (Hull 2012: 378–387.)

Hedging with foreign currency derivatives is reckoned among firms that have a significant foreign currency risk exposure and economies of scale in hedging, but also some other characteristics can be found among firms that hedge. First of all, hedging is more common for larger firms. The reason might be that smaller firms do not have the know-how of effective hedging and do not see it as salient as larger firms because they are dealing with smaller amounts of money. Thus, small and medium size firms often overlook the importance of foreign currency risk management. The lack of know-how is supported by the fact that firms that use other kinds of derivatives are more likely to use also foreign currency derivatives. Bartram et al. (2009) find that derivatives use is related to important financial characteristics such as leverage, debt maturity, holdings of

liquid assets, dividend policy, and operational hedges. On the other hand, the results also show that firms with less liquid derivatives markets are less likely to hedge. After Géczy et al. (1997) also firms with greater growth opportunities, greater analyst following, institutional ownership, and managerial option holdings are more likely to use foreign currency derivatives than others. (Nance et al. 1993; Mian 1996; Géczy et al. 1997; Allayannis & Ofek 2001; Hillier et al. 2012: 708–709.)

2.4.1. Options

An option gives to its holder a right to buy or sell the underlying asset at a pre-specified price and time in the future. On the contrary, an option writer has an obligation to sell or buy this underlying asset at a pre-specified price in the future. Option price, i.e. the option premium is the compensation for the writer for this obligation. The option holder is able to leave the option unexercised but the writer is always forced to sell or buy the underlying asset if the holder wishes so. The largest possible loss for an option holder is the premium paid for the option and the gain is theoretically unlimited. In contrast, the greatest possible gain for the option writer is the option premium while the loss is theoretically unlimited if the price moves unfavourably for the writer. Options have to be exercised before their maturity, or else they expire worthless. (Hillier et al. 2012: 207–211; Hull 2012: 7–9.)

Options can be divided into two categories: call options and put options. A call option gives to its holder a right to buy and obligates the writer to sell the underlying asset, whereas a put option gives to its holder a right to sell and obligates the writer to buy the underlying asset. Option buyers are referred to as having a long position and option sellers as having a short position. Secondly, options can be separated into American and European options. An American option can be exercised at any time up to its maturity, while a European option can be exercised only at the maturity. Therefore, an American option has a time value and is more valuable than a European option if other things equal. (Hull 2012: 7–9.)

Third way to distinguish between different kinds of options is to divide them after the difference between the strike or exercise price and the spot price of the underlying asset. If the strike price equals the spot or market price, option is called at-the-money. If the strike price is lower than the spot price, a call option is in-the-money, and it has an intrinsic value. If the strike price is higher than the spot price, a call option is out-of-the-

money, and it has no intrinsic value. On the contrary, if the strike price is higher than the spot price, a put option is in-the-money. If the strike price is lower than the spot price, a put option is out-of-the-money. (Hull 2012: 201.)

Many different indicators have an impact on the option price, which makes the pricing difficult. These indicators are a spot price, which in terms of the foreign currency derivatives is the spot exchange rate, and an interest rate, which is the interest rate difference between the currencies. In addition, the price is affected by the exercise price, time-to-maturity, volatility, and possible dividends. (Hull 2012: 214.)

There are several option pricing models but the most used and widely accepted is the Black-Scholes-Merton -option pricing model from year 1973. The idea behind the BSM-model is that a risk-free portfolio can be combined from an underlying asset and an option. The profit equals the risk-free interest in the market. The option price can be derived based on this and the assumption that arbitrage is not possible. However, BSM-model includes many unrealistic assumptions as it is based on efficient market hypothesis. It assumes no transaction costs or taxes, that short selling is possible, risk-free interest is constant, investors can lend and borrow at the risk-free rate, and underlying assets pay no dividends. Also, markets are assumed as infinite and arbitrage impossible. The underlying asset is assumed to follow the geometric Brownian motion, i.e. being log-normally distributed. In the real world none of these assumptions can be fulfilled. (Black & Scholes 1973; Merton 1973.)

The pricing of foreign currency options turned out to be even more complex, and it remained unsolved for years. Garman and Kohlhagen managed to solve it in 1983. The formula developed by them is the same as the BSM-model, which takes dividends into account, but the dividend rate is replaced with the foreign currency rate. Because of the possibility to exercise American options at any time, the pricing is much more complex than the pricing of European options. The formulas for European currency option prices are as follows:

(1) $$c = S_0 e^{-r_f T} N(d_1) - K e^{-rT} N(d_2)$$

(2) $$p = K e^{-rT} N(-d_2) - S_0 e^{-r_f T} N(-d_1),$$

where

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

$$d_2 = \frac{\ln\frac{S_0}{K} + \left(r - r_f - \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$$

c = call option price
p = put option price
S_0= spot foreign exchange rate
K = exercise price
T = maturity in years
r = domestic risk-free interest rate
r_f= foreign risk-free interest rate
σ = volatility
N(d) = function of cumulative standard normal distribution

Volatility is the measure of standard deviation so it shows the price fluctuation. Volatility has a substantive effect on the option price, and it can be stated that volatility determines the option price. Therefore, its estimation is the most important but also the most difficult issue in the option pricing as it cannot be directly noticed. Volatility can be measured using historical volatility or implied volatility. Hull (2012: 304–305) determines the historical volatility as follows:

(3) $$\hat{\sigma} = \frac{s}{\sqrt{\tau}},$$

which can be derived from the following:

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(u_i - \bar{u})^2}$$

τ = time period in years
n+1 = number of observations
$u_i = \ln\frac{S_i}{S_{i-1}}$, i = 1, 2,…, n
S_i = foreign exchange rate at the end of i, i = 0, 1, 2,…, n

Implied volatility is the market expectation of the future volatility. Implied volatility can be determined by solving the Black-Scholes -model in terms of volatility by setting the market price as an option price. The outcome is relatively low for at-the-money options but increases progressively as moved towards in-the-money and out-of-the-money options. Regarding currency options implied volatility is more relevant than historical volatility as foreign exchange rates are not log-normally distributed. This is because foreign currency volatilities are not constant and foreign exchange rates do not change constantly. Therefore, the number of outliers increases. Many studies also confirm that implied volatility is the best measure of future volatility. (Hull 2012: 318–320.)

Foreign currency options are mostly traded in over the counter -markets (Hull 2012: 199). Therefore, trading volume, exercise price, time-to-maturity, and other essential conditions are freely negotiable. Some of the trading concentrates in derivatives exchanges where the trading volume is determined after the currency. The biggest difference is the quotation. In derivatives exchanges options are quoted after the price, while in over the counter -markets they are quoted after the volatility. (Hull 2012: 2–4, 210.)

Options are especially suitable for hedging against the foreign currency risk. If a company believes that exchange rate is depreciating, it can hedge its revenues from this unfavourable exchange rate change. Options can be considered as an insurance against the foreign exchange losses. The foreign currency option holder ensures the certain exchange rate but can also enjoy favourable changes of the exchange rate. As a simplification, a company that wants to protect its cash flows should buy a foreign currency call option when it has foreign debt and this way to secure the debt on a predetermined level. Correspondingly, a company should buy foreign currency put when it has foreign revenues. In this case the option restricts the depreciation of the revenue or if exchange rate appreciates, the option expires worthless. The option premium is the cost a holder has to pay for this “insurance”. (Hull 2012: 347–350.)

2.4.2. Forwards

A forward is an agreement to buy or sell the underlying asset at a pre-specified price and time in the future. A forward differs from an option in a way that the buyer is always obligated to buy and the seller obligated to sell the asset and therefore a premium is not paid for a forward contract. Forward trading is concentrated in over the

counter -markets, and thus the contract is non-standardized. Forwards are mainly used for foreign currency hedging even though they can be used also for interest rate or commodity hedging. Forwards are also the most used derivatives in hedging the foreign currency risk because of their simplicity and high liquidity. (Hillier et al. 2012: 203–206; Hull 2012: 5–7.)

A forward can be exercised by delivering the underlying asset, or alternatively by paying the difference between the spot price and the exercise price. When the contract is made, the difference is zero and the forward is worthless. The value of a long forward is positive when the spot price is greater than the exercise price and negative when the spot price is lower than the exercise price. Thus, a long forward profits if the spot price of the underlying asset exceeds the exercise price, and contradictory a short forward profits when the exercise price exceeds the spot price at the maturity. (Hull 2012: 5–7.)

The price of a foreign currency forward is determined after the spot exchange rate and the difference between the interest rates of the two countries as follows (Hull 2012: 114–115):

$$F_0 = S_0 e^{(r-r_f)T}, \quad (4)$$

where
F_0 = forward rate
S_0 = spot foreign exchange rate
r = domestic risk-free interest rate
r_f = foreign risk-free interest rate
T = maturity in years

The forward rate of a currency is based on the interest rate parity so that arbitrage is not possible because of the different interest rates of currencies. The holder of foreign currency has the possibility to earn foreign risk-free interest r_f by investing the currency for time T. The same outcome occurs when the foreign currency is changed into domestic currency and invested with domestic risk-free interest r for time T. (Hull 2012: 114–116.)

The underlying asset in a foreign currency forward is the foreign currency. The measure is usually foreign currency per domestic currency. The buyer of a foreign currency

forward commits to buy the currency at a certain exchange rate at a certain time in the future. A long forward can be considered for hedging if a company has debt in foreign currency. Also, in a case that a company has revenues in foreign currency and the exchange rate is assumed to depreciate, the future revenues can be confirmed on market level (spot rate) with a forward contract. The risk is eliminated and the future revenues secured. (Hull 2012: 114–117.)

2.4.3. Futures

A futures contract is similar to a forward contract. It is also a contract of buying or selling the underlying asset at a predetermined price and date in the future. Standardization separates it from forwards. Futures contracts are usually standardized, and the trading concentrates in derivatives exchanges. The underlying asset, volume, and other terms of trade are therefore predetermined. Thus, the futures contract is more restrictive than a forward. Another difference to a forward contract is the daily settlement of futures. Hence, futures provide constant market information and a guarantee that the contract can be traded before the maturity at a valid market price. This cost-effectiveness replaces partly the non-flexibility of futures. (Hull 2012: 7.)

However, futures are considered more complex derivatives than forwards because of the daily settlement. But, in theory the futures price is assumed to be determined the same way as forward prices. In short-term contracts they often correspond each other, but this is not always the case, if for example the interest rate is not constant. Also, transaction costs, credit risk, and liquidity risk can set the futures price apart from the forward price. Another problem is that futures contract may have to be closed before the maturity. Thus, the hedger cannot be sure of the date when the underlying asset is bought or sold. (Hull 2012: 111–114.)

2.4.4. Swaps

A swap is a contract between two parties of the change of future cash flows. Trading concentrates in over the counter -markets. A swap is suitable for longer term hedging as it is based on long-term money markets and coupon instruments commonly used in those markets. There are several variations of swaps but the most used are interest rate

and currency swaps. In an interest rate swap the fixed interest rate is changed into floating interest rate or vice versa. (Hillier et al. 2012: 206–207; Hull 2012: 148.)

In a currency swap the parties of the contract change the principal and the interest of one currency into those of another currency. For example, if a Finnish company has domestic debt with fixed interest and it is willing to change this euro loan into dollars, it can sign a swap contract with a bank or other financial institution. The bank tries to find another party, which is willing to change a dollar loan into euros. Both parties sign the contract with the bank even though they change the payments with each other. In a currency swap the payment is determined in both currencies. Cash flows are changed in the beginning and in the end of the contract. The amount to be changed is based on the exchange rate in the beginning of the contract. Thus, the value can diverge greatly when the cash flows are changed in the end. (Hull 2012: 165–168.)

There are two ways to calculate the price of a currency swap. Pricing can be based on bond prices or on a portfolio of forward contracts. This is because a cash flow change in a currency swap with fixed interest rate is basically the same as a foreign currency forward. The interest rate is assumed fixed to be able to calculate the price. The price can be determined as the difference between domestic bond value and foreign bond value as follows (Hull 2012: 168–169):

$$V_{swap} = B_D - S_0 B_F, \quad (5)$$

where
V_{swap} = swap value
B_D = bond value in domestic cash flows
B_F = bond value in foreign cash flows
S_0 = spot exchange rate

3. DERIVATIVES USE AND FIRM MARKET VALUE

This section will concentrate on the previous studies of derivatives use. Generally, the hedging activity is widely studied, but only recent studies concentrate on the direct relationship between foreign currency derivatives hedging and firm value. This is due to unavailability of data since until 1990s firms did not disclose their derivatives use because it was thought as an important strategic factor (Allayannis & Weston 2001). Therefore, the earliest studies use survey data. Firm market value is most commonly measured by Tobin's Q. Only Nelson et al. (2005) examine the impact of foreign currency derivatives use and abnormal stock returns.

The direct relationship between derivatives use and firm market value or stock returns is particularly of the main interests of shareholders. The majority of value effect studies are in favour of hedging but the evidence is somewhat mixed. Also, the theory of corporate hedging suggests an increase in value due to market imperfections. The literature review of derivatives use and firm market value is divided into three subsections after the results of the previous studies whether the impact of hedging has been zero, positive, or negative. But, first the concept of firm market value is handled, specifically the factors affecting it and possible ways of measuring it.

3.1. Firm market value

Firm market value means the current value of all shares and thus tells how much the firm is worth at the moment. Market value usually differs from book value, which is based on historical or original values. Firm market value is a core indicator in firm performance, and therefore it is used in several studies as it gives an estimation of the current value of firm's assets and liabilities. It can be measured in different ways, but in this study Tobin's Q is chosen as an appropriate measure. To capture the effect of derivatives use more comprehensively annual stock returns are further determined, although they do not directly measure the firm value. (Brealey, Myers & Marcus 2007: 52–53.)

Several factors affect the market value of a firm, and therefore the measures are not fully comparable. Most measures take into account for example the size of a firm to assess the comparability, but there are also large differences between industries, geographical locations, and eras, which are not included in the measures. As stated

before, the firm market value indicates the performance of a company. Therefore, profitability and positive growth opportunities increase the firm market value, while leverage and bad credit classification decrease the value. Also, the ability to access financial markets has an impact on the firm market value. If a firm has no access to capital markets, it has a negative impact on the value because of the limitation of credit and financial services. (Allayannis & Weston 2001; Brealey et al. 2007: 52–53.)

The firm market value can be measured in various ways. The most common measures are price-earnings ratio (P/E-ratio), dividend yield, market-to-book ratio, and Tobin's Q. P/E-ratio is the stock price divided by earnings per share. Thus, it measures the price investors are ready to pay for each unit of earnings. A high P/E-ratio usually indicates good growth opportunities or relatively safe earnings, but it can be temporarily high also because of low earnings. (Brealey & Myers 2000: 829–830.)

Dividend yield is calculated by dividing the dividend per share by the stock price. A high dividend yield implements under-priced stock or decrease in future dividends as the dividends paid earlier have been too extensive compared to company performance. (Brealey & Myers 2000: 829–830.)

Market-to-book ratio is the stock price divided by the book value per share. It tells how much the company is worth regard to its book value. If market-to-book ratio equals 1, the current stock price equals the book value. A high market-to-book ratio means that the stock is overpriced or that the firm has grown rapidly and become more valuable. (Brealey & Myers 2000: 829–830.)

Tobin's Q is the fourth way represented here of measuring the firm market value. It is used in the empirical part of the study and therefore focused more accurately. Tobin's Q is developed by James Tobin (1969) as the market value of firm's assets per estimated replacement costs of the assets. Replacement costs mean the market price for newly produced goods. It is noticeable that the market value of assets includes all firm's equity and debt securities, while for example market-to-book ratio includes only common stock. Also the replacement cost includes all assets. It is an estimate of real costs to replace the assets, not what is shown in the firm's books as the inflation usually drives the real value above the original. (Brealey & Myers 2000: 829–830; Tobin 1969.)

Tobin's Q is based on the assumptions that the market value of all assets should equal the replacement cost of assets, and thus the value should theoretically equal 1. A high Tobin's Q value means that capital equipment is worth more than the cost of replacing it, and the stock is overvalued. Contradictory, a low Tobin's Q value states that the

equipment is worth less than it would cost to replace it, and the stock seems undervalued. Therefore, a high Q encourages companies to invest and implies good growth opportunities. After Tobin (1969) companies are willing to invest as long as the Q is greater than 1 but as soon as it drops below 1 the investment incentive disappears. It has turned out that companies with high Q are firms with a strong brand or know-how. If the Q is low, companies often act in highly competitive and shrinking industries. (Brealey & Myers 2000: 831; Tobin 1969.)

3.2. Hedging creates zero net present value

Modigliani and Miller (1958) provide a background for hedging studies, and especially for the impact on firm value. They argue that firm's hedging policy is irrelevant regarding to firm value. Shareholders can as well manage the risk by themselves and with the same costs than corporations. However, their findings do not reflect the reality as the markets are assumed to be efficient. In the real world the information is asymmetric and there exist taxes, transaction costs, bankruptcy costs, and costly external financing, which make the market inefficient. The zero net present value effect holds only when all the efficient market assumptions hold. Even though the real world does not function as assumed in Modigliani and Miller (1958), their paper started a debate of the value-adding effect of risk management, and several studies of the effects of hedging followed.

Jin and Jorion (2006) study a sample of oil and gas firms and either find no value effects. Their sample consists of 119 U.S. firms in years 1998–2001 for which they test the difference in firm values between those who hedge and those who choose to remain unhedged. Similar to Modigliani and Miller (1958) they suggest that hedging by firms does not entail special advantage as investors can hedge on their own. However, Jin and Jorion's (2006) results may be biased because their sample selection of firms in oil and gas industry is such that the investors might prefer firms not to hedge. As Jin and Jorion (2006) state, the foreign currency exposure is much harder to identify and the optimal hedging policies more complex, and therefore the foreign currency risk is more difficult to hedge away by individual investors. Thus, it might be more beneficial for firms to hedge the foreign currency risk than a certain commodity risk, such as the oil and gas price risk, suggesting that the hedging premium is largely dependent on the risk type to which the firm is exposed.

Guay and Kothari (2003) study cash flow and market value sensitivities of financial derivative portfolios to extreme changes in the underlying asset prices. They argue that based on the magnitudes of notional amounts of derivatives used by U.S. firms, the value implications of derivatives use are modest. At most, median firm's derivatives portfolio can generate 15 million dollars in cash and 31 million dollars in value when interest rates, foreign exchange rates, and commodity prices change by three standard deviations at the same time. These amounts are small compared to overall values and cash flows of firms. Also, they show that a median firm holds derivatives so that they cover only 3 % to 6 % of firm's interest rate or foreign currency exposures. Therefore, corporate derivatives use seems to be a negligible piece of nonfinancial firms' risk profile implying that derivatives are not used with a degree that is economically important.

3.3. Hedging creates positive net present value

Theories of hedging based on market imperfections mainly suggest that hedging is associated with increased firm value (e.g. Smith & Stulz 1985; Allayannis & Weston 2001; Mackay & Moeller 2007). As mentioned earlier, Graham and Rogers (1999) concentrate on the widely studied issue of hedging incentives. However, aside they make conclusions whether corporate hedging with foreign currency and interest rate derivatives maximize firm value. Their results show that hedging increases debt capacity and interest deductions and thus firm value. The estimated increase in value related to tax convexity is smaller than the tax gain associated with increased debt capacity. The value premium from tax benefits is positive, and thus hedging may increase firm value.

The first empirical examination of the direct relation between derivatives use and firm market value is by Allayannis and Weston (2001). Their study is widely recognised in the field of finance. Allayannis and Weston (2001) examine the association between foreign currency derivatives use and firm market value for a sample of 720 large U.S. firms in years 1990–1995. Using Tobin's Q and industry-adjusted Tobin's Q as proxies for the firm market value, they first perform a univariate test to show the relationship between hedgers and non-hedgers. Further, a multivariate test is performed to control for size, profitability, leverage, growth opportunities, access to financial markets, geographical and industrial diversification, credit quality, industry effects, firm fixed effects, and time effects.

Allayannis and Weston (2001) perform also sensitivity analysis and time-series analysis. Sensitivity analysis explores the robustness of alternative firm value measures and alternative estimation techniques for the impact of outliers. Allayannis and Weston (2001) use three alternative measures for firm value: Tobin's Q measured according to Perfect and Wiles (1994), a simple measure of the market value of a firm to the book value of assets, i.e. the simple Q, and the ratio of the market value of a firm to the book value of total sales. They find that the results are independent of the measurement technique. Time-series analysis controls for the reverse causality, so whether it is hedging that causes firms to have higher values, not that higher market value makes firms to hedge. This is tested because firms with high market value have high growth opportunities and thus their incentive and likelihood to hedge may be greater. Further, an event study is performed to test more directly the reverse causality. In the event study the changes in the hedging positions between different years are examined.

Allayannis and Weston (2001) find a statistically significant, positive hedging premium of 4.87 %, which states that the use of foreign currency derivatives raises firm value compared to firms that do not hedge their currency exposure. The value premium is positive for firms with and without foreign sales, but the size of the premium is bigger for firms with foreign sales. This can be expected as their exposure to foreign currency risk is larger than firms' that do not have foreign sales and expose only to the economic risk. In addition, majority of firms without foreign sales do not use foreign currency derivatives. The value premium is also positive both during the years when dollar has depreciated and appreciated, but the premium is larger during the years of appreciation. Further, the results show that firms that begin to hedge experience an increase in value, while firms that quit hedging experience a decrease in value. This affirms that hedging increases firm value, not that high market value firms choose to hedge.

Similar results are found by Nelson et al. (2005). Their greatest contribution is to use abnormal stock returns as a performance measure in addition to Tobin's Q. Abnormal stock returns are measured using Fama-French four factor model and compared between hedgers and non-hedgers. Thus, they show the direct stock return reaction to hedging activity. The simple model of Tobin's Q ratio is further used to capture the effect more profoundly. Nelson et al.'s (2005) sample consists of 1,308 U.S. companies from years 1995–1999. Only 21.6 % of these use derivatives in hedging. The low degree of hedging firms occurs presumably because Nelson et al. (2005) use a broad sample of all kinds of firms instead of only large companies, which are more likely to use derivatives. The most used derivatives are foreign currency and interest rate derivatives. After their results hedging firms enjoy a 4.3 % annual abnormal return on average. Specifically, the

classification between different types of derivatives reveals that the outperformance of hedging firms is due to the foreign currency derivatives. No abnormal returns are found for firms that hedge with interest rate or commodity derivatives. The comparison between large and small firms further shows that the benefits of hedging concentrate among larger firms, while the hedging premium for small firms is negative. It is also noteworthy that significant results cannot be found for any kind of derivatives when an augmented model is used, which controls for the role of intangible assets.

Carter et al. (2006) use similar methods to Allayannis and Weston (2001) to study the impact of commodity derivatives use on firm market value in the U.S. airline industry. The financial risk of fuel prices is economically very significant for airlines, and therefore price volatility has a large impact on firm's costs. Carter et al.'s (2006) findings provide support to Allayannis and Weston (2001). More explicitly, airlines which hedge fuel costs with commodity derivatives increase their value significantly. The hedging premium in airline industry can be as large as 10 %. Hedging alleviates the underinvestment problem by smoothing the income flows and allowing airlines to expand their operations also when times are bad. However, efficient hedges might be easier to obtain in airline industry than in markets that are exposed to foreign currency risk, because the future movements of fuel prices may be easier to forecast than the future movements of exchange rates. This contradicts to Jin and Jorion (2006) who suggest that this kind of specific commodity price risk can as well be hedged away by individual investors, and therefore firm hedging does not entail additional value. The contradictory results are surprising because of the similar sample selection of oil and gas industry and airline industry where the hedging effects ought to be similar.

Belghitar, Clark, and Judge (2008) study the effects of interest rate and foreign currency derivatives hedging on firm value among U.K. firms. In addition to the Tobin's Q they measure the value impact with a tax shield through increased debt capacity, i.e. the firm's ability to take on more debt. They find that derivative hedging is generally superior to other types of hedging. Also, interest rate hedgers are rewarded with higher value premiums than foreign currency hedgers. The difference between interest rate and foreign currency derivatives is substantial. Interest rate hedging seems to create over six times more value compared to foreign currency hedging, which explains mostly the outperformance of derivatives hedging compared to other types of hedging. The relationship between hedging and Tobin's Q is also much stronger than in previous studies from the U.S.. The overall value premium for foreign currency derivative hedgers varies between 8.5 % and 15.3 %. When only the foreign currency hedging, or alternatively only the interest rate hedging, is considered the value premiums are 13.9 %

for foreign currency derivatives and as large as 62.9 % for interest rate derivatives, both statistically significant. The larger value premium compared to previous studies may be however because U.K. firms have more foreign sales than their U.S. counterparts. Therefore, they are more strongly exposed to the foreign currency risk and thus potentially have greater benefits of hedging. Belghitar et al. (2008) suggest that the larger premiums might occur because the U.S. studies often include also non-derivative hedging firms, which may bias the results. Also, institutional differences in the bankruptcy codes can be a reason for larger value effects in the U.K.. They cause higher expected financial distress costs for U.K. firms, and thus the benefits from hedging are greater.

Clark and Judge (2009) continue the examination of the impacts of different hedging instruments and different risk exposures on firm value within U.K. firms using the exactly same sample as Belghitar et al. (2008). They investigate forwards, options, swaps, and foreign currency debt separately and mixing different combinations of these instruments. Foreign currency forwards and options are mainly used to hedge short-term exposure, and foreign currency swaps and foreign currency debt are used to hedge long-term exposure. Their findings show that foreign currency derivatives are associated with higher firm value, while foreign currency debt does not increase value except when combined with foreign currency derivatives. Long-term swap contracts create the highest value effects, the value premium varying from 18.5 % to 24 %. The value premium for options and forwards, i.e. the short-term derivative contracts, varies from 13.2 % to 14.2 %. These value premiums are of the same size as Belghitar et al.'s (2008) implying that the obtained premiums can be remarkable and raise firm value considerably. However, the value premiums may be larger again because of the same reasons that are stated above of the differences between the U.K. and the U.S. studies and their samples.

More evidence outside the U.S. is provided by Pramborg (2004) and Brunzell et al. (2011). They study all types of derivatives use in Sweden and in Nordic countries, respectively. Pramborg (2004) studies a sample of Swedish nonfinancial firms in years 1997–2001 and pays a specific attention on the impact of geographical diversification. His results show that firms that are geographically diversified and hedge are rewarded with value premiums. An interesting finding is that the positive value effect is associated with hedging the transaction exposure, while hedging the translation exposure does not increase firm value. Therefore, firms should primarily hedge to reduce the volatility in cash flows. Results from cross-sectional regression show that hedging creates 13.8 % additional value and that hedging translation exposure has a

negative impact on firm value. However, these results are not supported by the panel data regressions due to insignificant results, which possibly occur because of the rather short sample period. The evidence also suggests that firms with long position in foreign currency have higher value on average, while firms with short position in foreign currency have lower Tobin's Q and lower value.

Brunzell et al. (2011) study a sample of Nordic firms including also financial firms. They distinguish between firms that use derivatives for hedging purposes and those that use them for speculative purposes. They find that derivatives are more often used for hedging, but over half of the firms still report to use them for additional income, i.e. for speculation. Interesting observation is their finding of significant differences between firms with national currencies (Sweden, Denmark, and Iceland) and Finland, which is part of the Eurozone. Eurozone firms seem to use more derivatives, potentially due to a better access in derivatives that are traded in domestic currency. Brunzell et al. (2011) further examine the effect of derivatives use on firm value and find a small positive impact at 10 % significance level. The data are gathered with questionnaires, while in previous studies they are collected from annual reports. The problem lies in the response rate as less than one fifth of the firms to whom the questionnaire was sent answered. Further, the derivative use is studied in general level and does not separate for different types of derivatives.

More recently, studies such as Bartram et al. (2011) and Allayannis, Lel, and Miller (2012) use a wider array of data around the world to capture the value impact of derivatives use. Bartram et al. (2011) study the effects of derivatives use on firm risk and value for a large sample of nonfinancial firms from 47 countries. They study the impact of interest rate, foreign currency, and commodity derivatives use on cash flow volatility, standard deviation of stock returns, market betas, and market values. Because of the large data set of 6,888 firms and wide range of risk measures their results can be applied in various financial areas. Bartram et al. (2011) find a positive effect of derivatives use on firm value. Especially, they find that derivatives are associated with significantly higher value, larger abnormal returns, and larger profits during an economic downturn in 2001–2002. This sheds some light to the expected results of this study. In addition, Bartram et al. (2011) find that firms are more likely to use derivatives when they are more strongly exposed to the risk and that derivatives use reduces cash flow risk, total risk, and systematic risk of a firm.

Allayannis, Lel and Miller (2012) extend the previous field of study by involving the role of corporate governance in the relation between foreign currency derivatives use

and firm market value. Since derivatives can be used for hedging, manager's self interests, or for speculative purposes, companies with a descent corporate governance are most likely to use them only for hedging purposes, which should enhance investor value. On the contrary, the activities for manager's self interest and speculation are not expected to benefit investors. Allayannis et al.'s (2012) sample covers observations from 39 different countries with significant foreign exchange exposure. After their findings firms that use foreign currency derivatives and have strong governance are associated with a significant value premium. The association is more pronounced when both the internal firm level governance and external country level governance are strong. In contrast, no value premium is found for firms with weak corporate governance.

3.4. Hedging creates negative net present value

Naito and Laux (2011) research whether derivatives generally increase firm value or destroy it. Their sample consists of 434 nonfinancial firms listed in the S&P500 in February 2011. Their study is performed similarly to Allayannis and Weston (2001) by conducting both univariate and multivariate tests. Even though the univariate test does not provide the most reliable results due to the lack of control variables, according to it firm market value is greater for non-hedgers. The mean Tobin's Q for non-hedgers is 2.11 while for hedgers it is 1.84 at 10 % significance level. However, the multivariate tests in general support the hypothesis that the derivatives use increases firm value but the results turn out to be somewhat insignificant suggesting no value effect. Further, the multivariate tests that account for how derivatives are used suggest a negative association between derivatives hedging and firm value at 1 % significance level. The study suggests that derivatives hedging may be less relevant than previously thought but due to insignificant results, any major conclusions cannot be made.

When the movement of an exchange rate is opposite to the expectation, a derivative can lock a worse exchange rate than a market would provide at the end of the contract. Because exchange rates move unpredictably, the outcome of hedging can be sometimes worse than without any hedges. Some hedging strategies include barrier levels, which can eliminate the hedge and make the outcome very negative. For example, an option contract can include a clause that if a certain exchange rate level is reached, the option is not valid anymore. These are dangerous especially if big movements in exchange rates occur. The negative impact of hedging can also occur due to the fact that some

hedges are costly to implement. The option premium must be paid whatever the outcome turns out to be. If market movements differ from expected and the hedge is incorrect, the result of hedging is negative. Also, effective hedges are not easy to create as the future market movements cannot be reliably forecasted. Therefore, the cost of hedging may exceed the benefits.

3.5. Summary of value studies

Table 1 presents a summary of previous studies of hedging and firm market value. The first two columns point out the study. "Author" indicates the researchers of the study and "year" the time of publication. Next columns describe briefly the data. "Market" indicates the geographical location of the data, "observation period" the years under examination, and "sample size" the number of firms included in the data. Since Modigliani and Miller (1958) is only theoretical, any data samples are not used. The results of the study are seen in the column "value premium". Value premiums are primarily for foreign currency derivative hedging. But, as several studies do not separate for different kind of derivatives use (e.g. Guay & Kothari 2003; Pramborg 2004) the value premium reflects the overall hedging policy in these cases. Value premiums are statistically significant at least at 10 % significance level. The exception is Jin and Jorion (2006), which provides insignificant results. Further, Bartram et al.'s (2011) results are only partly significant, and Naito and Laux's (2011) results are significant only in the univariate test but turn out insignificant in the multivariate test. Therefore, the negative value premium of -12.8 % is from the univariate test. The column "hedging type" reflects the hedging policy how value premiums are obtained.

As noted in Table 1, the field of derivatives hedging study is novel as all the empirical studies are from the 2000s. Especially the first studies concentrate mostly in the U.S. market, but recent studies expand also to other market areas. Pramborg (2004) and Brunzell et al. (2011) study Nordic firms, and thus the firms included in their samples are similar to the companies in this study. Latest studies include a large international data set. The majority of previous studies have found a positive value premium even though in some cases it occurs to be only weak. Especially foreign currency derivatives use seems to entail additional value. Only few studies indicate negative or zero value premiums (Modigliani & Miller 1958; Jin & Jorion 2006; Naito & Laux 2011). Further, most of the studies use Tobin's Q as a proxy for firm market value (e.g. Allayannis & Weston 2001; Pramborg 2004; Belghitar et al. 2008; Naito & Laux 2011). Only Nelson

et al. (2005) use, additionally to Tobin's Q, abnormal stock returns to capture the value increasing effects.

Table 1. Summary of previous studies of hedging and firm market value.

Author	Year	Market	Observation period	Sample size	Value premium	Hedging type
Modigliani & Miller	1958				no	All hedging
Graham & Rogers	1999	U.S.	1995	531 firms	2.2-3.5 %	FCDs and IRDs
Allayannis & Weston	2001	U.S.	1990-1995	720 large firms	4.9 %	FCDs
Guay & Kothari	2003	U.S.	1995-1997	234 large firms	minimal	All derivatives
Pramborg	2004	Swedish	1997-2001	130 firms	13.8 %	All derivatives
Nelson, Moffit & Affleck-Graves	2005	U.S.	1995-1999	1308 firms	4.3 %	All derivatives
Carter, Rogers & Simkins	2006	U.S.	1992-2003	28 airline firms	5-10 %	CPDs
Jin & Jorion	2006	U.S.	1998-2001	119 oil and gas producers	no	CPDs
Belghitar, Clark & Judge	2008	U.K.	1995	412 firms	13.9 %	FCDs
Clark & Judge	2009	U.K.	1995	412 firms	13.7 %	FCDs
Brunzell, Hansson & Liljeblom	2011	Nordic	2006	112 firms (also financial)	1.8-2.1 %	All derivatives
Naito & Laux	2011	U.S.	2011	434 large firms	- 12.8 %	All derivatives
Bartram, Brown & Conrad	2011	International	1998-2003	6888 firms	5-15 %	All derivatives
Allayannis, Lel & Miller	2012	International	1990-1999	372 cross-listed firms	13.0-21.9 %	FCDs

FCDs refer to foreign currency derivatives, IRDs to interest rate derivatives, and CPDs to commodity price derivatives.

4. EMPIRICAL PART

This section concentrates on the empirical part of the study. The interest is in the value effect of foreign currency derivatives use. Explicitly, the effects on Tobin's Q and stock returns are examined. The sample covers Finnish companies during the financial downturn 2007–2012. The prior research in this area is incomplete, but the research results are relevant for Finnish companies.

The empirical part begins with an overview of foreign exchange rate movements during the data period. It is followed by a data description with a sample formation, explanation of regression variables, and summary statistics, which provides descriptive measures for the regression variables. Methodology provides a profound view of the empirical tests. It is divided to univariate and multivariate analysis. Univariate analysis covers mean and median tests and univariate regression where only foreign currency derivatives use is used as an explanatory variable. Multivariate regressions add also a set of control variables as explanatory variables. Finally, the results are presented and analysed separately for Tobin's Q regressions and stock return regressions.

4.1. Foreign exchange rate movements

The most important trade currencies regarding Finnish companies are the U.S. dollar (EUR/USD), the Swedish krona (EUR/SEK), the Russian rouble (EUR/RUB), the British pound sterling (EUR/GBP), the Japanese yen (EUR/JPY), the Chinese yuan renminbi (EUR/CNY), the Norwegian krone (EUR/NOK), the Danish krone (EUR/DKK), the Swiss franc (EUR/CHF), and the Polish zloty (EUR/PLN). In the parentheses are the abbreviations of euro exchange rate against each currency. Figure 1 shows exchange rate movements of those currencies during the observation period 2007–2012. Thus, it also shows how large foreign exchange effects may be if a firm has operations in foreign currencies and do not hedge them. In that case firms are exposed to the raw movements of exchange rates. On the other hand, unfavourable hedges may even impair the outcome. Nevertheless, with suitable hedges the outcome should be better, cash flows more constant, and extreme exchange rate movements ruled out.

During the observation period 2007–2012 of financial crisis and instability exchange rate movements have been big and sudden. The trend in the euro-dollar (EUR/USD)

exchange rate has been up-and-down, after the financial crisis escalated from the U.S. to Europe in 2008–2009. The substantial depreciation of the euro in the third quarter of 2008 made imports from the U.S. expensive. Similar rise in export prices occurred when the euro then appreciated. If a company left its positions unhedged, the amounts paid and received might have been far from budgeted.

The Norwegian krone (EUR/NOK) and the Swedish krona (EUR/SEK) exchange rates have followed each other. After the euro appreciation peak in late 2008 and early 2009 the value of euro has depreciated against both currencies. This is mostly because the euro area has suffered from the euro crisis. This can be seen also from the euro's movement against the Swiss franc (EUR/CHF), which is considered as a strong and stable currency. Apart from few spikes where the euro has appreciated, the value of the euro has quite evenly depreciated against the Swiss franc. But, in 2012 the exchange rate has been rather stable when also the euro area showed some signs of financial rebound. The exchange rate consequences of financial crisis are easily seen also in the euro-zloty (EUR/PLN) exchange rate especially in late 2008 and early 2009. The Danish krone has been stable against the euro (EUR/DKK), because the krone is bound to the euro via European Union's exchange rate mechanism (ERM II). It allows the Danish krone to fluctuate against the euro with a tight band of 2.25 % in both directions (European Commission 2013).

Until 2009 the euro has appreciated against the British sterling (EUR/GBP) and the Russian rouble (EUR/RUB), but afterwards the exchange rates have moved without a specific direction. Against the sterling the direction can be seen as slightly depreciative. The rouble is bound to a euro-dollar currency basket, and therefore the movements are highly affected by events in the U.S. dollar and in the euro. The pattern of the rouble has been similar to the Polish zloty after the worst of the crisis.

The euro has depreciated against the Japanese yen (EUR/JPY) and the Chinese yuan (EUR/CNY) during the observation period. Even though the financial crisis reached the entire world, except some developing countries, the crisis hit harder in Europe and in the U.S. than in Asia. Therefore, the trend has been depreciative even though spikes in both directions have occurred, especially in the Chinese yuan. As seen in Figure 1 the exchange rate movements have been enormous in late 2008 and early 2009 when the financial crisis was at its worst. It is easy to notice that major events shake exchange rates quickly and in a large scale. But, also minor news has an effect on exchange rates, as they are extremely sensitive and volatile by their nature. Therefore, hedging smoothens cash flows and revenues, and makes for example budgeting more efficient.

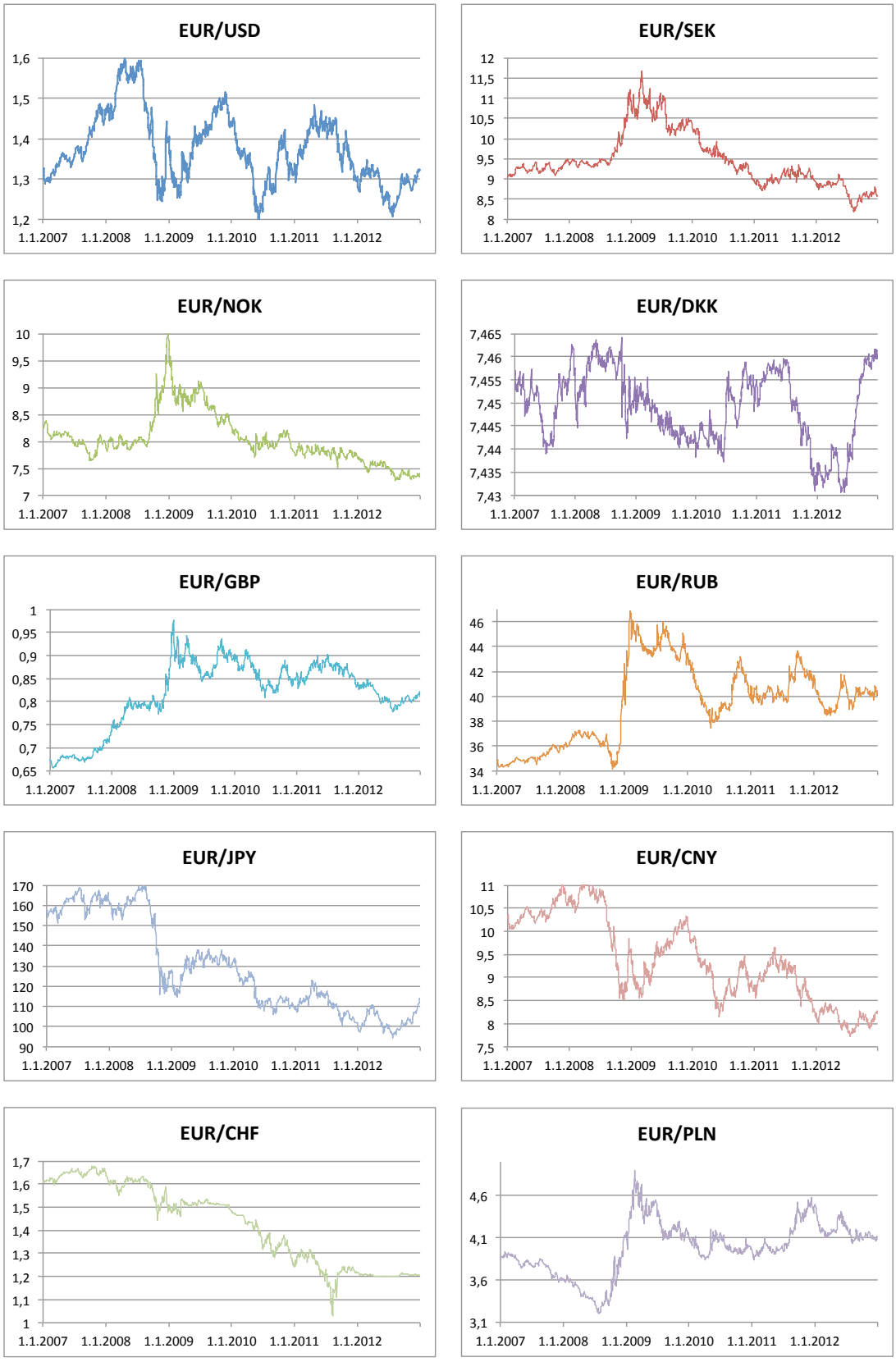

Figure 1. Exchange rate movements against the euro in 2007–2012.

4.2. Data

The data consist of the companies in Nasdaq OMX Helsinki in years 2007–2012 and thus concentrates on the Finnish market. The financial downturn under research started in 2007 with a sudden crisis and lasted the entire observation period of six years. The first two years were the worst part of the crisis, but also some new hot spots emerged during the slow recovery towards the end of the observation period.

The Finnish market differs from the widely studied U.S. market first in its size, as the Finnish market is significantly smaller than the U.S. market. Also, the environment is different because of the great difference in the size of these two countries. Therefore, Finnish companies are almost forced to operate with foreign counterparts, while the U.S. firms can only depend on the domestic market. For that reason Finnish firms normally have more foreign sales, and therefore the foreign currency risk exposure is larger. Evidence for this is provided by Bartram et al. (2009) who find that the magnitude of derivatives use is much higher in Europe than in the U.S.. Specifically, the degree of derivatives users in Europe is 50.9 % while in the U.S. it is 37.7. %. The currency is also different in Finland and in the U.S. the first one using the euro and the second using the U.S. dollar. These two currencies however are very liquid in derivatives market, and therefore it should not cause major differences between the access in derivatives markets. Cultural characteristics are similar, even though geographically Finland and the U.S. are located far from each other.

4.2.1. Sample description

The sample includes all nonfinancial firms listed in Nasdaq OMX Helsinki in 2007–2012 because the data are best available for listed firms. The sample mainly contains Finnish companies even though part of the ownership of these companies may belong to foreign owners. Also, Swedish companies listed in Nasdaq OMX Helsinki, such as TeliaSonera and Sotkamo Silver, are included in the sample. The sample size varies from 105 firm-year observations in 2011 to 112 firm-year observations in 2007 forming a final sample of 651 observations. All financial firms are excluded from the sample because they are usually market makers in the derivatives market, and therefore their derivatives use differs from nonfinancial companies. In total 107 companies are eliminated from the sample as financial firms, the number varying from 16 to 19 every

year. If the company has two listed shares, for example an A share and a B share, the most liquid is kept and the other one deleted. The deleted share is in every case the A, the K, or the R share. Even though a firm is listed or delisted during the data period, it is still included in the sample. This is possible because the regression model processes observations as independent cross sections, and thus the sample can be formed from different firms every year. Firms with incomplete information regarding the key figures are deleted. These concern firms with unavailable data for Tobin's Q, foreign currency derivatives use, and foreign sales. All firms with any missing information are deleted from the final multivariate regressions.

The data set is panel data or longitudinal data by its character since the data consist of repeated observations on the same cross sections. Cross-sectional units are firms and observations are the variables collected for the regression model. The number of cross sections is large (105–112) compared to the rather short time period of six years. The data have also pooled cross section features because the sample varies slightly between observation years. (Wooldridge 2011: 5–7.)

The data for this study are mainly acquired from Bloomberg database. The information of foreign currency derivatives use is manually collected from companies' annual reports and financial statements each fiscal year. Credit ratings are applied from Moody's Analytics Credit Edge. Foreign sales ratio is applied from Datastream. The data are completed using annual reports and Datastream and Worldscope databases. The summary of data sources is in Table 4.

4.2.2. Regression variables

Natural logarithm of Tobin's Q and logarithmic stock returns are separately used as dependent variables in univariate and multivariate regressions. The test variable in both regressions is the foreign currency derivatives use. A set of control variables is used in multivariate regressions. These controls are size, profitability, leverage, growth opportunities, ability to access financial markets, geographical and industrial diversification, credit quality, sector, and time effect. In addition, beta is used to model the systematic risk in the stock return regression.

Natural logarithm of *Tobin's Q* is used as the dependent variable in the regression model to measure the market value of a firm. Tobin's Q is useful because it standardizes

different size firms. It is defined as the ratio of market value of assets and the replacement cost of these assets (Equation 6). The market value of total assets is the book value of total assets subtracted by the book value of equity plus the market value of equity. The book value of total assets is used as the replacement cost of the assets. This simple form of Tobin's Q is used also in most of the previous studies (e.g. Allayannis & Weston 2001; Pramborg 2004; Belghitar et al. 2008; Naito & Laux 2011). In addition, Allayannis and Weston (2001) find it irrelevant which form of Tobin's Q to use. All measures provide similar results. The mean (1.63) and median (1.25) values of Tobin's Q differ suggesting that the Tobin's Q distribution is skewed (Table 5). Therefore, natural logarithm of Tobin's Q is used.

(6) $$Tobin's\ Q = \frac{market\ value\ of\ all\ assets}{replacement\ cost\ of\ all\ assets}$$

The test variable is *foreign currency derivatives (FCD) use*. Firms are classified as FCD users if they have used foreign currency options, forwards, futures, swaps, or exotic derivatives during the observation year. Most of the companies use either options or forwards, but there are also some firms that use swaps and futures. The problem is that firms do not describe explicitly their foreign currency exposure or hedging rate. Sometimes only the binomial value of FCD use is reported. Therefore, a dummy variable is used and firms classified only as hedgers or non-hedgers. Dummy variable equals one if a firm has used foreign currency derivatives during the observation year. If a firm reports that no currency derivatives were used during the financial year, or if the annual report does not contain any information about firm's derivatives use, it is regarded as non-hedger and the dummy variable is set to zero. The data are manually collected from firms' annual reports. Annual reports for listed firms are available in Internet. Key words, such as "derivative", "forward", "future", "option", "swap", "foreign currency", "foreign exchange", "risk management", and "currency risk" are used. The sample also includes firms that have only minor foreign exchange risk exposure and for that reason do not use foreign currency derivatives. These firms are regarded as non-hedgers without foreign sales.

The number of firms using foreign currency derivatives has been quite constant during the observation period. This can be seen in Table 2. In general 65.75 % of OMXH companies uses foreign currency derivatives. The amount of hedgers is somewhat bigger than in Bartram et al. (2009), which finds that 50.9 % of European firms hedge with foreign currency derivatives. The percentage of hedgers increases steadily from

63.39 % in 2007 to 68.87 % in 2012. Still, about one-third does not use foreign currency derivatives. The reason may be simply because firms do not have foreign currency exposure. However, the comparison between firms that have foreign operations and those that do not have them reveals that 22.43 % of firms with foreign operations remains unhedged. Firms are regarded as having foreign operations if foreign sales of total sales exceed 10 %.

An absolute majority of firms, which do not have foreign operations do not use foreign currency derivatives either, the percentage being 92.77 %. From the entire sample 11.83 % of firms belong to this group. However, few firms without foreign operations are still using foreign currency derivatives. This may be rational because firms with no foreign sales may have foreign currency exposure through export and import competition. Overall, an indisputable majority of firms with foreign operations use foreign currency derivatives and majority of firms without foreign operations do not use them.

Table 2. Foreign currency derivatives use profile.

	2007	2008	2009	2010	2011	2012	All
Number of firms	112	110	109	109	105	106	651
Firms using FCDs	71	70	71	72	71	73	428
%	(63.39)	(63.64)	(65.14)	(66.06)	(67.62)	(68.87)	(65.75)
Firms not using FCDs	41	40	38	37	34	33	223
%	(36.61)	(36.36)	(34.86)	(33.94)	(32.38)	(31.13)	(34.25)
Firms using FCDs with foreign sales	71	69	69	71	71	71	422
%	(63.39)	(62.73)	(63.30)	(65.14)	(67.62)	(66.98)	(64.82)
Firms not using FCDs with foreign sales	28	28	25	23	20	22	146
%	(25.00)	(25.45)	(22.94)	(21.10)	(19.05)	(20.75)	(22.43)
Firms using FCDs without foreign sales	0	1	2	1	0	2	6
%	(0.00)	(0.91)	(1.83)	(0.92)	(0.00)	(1.89)	(0.92)
Firms not using FCDs without foreign sales	13	12	13	14	14	11	77
%	(11.61)	(10.91)	(11.93)	(12.84)	(13.33)	(10.38)	(11.83)

Ten control variables are chosen, which besides the foreign currency derivatives use may have an impact on firm market value. These variables are size, profitability, leverage, growth opportunities, ability to access financial markets, geographical and industrial diversification, credit quality, sector, and time effect. (Lang & Stulz 1994;

Allayannis and Weston 2001; Pramborg 2004; Jin & Jorion 2006; Naito & Laux 2011; Allayannis et al. 2012.)

Size is measured as natural logarithm of the book value of total assets. Total assets include all assets that a company owns and that can be converted into cash. Therefore, it is the best measure of firm size. The evidence shows that large firms are more likely to use derivatives than small firms. Firm size may also have an effect on firm market value, and therefore it has to be controlled. It must be noted that Tobin's Q measure standardizes market values between different sized firms and makes them comparable. But, size may affect firm value also otherwise. However, the value effect is unclear and the predicted sign may be either positive or negative. (Allayannis & Weston 2001; Jin & Jorion 2006.)

Profitability usually affects firm value directly. Profitable firms have higher Tobin's Q values than less profitable firms. Therefore, return on assets (ROA) is used to control for the profitability. Return on assets shows how efficiently assets are used to generate earnings. It is calculated as the ratio of net income to total assets. Return on assets is a common measure of profitability, which is expressed as a percentage and therefore easy to compare between firms. (Allayannis & Weston 2001; Jin & Jorion 2006.)

Leverage is controlled because the capital structure of a firm may have an impact on firm value. It is measured as the ratio of long-term debt to shareholders' equity at year-end. Leverage is expected to have a negative effect on firm value because firms that are highly financed with debt are seen less valuable than firms that have a low level of debt and are mainly financed with equity. (Allayannis & Weston 2001; Jin & Jorion 2006.)

Growth opportunities are measured as the ratio of capital expenditures to total sales (Allayannis & Weston 2001; Jin & Jorion 2006; Allayannis et al. 2012). Capital expenditures represent funds used to acquire fixed assets and thus future benefits. Capital expenditures are divided by total sales to form a ratio, which models firm's growth prospects, i.e. how much of sales are used for investing in the future. This is included in the regression because future growth opportunities may have an impact on firm value. Hedgers are also more likely to have growth opportunities in the future (Froot et al. 1993; Géczy 1997). A positive association is expected between growth and firm market value. Few firms have missing information of capital expenditures. Firms with missing information are deleted from multivariate regressions.

Ability to access financial markets is measured by a dividend dummy, which equals one if a company paid a dividend in current year. A company that pays dividends has lower

probability of being financially constrained, and therefore it has a better access to financial markets (Fazzari, Hubbard & Petersen 1988; Allayannis & Weston 2001; Jin & Jorion 2006). The expected direction of the relation is two-edged. Negative relation between Tobin's Q and dividend dummy is expected because firms that are more constrained are more likely to undertake only positive net present value projects, while firms with excess free cash flow are more likely to invest in projects with negative net present value (Lang & Stulz 1994; Allayannis & Weston 2001). On the other hand, Jin and Jorion (2006) suggest that dividends are a positive signal from management, and thus the relation may be also positive.

Geographical diversification is measured as the ratio of foreign sales to total sales. It is controlled because multinational companies are expected to have greater firm value. Multinational firms incorporate companies that have foreign sales. Most of the listed Finnish firms are multinational because the small size of the Finnish market forces them to operate also overseas. Because of the foreign operations, Finnish firms may also have greater exposure to foreign currency risk and greater benefits from hedging. Firms are categorized after foreign sales ratio as foreign or domestic operators, i.e. as having foreign sales or not having foreign sales. (Allayannis & Weston 2001.)

Industrial diversification is controlled with a diversification dummy that equals one if a firm has more than one business segment and zero otherwise (Allayannis et al. 2012). Most of the previous empirical studies suggest that industry diversification is value destroying (e.g. Lang & Stulz 1994). Therefore, it is expected to impact negatively on firm value. The data for industrial diversification are acquired from annual reports. Most of the sample firms operate only within one industry and get dummy variable equal to zero.

Credit quality of a firm is likely to affect the value. Firms with higher credit ratings are likely to have also higher value. Credit ratings are acquired from Moody's Analytical Credit Edge. Credit ratings are categorized into seven classes. First class includes Aaa firms, second Aa1 to Aa3 firms, third A1 to A3, fourth Baa1 to Baa3, fifth Ba1 to Ba3, sixth B1 to B3, and seventh all firms below Caa1. (Allayannis & Weston 2001.)

Global Industry Classification Standard (GICS) by Morgan Stanley Capital International is used to control for the *sector* or *industry effects* (Allayannis & Weston 2001; Allayannis et al. 2012). Industry effects are controlled because Tobin's Q is much dependent on the industry and varies between different industries. GICS classifies industries in ten sectors: Energy, materials, industrials, consumer discretionary,

consumer staples, health care, financials, information technology, telecommunication services, and utilities. Financial firms are excluded using GICS classification.

Table 3. Number of firms within industries and their foreign currency hedging profile.

Industry (GICS)	Number of firms	Hedgers	Non-hedgers
Energy	6	6	0
%		(100.00)	(0.00)
Materials	64	59	5
%		(92.19)	(7.81)
Industrials	243	186	57
%		(76.54)	(23.46)
Consumer Discretionary	97	42	55
%		(43.30)	(56.70)
Consumer Staples	42	36	6
%		(85.71)	(14.29)
Health Care	32	14	18
%		(43.75)	(56.25)
Financials	0		
InformationTechnology	149	73	76
%		(48.99)	(51.01)
Telecommunication Services	12	6	6
%		(50.00)	(50.00)
Utilities	6	6	0
%		(100.00)	(0.00)
All	651	428	223
%		(65.75)	(34.25)

Table 3 shows distribution between different industry classes and firms' foreign currency hedging profile. The biggest classes are industrials and information technology with 243 and 149 observations, respectively. In contrast, the smallest industry classes, energy and utilities, have only six observations. Under each industry firms are classified as hedgers or non-hedgers on the basis of their foreign currency derivatives use reporting. Within energy and utilities all firms seem to hedge. However, the amount of observations is small, and therefore any conclusions cannot be made. The number of hedgers is also high within materials (92.19 %), consumer staples (85.71 %), and industrials (76.54 %). Within consumer discretionary, health care, information technology, and telecommunication services only 50 % or less of firms hedge their foreign currency exposure. However, the number of firms within telecommunication services is minor and therefore the percentage misleading. Also, firms are not separated

after their foreign sales ratio, and therefore Table 3 includes also firms that do not have foreign sales.

Finally *time effects* are controlled with year dummies (Allayannis & Weston 2001). The observation period includes six years 2007–2012. Therefore, five dummy variables are used to control for the time effects. Even though the observation period includes only years of downturn, the magnitude of downturn varies over time. Also, some other time-varying features may affect Tobin's Q and stock returns, and hence it needs to be controlled. It is interesting to see if the effects are different between different years, and if the overall hedging policy has changed during the observation period.

The analysis is extended to use annual *stock returns* as the dependent variable to capture the effect of foreign currency derivatives use on firm performance. Equation 7 shows how stock returns are calculated. Again, natural logarithm is used because the distribution is skewed. The mean stock return is 4.01 %, and the median stock return -2.74 % (Table 5).

(7) $$Stock\ returns = \frac{(P_1 - P_0) + D}{P_0},$$

where
P_1 = Stock price, year-end
P_0 = Stock price, previous year-end
D = Dividend / share

Similar regression model is used for stock return regression as for Tobin's Q regression. Same control variables are used, but another control variable, *beta*, is added to the stock return regression. Beta measures the systematic risk of a stock, which is the undiversifiable or market risk. Beta is based on the stock price movements compared to the OMXH index and calculated dividing the covariance of stock return and market return by the variance of market return. For the sample of OMXH-firms beta obtains values between -0.18 and 1.88 (Table 5). If beta is less than 0, the stock moves to the opposite direction compared to the OMXH index. If the value is equal to 0, the stock is uncorrelated with the market. If beta is between 0 and 1, the stock price moves less than the OMXH index but to the same direction. Beta equal to 1 means that the stock price moves similarly to the OMXH index. So, the movement is generally of the same amount and same direction. If beta is greater than 1, the stock price moves more than the market. (Brealey & Myers 2000: 173–175.)

Table 4 summarizes the variables used in the regression model. In addition, it shows the predicted sign of the variable and the definition of each variable. FCD refers to foreign currency derivatives. The last column tells the source of the data. Financial statement and stock data are from Bloomberg database. Information of derivatives use and other qualitative factors are manually gathered from firms' annual reports. Credit rating information is from Moody's Analytical Credit Edge. The data are completed with information from Datastream, Worldscope, and annual reports.

Table 4. Regression variables.

Variable	Predicted sign	Variable description	Source
Tobin's Q		(Book value of total liabilities + Market value of equity) / Book value of total assets	Bloomberg
FCD use	+	FCD dummy variable that equals 1 if a firm uses FCDs	Annual report
Firm size	+/-	ln(Total assets)	Bloomberg
Profitability	+	Return on assets ROA = Net income / Total assets	Bloomberg
Leverage	-	(Long-term debt) / Equity	Bloomberg
Growth	+	Capital expenditures / Total sales	Bloomberg, Datastream, Worldscope
Access to financial markets	+/-	Dividend dummy that equals 1 if a firm paid a dividend in current year	Bloomberg
Geographical diversification	+	Foreign sales / Total sales	Datastream, Worldscope
Industrial diversification	-	Diversification dummy that equals 1 if a firm operates in more than one industry	Annual report
Credit quality	+	Credit rating	Moody's Analytics Credit Edge
Sector	+/-	Industry control after GICS	Bloomberg
Time effects	+/-	Year dummy for each year	
Stock returns		[Price(1) - Price(0) + Dividend] / Price(0)	Bloomberg
Systematic risk	+/-	Beta = [Covariance(stock return, OMXH return)] / [Variance(OMXH return)]	Bloomberg

4.2.3. Summary statistics

Table 5 describes the summary statistics of the key regression variables. Mean Tobin's Q for the entire sample is 1.63 and median 1.25. This means that stocks are generally overvalued because Tobin's Q is greater than one. Thus, capital equipment is worth more than the cost of replacing it. Tobin's Q is substantially higher for firms without foreign sales with mean of 2.27 and median of 1.51 compared to firms with foreign sales with mean of 1.54 and median of 1.22. It is noteworthy that mean value is in every sample greater than the median value, which means that the distribution is skewed. Therefore, natural logarithm of Tobin's Q is used in the regression models later. The variability of Tobin's Q is greater in the sample of firms without foreign sales. Both the minimum and maximum values are reached in this sample, and the standard deviation is much higher (4.23) than in the samples of firms with foreign sales (1.57) or all firms (2.12). However, the small sample of firms without foreign sales may bias the result.

Foreign currency derivatives (FCD) dummy equals 1 if a firm has reported using foreign currency derivatives during the observation year. Otherwise the dummy equals zero. As found earlier, the number of firms using foreign currency derivatives is 65.75 % (mean 0.66 in Table 5). Predictably, the amount of firms using foreign currency derivatives is higher under firms with foreign sales. These firms have a direct link to the foreign currency risk, and therefore the benefits of derivatives use are easier to notice. In turn, firms without foreign sales or other foreign operations may expose to the foreign exchange risk indirectly, and therefore the risk is often left unhedged even though it might be beneficial to hedge it. These firms expose to the foreign currency risk through import and export competition.

Market value of equity, i.e. the total value of all firm's outstanding shares, and total assets are only minor for firms without foreign operations. The market value of equity is over five times larger for firms with foreign sales and the total assets are over eight times larger for firms with foreign sales compared to the firms without foreign sales. This suggests that firms without foreign operations belong to different size class than firms, which have expanded their actions abroad. For large companies the Finnish market is too small to operate profitably. But, for smaller firms it might be a strategic choice to focus only on domestic market. The greater size of firms with foreign operations supports the previous finding from Géczy et al. (1997) that larger firms are more likely to hedge as firms without foreign operations are unlikely to use foreign currency derivatives and firms with foreign operations are likely to use foreign currency

Table 5. Summary statistics of the regression variables.

	Mean	Median	Min	Max	Std.Dev.	Obs.
Firms with foreign sales						
Tobin's Q	1.54	1.22	0.50	30.01	1.57	568
FCD dummy	0.74	1	0	1	0.44	568
Market value of equity (EUR)	1592	195	1	105624	6020	568
Total assets (EUR)	2050	236	1	39582	5383	568
ROA (%)	4.21	3.71	-259.36	1145.19	50.85	568
Long-term debt / Equity (%)	76.65	43.81	-321.51	11373.91	479.75	568
Capital expenditures / Total sales (%)	-14.21	-2.77	-5200.00	3.90	218.23	568
Total sales (EUR)	1891	281	0	51058	5004	568
Dividend (EUR)	0.36	0.21	0.00	5.60	0.47	568
Foreign sales / Total sales (%)	61.61	60.93	10.00	100.00	24.73	568
Stock return (%)	4.50	-2.63	-91.43	247.69	50.12	568
Beta	0.60	0.51	-0.18	1.88	0.40	568
Firms without foreign sales						
Tobin's Q	2.27	1.51	0.29	38.50	4.23	83
FCD dummy	0.07	0	0	1	0.26	83
Market value of equity (EUR)	297	81	2	2706	607	83
Total assets (EUR)	251	88	1	2031	483	83
ROA (%)	-3.33	2.68	-151.27	26.51	24.79	82
Long-term debt / Equity (%)	439.97	49.64	-384.92	33028.00	3621.53	83
Capital expenditures / Total sales (%)	-23.56	-2.25	-1555.67	0.00	172.60	81
Total sales (EUR)	202	55	0	1553	363	83
Dividend (EUR)	0.23	0.04	0.00	1.30	0.35	83
Foreign sales / Total sales (%)	2.32	0.00	0.00	9.61	3.27	83
Stock return (%)	0.61	-9.09	-70.50	150.00	41.82	83
Beta	0.35	0.32	-0.14	1.26	0.28	83
All firms						
Tobin's Q	1.63	1.25	0.29	38.50	2.12	651
FCD dummy	0.66	1.00	0.00	1.00	0.47	651
Market value of equity (EUR)	1427	162	1	105624	5643	651
Total assets (EUR)	1821	186	1	39582	5066	651
ROA (%)	3.26	3.70	-259.36	1145.19	48.39	650
Long-term debt / Equity (%)	122.97	44.74	-384.92	33028.00	1367.50	651
Capital expenditures / Total sales (%)	-15.38	-2.70	-5200.00	3.90	212.98	649
Total sales (EUR)	1675	215	0	51058	4709	651
Dividend (EUR)	0.34	0.20	0.00	5.60	0.46	651
Foreign sales / Total sales (%)	54.05	54.73	0.00	100.00	30.44	651
Stock return (%)	4.01	-2.74	-91.43	247.69	49.13	651
Beta	0.57	0.48	-0.18	1.88	0.39	651

derivatives. The size is also more variable within firms with foreign sales than those that operate mainly nationally. In the far end of the size measures is one company, which is considerably greater than any other company listed in the Nasdaq OMX Helsinki. It makes the variability of the market value of equity and total assets greater as well as raises the mean and median values for firms with foreign sales.

Return on assets (ROA) turns out to be negative on average for firms without foreign sales. The reason is however the very negative values for few firms. Negative ROA values can be due to small income and simultaneous high amounts invested in the production. If the debt level is additionally high, the impact on negative ROA is even larger. Within firms with foreign sales extreme values occur in negative and positive end, but within firms without foreign sales only negative end gets an extreme value biasing the outcome. ROA value varies highly between sample firms indicating that the profitability is extremely volatile among the listed Finnish firms during the observation years 2007–2012. Also leverage, measured with the ratio of long-term debt to equity, is more pronounced under firms without foreign sales. As noted earlier the value of equity for firms without foreign sales seems to be small. Therefore, the leverage percentage is very high (439.97 %). The reason might be that firms without foreign sales are very likely younger firms, which have financed their operations more likely with debt than equity. Because the firms are young and operations volume is minor, they have not yet expanded abroad. Thus, their foreign currency exposure is smaller, and they are not likely to hedge with foreign currency derivatives.

Capital expenditures per total sales describe the growth potential. The ratio is quite stable between different groups. Total sales are of course smaller for firms without foreign operations, which are generally smaller firms. But, when the sales are smaller also capital expenditures are smaller, and the ratio remains at the same levels. The ratio is negative because capital expenditures are costs and thus usually negative.

The average amount of dividends paid is 0.34 euros per share. The amount paid by firms without foreign sales is slightly smaller (0.23 euros) than what firms with foreign sales have paid (0.36 euros). However, the multivariate analysis only considers the binomial dummy variable. If a firm has paid a dividend, it is seen as having better access to financial markets. 72 % of the sample firms paid dividends during the observations years and are considered to have a good access to financial markets. 74 % of firms with foreign sales paid dividends, while only 54 % of firms without foreign sales paid dividends.

Foreign sales are on average 54.05 % of total sales. Firms without foreign sales have foreign sales less than 10 % of total sales. Therefore, the foreign sales ratio is only few percentages on average for firms without foreign sales. Under the sample of all firms the percentage of foreign sales per total sales varies between zero and one hundred. Firms with foreign sales have the foreign sales percentage of 61.61 % on average.

Mean stock return is higher for firms with foreign sales (4.50 %) than for firms without foreign sales (0.61 %). On average, the stock return is 4.01 %. It is noteworthy that the median stock return is always negative, while the mean stock return is always positive. Thus, the median stock return is always smaller than the mean, and the distribution is skewed to the same direction as the Tobin's Q distribution. Therefore, in the regression tests later logarithmic stock returns are used. Mean systematic risk, measured by beta, is also larger for firms with foreign sales (0.60) than for firms without foreign sales (0.35). This means that the stock price moves on average more with the index within firms with foreign sales. For the sample of all firms the mean and median betas are 0.57 and 0.48, respectively. Thus, the average beta is about half as volatile as the market.

4.3. Methodology

The association between foreign currency derivatives use and Tobin's Q, and the association between foreign currency derivatives use and stock returns are first examined in univariate context. It means that the model contains only a single variable, foreign currency derivatives use. Tobin's Q values and stock returns are examined between firms that use foreign currency derivatives and those that do not use them. Other variables that may affect firm market value or stock returns are not included in the univariate model.

However, it is an indisputable fact that also other factors than foreign currency derivatives use affect firm market value and stock returns. Those factors are listed in the regression variables part, and their effect is very likely greater than the effect of foreign currency derivatives use. Therefore, they are included in the regression model. Multivariate analysis regards also these control variables.

4.3.1. Univariate analysis

The univariate analysis tests the difference in Tobin's Q and stock returns between firms that use foreign currency derivatives and those that do not use them. According to the majority of previous studies Tobin's Q is expected to be higher for firms that hedge (e.g. Allayannis & Weston 2001; Belghitar et al. 2008; Clark & Judge 2009; Allayannis et al. 2012). After Nelson et al. (2005), who included abnormal stock returns to their study, the assumption is that also stock returns are higher for hedgers. The univariate analysis compares mean and median values of Tobin's Q and stock returns between hedgers and non-hedgers. Both mean and median values are compared because the mean values of Tobin's Q and stock return are higher than the median values suggesting that the distributions are skewed (Table 5). The separation is made between firms, which have foreign sales and those that do not have foreign sales as well as for a sample of all firms. The results of the mean and median comparisons are in Table 7. In addition, a simple regression is estimated to test the univariate context. (Allayannis & Weston 2001.)

Mean and median values for Tobin's Q and stock returns are calculated from the sample of all 651 observations. T-test is used to assess whether the means of hedgers and non-hedgers are different from each other. When the absolute value of t-statistic is equal or above 1.645, it is considered statistically significant. If t-statistic is 1.96, it is significant at 5 % significance level. If t-statistic is above 2.58 it is statistically highly significant where t-statistic of 2.58 represents 1 % significance level. Absolute values of t-statistics turn out to be between 0.72 and 3.27 (Table 7). P-values for mean differences are obtained from the t-test. Statistical significance of median differences between hedgers and non-hedgers are obtained using the Wilcoxon rank sum test (Wilcoxon-Mann-Whitney test). (Verbeek 2004: 23–25.)

Univariate analysis is extended with a regression model. A pooled OLS regression is estimated using natural logarithm of Tobin's Q and logarithmic stock returns as dependent variables. The univariate test assumes that the dependent variable is only influenced by one independent variable, the foreign currency derivatives use. This is of course a wrong assumption but the model provides an indication how Tobin's Q and stock returns vary between hedgers and non-hedgers. Equations 8 and 9 show the regression models that are used for univariate Tobin's Q regression and stock return regression, respectively. β_0 represents the intercept, β_1 the coefficient for foreign

currency derivatives use, and u the error term. The results of univariate regressions are in Table 8.

(8) $$\ln(Q) = \beta_0 + \beta_1 FCD + u$$

(9) $$\ln(r) = \beta_0 + \beta_1 FCD + u$$

4.3.2. Multivariate analysis

Univariate test only measures if firms, which use foreign currency derivatives have a higher Tobin's Q or stock returns. It does not account for other factors that may affect the firm value and returns. Therefore, multivariate test is performed in order to specify the effect of other variables. These control variables affecting firm market value are size, profitability, leverage, growth opportunities, ability to access financial markets, geographical and industrial diversification, credit quality, sector, and time effect. Same control variables are included in the stock return regression. In addition, beta is added as a control to measure the systematic risk of a stock. The measurement of each variable is determined in Table 4. Multivariate regression model is estimated using two approaches. First, a pooled OLS regression is estimated, and further a fixed effects regression is estimated.

An OLS regression minimizes the sum of squared residuals, i.e. it minimizes the distance between the linear regression function and actual observations. In a pooled OLS regression the observations in the OLS regression are pooled, and thus the panel structure is ignored. However, the statistical power is improved pooling the cross sections across time. A pooled OLS regression requires certain preconditions: First is the linearity in alpha and beta. This means that the dependent variable is a linear function of a set of independent variables and the error term. Second, the expected value of the error term is zero. Thus, the error terms should be evenly distributed around zero. Third, the conditional variance of the error term is constant over time. The assumption is called homoskedasticity. If the condition is not met, error terms are said to be heteroskedastic. Fourth, error terms are not correlated over time. If they are correlated, autocorrelation becomes an issue. Fifth, no linear dependence occurs between explanatory variables. This assumption is called multicollinearity. Under these five

assumptions an OLS regression produces optimal estimates for the parameters, i.e. estimators are BLUE (best linear unbiased estimators). Sometimes an additional assumption of error term normality is included. But, it is not a requirement for OLS estimation. Before the estimation of multivariate regression models the five OLS assumptions are examined. (Wooldridge 2003: 329–337; Verbeek 2004: 16–20; Wooldridge 2011: 191–192.)

The first OLS assumption requires the dependent variable to be a linear function of the independent variables and the error term. This linearity assumption is investigated by plotting the dependent variable against independent variables. If the plots are linearly ordered, the assumption holds true. After these tests Tobin's Q and stock returns seem to be linear functions of the test variable and control variables.

The expected value of the residuals is required to be zero, or else the intercept is biased. However, the slope parameters still remain unbiased. The assumption is examined by plotting the residuals versus the fitted values of Tobin's Q and stock returns. Residuals are evenly distributed around zero. Thus, their expected sum is zero and the assumption holds true. (Verbeek 2004: 16–17.)

After the homoskedasticity assumption error terms have a constant variance. On the contrary, heteroskedasticity means that the variance of the error terms depends on the values of the regression variables, and therefore the variance is not constant. If the variance of the error term is not constant between observations, the uncertainty of the model varies. Breusch-Pagan test is performed to test the heteroskedasticity in the regression models. After the Breusch-Pagan test the null hypothesis of constant variance is rejected in both Tobin's Q and stock return regressions. P-values are 0.0016 and 0.000 for Tobin's Q and stock return heteroskedasticity tests, respectively. Null hypothesis is rejected at 1 % significance level. Heteroskedasticity occurs in the regression models. The OLS estimators are still unbiased and consistent even though heteroskedasticity exists. However, the estimators are not anymore the best linear unbiased estimators, and the variances and standard errors of coefficients might be biased. Thus, p-values are not reliable anymore. Because heteroskedasticity exists, robust standard errors are used. When robust standard errors are used, the coefficient estimates do not change. But, robust standard errors relax the assumptions that errors are independent and identically distributed. Therefore, robust standard errors are more reliable than ordinary standard errors. Also, the p-values are more reliable. (Wooldridge 2003: 333; Verbeek 2004: 82–91.)

Autocorrelation (serial correlation) exists if the error terms of the regression model are correlated over time. Unfortunately, autocorrelation is a common problem in economic time series. The Wooldridge test for autocorrelation in panel data is used to detect the autocorrelation since Durbin-Watson test for autocorrelation does not allow including multiple panels. Wooldridge test is suitable also for data where the number of years is small compared to the number of cross sections as here. A significant test statistic from Wooldridge test rejects the null hypothesis of no autocorrelation. Thus, it indicates that autocorrelation is present in the sample of listed Finnish firms. Autocorrelation is more significant in the Tobin's Q regression (p-value 0.000) than in the stock return regression (p-value 0.0474). When autocorrelation exists, standard errors and p-values of the regression parameters become biased. (Wooldridge 2003: 333–334; Verbeek 2004: 97–111.)

Lastly, multicollinearity is examined with a correlation matrix. The correlation coefficients are determined for the variables used in the multivariate regressions. The correlation coefficients measure the dependence between variables. Practically, they show how two variables move in relation to each other. If the explanatory variables in a regression model are perfectly or highly correlated, multicollinearity becomes an issue. If multicollinearity exists, the individual explanatory variables become biased, but the model itself is still reliable. However, the interest is not only on Tobin's Q or stock returns as dependent variables but also on every individual explanatory variable. Also, if multicollinearity exists, the variances and standard errors increase. Pearson pairwise correlation coefficients are detected to find whether multicollinearity exists or not. They are reported in Table 6. Specifically, Table 6 presents linear dependencies between natural logarithm of Tobin's Q, natural logarithm of stock returns, foreign currency derivatives use, beta, size, profitability, leverage, growth, access to financial markets, geographical diversification, industrial diversification, credit quality, sector, and time effects. (Verbeek 2004: 42–44.)

Correlation coefficients in Table 6 vary between -0.442 and 1.000. Correlation of 1 means perfect linear dependence and occurs only in correlations between a variable and itself. Otherwise, 0.609 is the highest positive correlation that occurs. Even though some significant correlations exist, they are rather low. Thus, multicollinearity is not a problem in the regression for all firms. Nevertheless, when the regression is estimated only for a sample of firms without foreign sales, multicollinearity seems to exist. In the regression for firms without foreign sales industrial diversification is omitted because of collinearity.

After the correlation matrix foreign currency derivatives use is negatively correlated with Tobin's Q. Tobin's Q is also negatively correlated with size, growth, and time. Positive correlation with Tobin's Q is found in profitability, access to financial markets, credit quality, and sector. The correlation between foreign currency derivatives use and stock returns is positive but insignificant. Stock returns are also positively correlated with profitability, access to financial markets, credit quality, and time. Negative correlation occurs between stock returns and leverage. The direction of correlation, i.e. whether it is positive or negative, is thus mainly as predicted in Table 4.

Foreign currency derivatives use is positively correlated with beta, size, access to financial markets, and geographical and industrial diversification. Negative correlation occurs with sector. Thus, larger firms, which have foreign sales are more likely to use foreign currency derivatives. Also, if they act in more than one industry and are likely to pay dividends, they are associated with higher likelihood to use foreign currency derivatives. The positive correlation between access to financial markets and foreign currency derivatives use is contrary to Nance et al. (1993) and Géczy et al. (1997) who find that firms with tighter financial constraints are more likely to hedge.

It is noteworthy that access to financial markets has a statistically significant correlation with every other variable except industrial diversification. The correlation is mainly positive and only small. The correlation between access to financial markets and leverage is negative which can be expected as highly leveraged firms are unlikely to pay dividends. Also, the correlation between access to financial markets and sector and time is negative. It means that firms are more likely to pay dividends in the early stage of the observation period. Geographical diversification has a positive correlation with foreign currency derivatives use and access to financial markets but also with beta, size, profitability, and industrial diversification. This means that firms, which act in more than one industry segment, are focused on international markets and have high foreign sales ratio. Credit quality is negatively correlated with beta and leverage, and positively with size, profitability, geographical diversification, and time effects. In addition, beta and size have a positive correlation, and profitability and growth have a minor positive correlation.

Table 6. Correlation coefficients for multivariate regression variables.

	ln(Tobin's Q)	ln(stock returns)	FCD use	Beta	Size	Profitability	Leverage	Growth	Access to financial markets	Geographical diversification	Industrial diversification	Credit quality	Sector	Time effects
ln(Tobin's Q)	1.000													
ln(stock returns)	0.281 ***	1.000												
	(0.000)													
FCD use	-0.154 ***	0.027	1.000											
	(0.000)	(0.488)												
Beta	-0.020	0.060	0.350 ***	1.000										
	(0.619)	(0.127)	(0.000)											
Size	-0.227 ***	0.043	0.526 ***	0.609 ***	1.000									
	(0.000)	(0.268)	(0.000)	(0.000)										
Profitability	0.186 ***	0.096 **	0.001	0.006	-0.005	1.000								
	(0.000)	(0.014)	(0.971)	(0.882)	(0.894)									
Leverage	0.007	-0.111 ***	0.037	-0.042	-0.039	-0.022	1.000							
	(0.864)	(0.005)	(0.345)	(0.282)	(0.326)	(0.573)								
Growth	-0.116 ***	-0.037	0.046	0.003	0.052	0.099 **	0.013	1.000						
	(0.003)	(0.353)	(0.245)	(0.940)	(0.185)	(0.012)	(0.741)							
Access to financial markets	0.084 **	0.230 ***	0.206 ***	0.191 ***	0.371 ***	0.100 **	-0.089 **	0.081 **	1.000					
	(0.032)	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.024)	(0.038)						
Geographical diversification	-0.060	0.041	0.492 ***	0.359 ***	0.329 ***	0.070 *	-0.064	-0.029	0.125 ***	1.000				
	(0.127)	(0.301)	(0.000)	(0.000)	(0.000)	(0.076)	(0.105)	(0.458)	(0.001)					
Industrial diversification	0.003	0.046	0.082 **	0.030	0.057	0.010	-0.012	0.011	0.041	0.111 ***	1.000			
	(0.934)	(0.240)	(0.038)	(0.450)	(0.145)	(0.799)	(0.770)	(0.774)	(0.296)	(0.005)				
Credit quality	0.347 ***	0.291 ***	-0.016	-0.108 ***	0.174 ***	0.086 **	-0.067 *	0.028	0.446 ***	-0.109 ***	0.016	1.000		
	(0.000)	(0.000)	(0.678)	(0.006)	(0.000)	(0.029)	(0.088)	(0.478)	(0.000)	(0.005)	(0.687)			
Sector	0.203 ***	0.004	-0.247 ***	-0.191 ***	-0.251 ***	0.013	0.016	-0.038	-0.112 ***	-0.076 *	-0.160 ***	-0.058	1.000	
	(0.000)	(0.913)	(0.000)	(0.000)	(0.000)	(0.749)	(0.682)	(0.328)	(0.004)	(0.054)	(0.000)	(0.141)		
Time effects	-0.078 **	0.115 ***	0.041	0.072 *	0.020	0.002	-0.014	0.013	-0.100 **	0.092 **	0.004	0.219 ***	-0.020	1.000
	(0.048)	(0.003)	(0.293)	(0.067)	(0.620)	(0.962)	(0.718)	(0.737)	(0.011)	(0.019)	(0.910)	(0.000)	(0.605)	

P-values are in parentheses. ***, **, and * imply 1 %, 5 %, and 10 % significance levels, respectively.

After the five OLS assumptions are examined, the pooled OLS regression is run separately for a sample of all firms, for a sample of firms with foreign sales, and for a sample of firms without foreign sales. The pooled OLS regression is appropriate when dealing with panel data with a large amount of cross sections and only a short time period because the observations in OLS regression are pooled. Therefore, it ignores the panel structure of the data and the underlying sample does not need to be exactly the same each year. But, as the samples in different years contain very much the same firms, the accuracy and statistical power can be improved pooling the cross sections across time. Therefore, it is an appropriate regression method for this kind of data. Observations from different years are combined and the time effect controlled with year dummies. The following pooled OLS regression model is estimated using natural logarithm of Tobin's Q as the dependent variable: (Wooldridge 2003: 427; Wooldridge 2011: 191–192.)

(10) $$\ln(Q) = \beta_0 + \beta_1 FCD + \beta_2 size + \beta_3 profitability + \beta_4 leverage + \beta_5 growth + \beta_6 access\ to\ financial\ markets + \beta_7 geographical\ diversification + \beta_8 industrial\ diversification + \beta_9 credit\ quality + \beta_{10} sector + \beta_{11} time\ effects + u$$

The test variable is foreign currency derivatives use (FCD). In addition, the regression includes ten control variables: size, profitability, leverage, growth opportunities, ability to access financial markets, geographical diversification, industrial diversification, credit quality, sector, and time effects. Description of control variables is in Table 4. β_0 is the intercept, and $\beta_{1\text{-}11}$ represent the coefficients for regression variables. The u in the end of the regression model is the error term. It includes for example omitted variables, nonlinearities, measurement errors, and unpredictable effects.

Robust standard errors are used in the regression estimation because of heteroskedasticity. They do not change the coefficient estimates but the standard errors and p-values become more reliable. Collinear variables are omitted because of multicollinearity. Therefore, the coefficients for individual explanatory variables are also unbiased, and variances and standard errors correct. However, the model corrected for autocorrelation is a more difficult question. Autocorrelation can be corrected in panel data where the number of time periods is large and the number of cross sections small. But, as the time period in the data set is very short and the number of cross

sections large, there is no way to correct the autocorrelation in the pooled OLS regression. The results of the pooled OLS regression for Tobin's Q are presented in Table 9.

A similar pooled OLS regression model is used for stock return effects, but instead of Tobin's Q logarithmic stock returns are used as the dependent variable. Beta is used as another control variable to capture the effect of systematic risk. The regression model is as follows:

(11) $$\ln(r) = \beta_0 + \beta_1 FCD + \beta_2 beta + \beta_3 size + \beta_4 profitability + \beta_5 leverage + \beta_6 growth + \beta_7 access\ to\ financial\ markets + \beta_8 geographical\ diversification + \beta_9 industrial\ diversification + \beta_{10} credit\ quality + \beta_{11} sector + \beta_{12} time\ effects + u$$

Foreign currency derivatives use is again the test variable. Eleven control variables are used because beta is added as another control to the regression model. Other control variables are size, profitability, leverage, growth opportunities, ability to access financial markets, geographical diversification, industrial diversification, credit quality, sector, and time effects. u represents the error term, β_0 the intercept, and $\beta_{1\text{-}12}$ the coefficients for regression variables. Again, robust standard errors are used to correct the heteroskedasticity and collinear variables omitted to remove the multicollinearity. Autocorrelation still remains a problem. Table 11 presents the results of the pooled OLS regression when stock returns are used as the dependent variable.

The major problem in both pooled OLS regressions is that autocorrelation is not corrected even though it exists. Also, R-squares measuring the goodness of fit turn out to be rather low. R-square is the proportion of variance in the dependent variable that is explained by the model. Thus, it tells how well the estimated regression line fits the observations. Because of a low R-square in the pooled OLS regression, an alternative regression method, fixed effects regression, is estimated. Basically, both regressions should produce similar outcome, but the statistical power is better in the fixed effects regression. It is a better alternative than the pooled OLS regression first because the number of cross sections in the data set is large. The fixed effects model captures all unobserved, time-constant factors that affect the dependent variable, firm value, or stock returns. The unobserved effects estimator is necessary in the regression models because

it is impossible to include all factors affecting market value or stock returns to the regression. As the fixed effect is captured, the error term in the fixed effects regression represents only time-varying errors. The most important improvement compared to the pooled OLS regression is that fixed effects regression can correct for multicollinearity, heteroskedasticity, and autocorrelation also in a sample where the number of time periods is small and the number of cross sections large. (Wooldridge 2003: 439; Verbeek 2004: 20–21.)

The fixed effects model assumes strict exogeneity among explanatory variables. Therefore, time-constant variables, such as industrial diversification and sector, cannot be included as explanatory variables. Industrial diversification and sector are omitted from the regression model since they remain constant for all cross section units for the entire observation period. In the fixed effects transformation (within transformation) the cross section equation is subtracted from the first averaging equation, which eliminates the unobserved effect. Therefore, more than one time period is required. The fixed effects regression is estimated similarly to the pooled OLS regression (Equation 10 and Equation 11). Natural logarithm of Tobin's Q and natural logarithm of stock returns are used as the dependent variables and foreign currency derivatives use as the test variable. Control variables are again size, profitability, leverage, growth opportunities, ability to access financial markets, geographical and industrial diversification, credit quality, sector, and time effect, and additionally beta for the stock return regression. The results of the fixed effects regressions are presented in Table 10 for the Tobin's Q regression and in Table 12 for the stock return regression. (Wooldridge 2011: 300–304.)

4.4. Results

The univariate test results are presented in Table 7 and Table 8. The results of the multivariate pooled OLS regressions and fixed effects regressions are seen in Tables 9–12. The results are analysed in subchapters. First, the association between foreign currency derivatives use and Tobin's Q is covered. Then, the association between foreign currency derivatives use and stock returns is sifted through.

Table 7 presents the surprising results of the mean and median tests. After the results mean and median Tobin's Q values are smaller for hedgers than for non-hedgers. Mean results regarding stock returns are positive but insignificant. Also, median test for stock returns is insignificant. The results are analysed in subchapters.

Table 7. Comparison of mean and median Tobin's Q values and stock returns between hedgers and non-hedgers.

	Tobin's Q		Stock returns		
	Mean	Median	Mean	Median	Obs
Firms with foreign sales					
Hedgers	1.4308	1.1851	0.0582	-0.0412	422
Non-hedgers	1.8581	1.3198	0.0070	0.0000	146
Difference	-0.4273 ***	-0.1348 ***	0.0512	-0.0412	
t-statistic	2.8473		-1.0649		
p-value	0.0046	0.0037	0.2874	0.7229	
					568
Firms without foreign sales					
Hedgers	2.0517	1.8265	0.1240	0.1008	6
Non-hedgers	2.2887	1.5064	-0.0031	-0.0909	77
Difference	-0.2370	0.3200	0.1272	0.1917	
t-statistic	0.1313		-0.7154		
p-value	0.8959	0.3513	0.4764	0.7251	
					83
All firms					
Hedgers	1.4395	1.1941	0.0591	-0.0412	428
Non-hedgers	2.0068	1.3872	0.0035	-0.0065	223
Difference	-0.5672 ***	-0.1931 ***	0.0556	-0.0347	
t-statistic	3.2702		-1.3725		
p-value	0.0011	0.0000	0.1704	0.6294	
					651

***, **, and * imply 1 %, 5 %, and 10 % significance levels, respectively.

Table 8 shows the results of the univariate pooled OLS regression. The results are similar to the mean and median tests. The association between foreign currency derivatives use and Tobin's Q is negative during the period of financial downturn. The results of the stock return regression turn out insignificant. However, the R-square is very low, and thus the model does not explain the variation in Tobin's Q and stock returns very well. The results are further analysed in the subsections.

Table 8. The univariate pooled OLS regression results.

	Firms with foreign sales	Firms without foreign sales	All firms
ln(Tobin's Q)			
Constant	0.3878 ***	0.4837 ***	0.4209 ***
	(0.000)	(0.000)	(0.000)
FCD dummy	-0.1258 ***	0.1503	-0.1538 ***
	(0.008)	(0.399)	(0.000)
R^2	0.0154	0.0039	0.0237
Obs	568	83	651
ln(stock returns)			
Constant	-0.0997 **	-0.0820 *	-0.0936 ***
	(0.017)	(0.086)	(0.003)
FCD dummy	0.0349	-0.0820	0.0285
	(0.471)	(0.995)	(0.478)
R^2	0.0009	0.0000	0.0007
Obs	568	83	651

P-values are in parentheses. ***, **, and * imply 1 %, 5 %, and 10 % significance levels, respectively.

4.4.1. Tobin's Q regressions

Against the expectation and most of the previous studies (e.g. Allayannis & Weston 2001; Belghitar et al. 2008; Clark & Judge 2009; Bartram et al. 2011), the univariate test states that Tobin's Q is smaller for hedgers than for non-hedgers. Mean Tobin's Q is 28 % smaller for hedgers (1.44) than for non-hedgers (2.01). The difference is statistically highly significant. In the sample of firms with foreign sales the difference in mean between hedgers and non-hedgers is also negative and statistically highly significant. Tobin's Q is 23 % smaller for hedgers (1.43) than for non-hedgers (1.86). Also median values in the sample of all firms and in the sample of firms with foreign sales are lower for hedgers than for non-hedgers but in a minor extent. Generally, median Tobin's Q for hedgers is 1.19, while for non-hedgers it is 1.39. Thus, the value is 14 % smaller for hedgers. The results are statistically highly significant. In the sample of firms with foreign sales the median Tobin's Q is 1.19 for hedgers and 1.32 for non-

hedgers. Thus, median Tobin's Q is 10 % smaller for hedgers. Also, Nelson et al. (2005) find a negative value premium for small firms like most of the OMXH-firms are. Because the difference in medians is smaller than the difference in means, there might occur some outlier values for Tobin's Q, which distort the mean. In the sample of firms without foreign sales, the median Tobin's Q value for hedgers is greater than for non-hedgers. However, the mean value is still lower for hedgers than for non-hedgers. This suggests that individual observations have too big influence on the mean because of the small number of hedgers without foreign sales. The results in the sample of firms without foreign sales turn out insignificant.

Table 8 presents the results of the univariate pooled OLS regression. As in the mean and median tests, Tobin's Q is lower for firms that use foreign currency derivatives. Generally, Tobin's Q is 15.38 % lower for hedgers than for non-hedgers. When only firms that have foreign sales are included, natural logarithm of Tobin's Q is 12.58 % lower for hedgers. These results are statistically highly significant. Thus, the results again suggest that foreign currency derivatives use is value destroying. The results are similar to Naito and Laux (2011). Also they find a negative value premium in the univariate analysis. For firms without foreign sales the results turn out to be insignificant because of the small amount of observations. However, the R-square is low in the regression model. It means that that the model does not explain the variation in Tobin's Q. Thus, it is not appropriate for further conclusions of the association between foreign currency derivatives use and firm market value. Additional variables must be included in the regression model to improve the goodness of fit.

Variables included in the multivariate regression are listed in Table 4. Correlation matrix in Table 6 indicates relationships between the multivariate regression variables. In accordance with univariate test foreign currency derivatives use is negatively correlated with Tobin's Q. Thus, also the correlation test suggests that foreign currency derivatives use is associated with lower firm market value. Significant negative correlation with Tobin's Q occurs also in size, growth, and time. It states that smaller firms are associated with higher market value and that the market value decreases with time. In addition to the negative correlation between foreign currency derivatives use and Tobin's Q, also the negative correlation between Tobin's Q and growth is surprising. Growth opportunities are predicted to have a positive association with market value as high market value firms are seen more successful and therefore likely to expand. Positive correlation with Tobin's Q is found in profitability, access to financial markets, credit quality, and sector as expected.

Table 9 shows the results of the pooled OLS regression using natural logarithm of Tobin's Q as the dependent variable. The results are separated for firms with foreign sales, firms without foreign sales, and all firms. Firms with missing information are excluded from the pooled OLS regression model. Therefore, the total number of firms included in the regression is 647 instead of 651. 567 firms are regarded as having foreign sales and 80 as not having foreign sales. R-square measures the goodness of fit of the model. The model explains about 30 % of the total variation in Tobin's Q. Specifically, it explains 32.01 % in the sample of firms with foreign sales, 34.39 % in the sample of firms without foreign sales, and 29.48 % in the sample of all firms.

Table 9. The results of pooled OLS regression using natural logarithm of Tobin's Q as the dependent variable.

ln(Tobin's Q)	Firms with foreign sales	Firms without foreign sales	All firms
Constant	0.1046	0.2461	0.2018 ***
(p-value)	(0.145)	(0.330)	(0.005)
FCD dummy	-0.0198	0.4158 **	-0.0163
	(0.650)	(0.011)	(0.711)
Size	-0.0604 ***	-0.1075 **	-0.0620 ***
	(0.000)	(0.012)	(0.000)
Profitability	0.0021 ***	-0.0119 *	0.0019 **
	(0.006)	(0.070)	(0.027)
Leverage	0.0013	-0.0004	0.0012 ***
	(0.180)	(0.443)	(0.000)
Growth	-0.0279 ***	0.0042	-0.0273 ***
	(0.000)	(0.705)	(0.000)
Access to financial markets	0.0497	0.1029	0.0146
	(0.217)	(0.442)	(0.706)
Geographical diversification	0.0022 **	0.0173	0.0012
	(0.013)	(0.331)	(0.123)
Industrial diversification	0.0480	omitted	0.0467
	(0.246)		(0.278)
Credit quality	0.1218 ***	0.1901 ***	0.1250 ***
	(0.000)	(0.000)	(0.000)
Sector	0.0236 ***	0.0302	0.0237 ***
	(0.004)	(0.310)	(0.002)
Time effects	0.0014	-0.0415	0.0012
	(0.875)	(0.185)	(0.892)
Observations	567	80	647
R^2	0.3201	0.3439	0.2948

P-values are in parentheses. ***, **, and * imply 1 %, 5 %, and 10 % significance levels, respectively.

Table 10 presents the results of the fixed effects regression for Tobin's Q. The number of firms within each group is the same as in the pooled OLS regression. Because the autocorrelation is controlled in the fixed effects regression, the results should be more reliable than the results of the pooled OLS regression. Also, R-squares are generally higher than in the pooled OLS regression. Only the R-square for firms with foreign sales is lower (29.84 %). R-square for firms without foreign sales is significantly higher (66.21 %). In the regression of all firms R-square is also higher in the fixed effects regression (34.72 %) than in the pooled OLS regression (29.48 %).

Table 10. The results of fixed effects regression using natural logarithm of Tobin's Q as the dependent variable.

ln(Tobin's Q)	Firms with foreign sales	Firms without foreign sales	All firms
Constant	2.3247 ***	2.4954 ***	2.5934 ***
(p-value)	(0.005)	(0.000)	(0.000)
FCD dummy	-0.0704	-0.0139	-0.0501
	(0.169)	(0.894)	(0.328)
Size	-0.3992 ***	-0.5416 ***	-0.4580 ***
	(0.006)	(0.000)	(0.000)
Profitability	0.0009 ***	-0.0038 *	0.0009 ***
	(0.000)	(0.064)	(0.000)
Leverage	-0.0014 *	-0.0016 ***	-0.0017 ***
	(0.098)	(0.000)	(0.000)
Growth	-0.0068 ***	0.0264 ***	-0.0066 ***
	(0.000)	(0.000)	(0.000)
Access to financial markets	0.1054 ***	0.2092 ***	0.1227 ***
	(0.005)	(0.008)	(0.000)
Geographical diversification	0.0005	0.0575 *	0.0005
	(0.508)	(0.058)	(0.551)
Industrial diversification	omitted	omitted	omitted
Credit quality	0.0767 ***	0.0778 ***	0.0779 ***
	(0.000)	(0.003)	(0.000)
Sector	omitted	omitted	omitted
Time effects	0.0082	-0.0192	0.0047
	(0.318)	(0.437)	(0.535)
Observations	567	80	647
R^2	0.2984	0.6621	0.3472

P-values are in parentheses. ***, **, and * imply 1 %, 5 %, and 10 % significance levels, respectively.

The results of the multivariate pooled OLS regression indicate that foreign currency derivatives use decreases firm value 1.63 % for all firms and 1.98 % for firms with foreign sales in the period of financial downturn (Table 9). However, these results turn out to be insignificant. Surprisingly, foreign currency derivatives use seems to increase firm value 41.58 % for a sample of firms without foreign sales. The result is statistically significant at 5 %. Even though these firms do not have notable foreign operations, they expose to the foreign currency risk through import and export competition. When a currency is undervalued, the competitive advantage increases since the goods are

cheaper only because of the undervalued currency. Also, Belghitar et al. (2008) obtain very high value premiums in their study, which consists of U.K. firms. For example, for interest rate derivative users the premium is 62.9 %. Bartram et al. (2011) find that value premium is high especially during an economic downturn. However, it has to be noted that autocorrelation remains a problem in the pooled OLS regression, and therefore p-values need to be considered with caution. Also, the small number of observations may bias the result.

Because the probabilities of the pooled OLS regression may be biased, the fixed effects regression is further estimated. In the fixed effects regression the effect of foreign currency derivatives use is again negative but insignificant (Table 10). Generally, the model indicates that firm market value is 5.01 % lower for firms, which do not use foreign currency derivatives during the financial crisis 2007–2012. The value-destroying effect seems to be even greater among firms that have foreign sales compared to firms that do not have foreign sales. Nevertheless, definitive conclusions remain uncertain because the results are insignificant.

The association between the control variables and firm market value is also interesting. The expected effect of firm size, measured by natural logarithm of total assets, on market value is difficult to determine. When the value measure is standardized, it cannot be unanimously stated whether small or large firms have greater value. After the pooled OLS regression and the fixed effects regression size has a negative association with Tobin's Q. Thus, the market value is smaller for larger firms. This holds true in the sample of all firms as well as in the samples separated after foreign sales. The results of the pooled OLS regression are statistically highly significant except in the sample of firms without foreign sales where the significance level is 5 %. The results of the fixed effects regression are statistically highly significant in all samples.

Profitability is expected to have a positive effect on firm market value. This holds true in the sample of all firms and in the sample of firms with foreign sales, but is negative in the sample of firms without foreign sales. The regression results are similar in both the pooled OLS regression and the fixed effects regression. The effect of profitability is only small. Profitability is statistically highly significant for both sub-samples and significant at 5 % for all firms in the pooled OLS regression. In the fixed effects regression the effect of profitability is highly significant except for the sample of firms without foreign sales where the significance level is 10 %.

In the pooled OLS regression leverage obtains only insignificant coefficients when the sample is divided after foreign sales position. However, the effect within all firms is

highly significant and surprisingly slightly positive. Again, the fixed effects model produces more reliable outcome. In the fixed effects regression leverage has a negative effect on firm value, as expected. The results are statistically highly significant except in the sample of firms with foreign sales where the significance level is 10 %.

Against the expectations the significant coefficients of growth obtain negative values in the pooled OLS regression. The negative coefficients occur for the sample of all firms and for the sample of firms with foreign sales. For the sample of firms without foreign sales the coefficient is positive but insignificant. The sign of the coefficients is the same also in the fixed effects regression. The results are statistically highly significant in the fixed effects regression. The unexpected negative effect turns out to be smaller than the positive effect in the sample of firms without foreign sales. Especially in the fixed effects regression the negative coefficients are only minor.

The expectation of the access to financial markets control is bipartite as financially constrained firms can be seen as having higher market value and the sign be positive. On the other hand, firms that are financially constrained are likely to undertake only positive net present value projects, which increases the market value of a firm and the sign can be negative. Access to financial markets seems to have a positive effect on firm market value. Coefficients turn out to be insignificant for all samples in the pooled OLS regression. However, the fixed effects regression produces more significant results. Again, coefficients are positive and, contrary to the pooled OLS regression, statistically highly significant.

Geographical diversification has a positive impact on market value. Thus, foreign operations are value-adding. In the pooled OLS regression the coefficient in the sample of firms with foreign sales obtains a significant value. On the contrary, in the fixed effects regression the results are significant only in the sample of firms without foreign sales.

According to the pooled OLS regression industrial diversification seems to have a positive impact on value. Therefore, firms that act in multiple industries are rewarded with higher market value. However, the coefficients are insignificant. Industrial diversification is omitted in the sample of firms without foreign sales because of collinearity. Industrial diversification is entirely omitted in the fixed effects model, because it remains the same during the observation period for all cross sections. Therefore, it is regarded as an unobserved or fixed effect. Also, the sector where a company works is regarded as a fixed effect and omitted from the fixed effects

regression. However, the pooled OLS regression indicates that sector has a statistically significant effect at least in the samples of all firms and firms with foreign sales.

The relationship between credit quality and value is direct. As expected firms with higher credit rating are rewarded with higher firm market value. The result is statistically highly significant within all samples and both regression models. Lastly, the time effect is controlled with year dummies. The effect of year dummies is contradictory between different groups and also insignificant in both pooled OLS and fixed effects regressions. However, the coefficients are similar in both regressions as they have the same signs in each group.

4.4.2. Stock return regressions

The results above are obtained when Tobin's Q is used as the dependent variable. The interest is also how foreign currency derivatives use and control variables affect stock returns. Table 7 shows the mean and median test results between hedgers and non-hedgers for stock returns. Mean stock returns are higher for hedgers than for non-hedgers in all groups, but the results are insignificant. Median stock returns are higher for hedgers in the sample of firms without foreign sales. Otherwise, median differences between hedgers and non-hedgers are negative implying that stock returns are lower for hedgers. However, the results are again insignificant. This suggests that stock returns are not dependent on whether a firm hedges with foreign currency derivatives or not.

The results of the univariate pooled OLS regression for logarithmic stock returns are seen in Table 8. The coefficients for foreign currency derivatives use are again insignificant in accordance to the results in the mean and median tests. Generally, the insignificant coefficients are positive. Only the coefficient in the sample of firms without foreign sales is negative. The results indicate that foreign currency derivatives use provides a positive premium in stock returns. However, the R-square is even lower in the stock return regression than in the Tobin's Q regression. The R-square near zero indicates that the model does not explain any of the variability of stock returns around its mean. Therefore, the model is not appropriate. (Verbeek 2004: 20–23.)

Univariate analysis gives only a rough indication of the stock return effects. Therefore, the results of multivariate analysis have a greater importance. The correlation matrix in Table 6 provides the relationships between variables in the multivariate regressions. The

correlation between foreign currency derivatives use and stock returns is positive but insignificant. Thus, it provides similar results as the univariate test that foreign currency derivatives use seems to be stock return enhancive. Stock returns are significantly correlated with profitability, leverage, access to financial markets, credit quality, and time. Other correlations between stock returns are positive, only leverage is negatively correlated with stock returns. The multivariate regressions should provide similar results.

Table 11 shows the results of the pooled OLS regression using logarithmic stock returns as the dependent variable. The number of firms in each group is same as in the Tobin's Q regression. R-square of this model is significantly lower than in the Tobin's Q regression. Therefore, the model does not describe the variation in stock returns very well. The regression model should for example include some additional control variables. However, the R-square is significantly higher in the sample of firms without foreign sales (33.88 %) than in the sample of firms with foreign sales (16.89 %) or in the sample of all firms (16.56 %). However, R-squares are decent compared to Allayannis and Weston's (2001) fixed effect regression R-squares.

Table 11. The results of pooled OLS regression using natural logarithm of stock returns as the dependent variable.

ln(stock returns)	Firms with foreign sales	Firms without foreign sales	All firms
Constant	-0.4888 ***	-0.4275 **	-0.4829 ***
(p-value)	(0.000)	(0.050)	(0.000)
FCD dummy	0.0050	0.4038	0.0367
	(0.923)	(0.141)	(0.455)
Stock volatility	0.1282 *	0.3085	0.1812 ***
	(0.057)	(0.161)	(0.004)
Size	-0.0334 **	-0.0984 *	-0.0428 ***
	(0.016)	(0.081)	(0.001)
Profitability	0.0006	-0.0017	0.0006
	(0.200)	(0.570)	(0.206)
Leverage	-0.0078 ***	-0.0035 ***	-0.0027 ***
	(0.000)	(0.000)	(0.001)
Growth	-0.0116 ***	-0.0147	-0.0131 ***
	(0.000)	(0.420)	(0.000)
Access to financial markets	0.1367 **	0.2183 *	0.1409 ***
	(0.014)	(0.092)	(0.004)
Geographical diversification	0.0004	0.0116	0.0003
	(0.653)	(0.579)	(0.701)
Industrial diversification	0.0752	omitted	0.0881
	(0.445)		(0.365)
Credit quality	0.1094 ***	0.1144 ***	0.1056 ***
	(0.000)	(0.002)	(0.000)
Sector	-0.0059	0.0481	0.0017
	(0.587)	(0.111)	(0.865)
Time effects	0.0659 ***	-0.0064	0.0559 ***
	(0.000)	(0.823)	(0.000)
Observations	567	80	647
R^2	0.1689	0.3388	0.1656

P-values are in parentheses. ***, **, and * imply 1 %, 5 %, and 10 % significance levels, respectively.

Table 12 shows the results of the fixed effects regression for stock returns. Again, the number of firms in each group is the same as previously (647 in total). As in the Tobin's Q regression, also in the stock return regression the goodness of fit improves when the fixed effects model is estimated. R-squares are 19.83 % for firms with foreign sales, 36.43 % for firms without foreign sales, and 19.36 % for all firms. Still, the R-squares are fairly low.

Table 12. The results of fixed effects regression using natural logarithm of stock returns as the dependent variable.

ln(stock returns)	Firms with foreign sales	Firms without foreign sales	All firms
Constant	0.5939	0.0986	0.2750
(p-value)	(0.361)	(0.888)	(0.529)
FCD dummy	-0.0978	0.9059 ***	0.0191
	(0.459)	(0.000)	(0.884)
Stock volatility	0.1776 *	0.2508	0.1934 **
	(0.094)	(0.339)	(0.050)
Size	-0.2705 **	-0.2549	-0.2405 ***
	(0.016)	(0.192)	(0.002)
Profitability	0.0008 ***	0.0006	0.0009 ***
	(0.000)	(0.858)	(0.000)
Leverage	-0.0106 ***	-0.0048 ***	-0.0032 ***
	(0.000)	(0.000)	(0.003)
Growth	-0.0289 ***	0.0124 ***	-0.0300 ***
	(0.000)	(0.004)	(0.000)
Access to financial markets	0.1794 *	0.1562	0.1833 **
	(0.074)	(0.219)	(0.027)
Geographical diversification	-0.0008	0.0517 *	-0.0003
	(0.649)	(0.085)	(0.859)
Industrial diversification	omitted	omitted	omitted
Credit quality	0.2225 ***	0.1838 ***	0.2234 ***
	(0.000)	(0.006)	(0.000)
Sector	omitted	omitted	omitted
Time effects	0.1003 ***	0.0334	0.0864 ***
	(0.000)	(0.152)	(0.000)
Observations	567	80	647
R^2	0.1983	0.3643	0.1936

P-values are in parentheses. ***, **, and * imply 1 %, 5 %, and 10 % significance levels, respectively.

As seen in Table 11 and Table 12, the effect of foreign currency derivatives on stock returns seems to be positive. The coefficients obtained from the pooled OLS regression are all positive, and only the coefficient for firms with foreign sales in the fixed effects regression is negative. Unfortunately, only the result in the sample of firms without foreign sales is statistically significant (at 1 % significance level in the fixed effects regression) and positive. Precisely, the foreign currency derivatives use is estimated to

increase stock returns by 90.59 % when the fixed effects regression is estimated. Therefore, the effect of derivatives use seems to be immense especially among firms that do not have foreign operations. Similar results are obtained from the pooled OLS regression when Tobin's Q is used as the dependent variable. Firms that do not have foreign sales expose to the foreign currency risk through import and export competition. However, the small amount of observations in the sample of firms without foreign sales may bias the premium of 90.59 %.

An additional control variable, beta, is added to the stock return regressions. The expected sign of the coefficient is either negative or positive. This is because stocks that are more risky usually generate higher returns, but because of the risk factor the outcome can also be very negative. The results from both the pooled OLS regression and the fixed effects regression show that beta has a positive effect on stock returns. The result confirms that stocks that are more risky compensate the risk factor with higher returns. The coefficients in the samples of all firms and firms with foreign sales are significant.

The size coefficients in the regressions against stock returns are similar to the coefficients in the Tobin's Q regression. Size has also a negative and significant effect on stock returns. Therefore, smaller firms have generally higher returns. The coefficients are again significant except in the fixed effects regression for a sample of firms without foreign sales.

The pooled OLS regression does not produce significant profitability coefficients for the stock return regression. However, the fixed effects regression shows that the relationship between stock returns and profitability is positive. In the sample of all firms and in the sample of firms with foreign sales the significance level is 1 %. The coefficient for the sample of firms without foreign sales is insignificant. Also, it has to be noted that the probabilities of the pooled OLS regression are not valid because of the autocorrelation.

The coefficients for leverage are statistically highly significant in both regression models. The sign is negative as expected stating that leverage has a negative impact on stock returns. The pooled OLS regression also shows that growth has a negative impact on stock returns. The results are statistically highly significant except for firms without foreign sales. The coefficients obtained from the fixed effects model are also negative and statistically highly significant implementing that firms' growth opportunities have negative impact on stock returns. This holds true in every sample.

Access to financial markets has a positive impact on stock returns. The positive coefficient is statistically significant for all samples in the pooled OLS regression. For the samples of all firms and firms with foreign operations the result is highly significant, while for firms without foreign operations the coefficient is significant at 10 %. Also, the fixed effects regression indicates positive relationship between stock returns and access to financial markets. The statistical power is however weaker as the coefficient is significant at 5 % for all firms, at 10 % for firms with foreign operations, and at 1 % for firms without foreign operations. However, these probabilities are more reliable because of the autocorrelation in the pooled OLS regression. Thus, firms that are financially constrained and have lower access to financial markets have lower stock returns.

Geographical diversification seems to have a positive impact on stock returns. Even though the results from the pooled OLS regression are insignificant, the fixed effects regression result for firms without foreign operations is positive and significant. The coefficients in the fixed effects regression for the samples of all firms and firms with foreign sales are negative but also insignificant.

Industrial diversification and sector are again omitted from the fixed effects regression because they are treated as unobservable or fixed effect. Industrial diversification is also omitted from the pooled OLS regression because of collinearity. After the pooled OLS regression industrial diversification seems to have a positive effect on stock returns, but as the coefficients are insignificant, any further conclusions cannot be made. The association between stock returns and sector is insignificant. This suggests that the sector does not affect stock returns, but the returns are evenly distributed across sectors.

Firms with higher credit ratings have higher stock returns. The relationship between credit quality and stock returns is statistically highly significant. Normally higher risk is rewarded with higher return, but during the financial crisis high-risk firms may have collapsed and therefore the association is positive. Finally, time effect has a positive impact on stock returns in the samples of all firms and firms with foreign sales. Specifically, during the observation period stock returns have increased towards the end. This means that stock returns have increased after the economy has recovered from the worst crisis in the beginning of the observation period.

5. SUMMARY AND CONCLUSIONS

The purpose of the study is to examine the association between foreign currency derivatives use and firm market value as well as the association between foreign currency derivatives use and stock returns. Stock returns measure firm performance, but they are not a direct measure of the value. The observation period 2007–2012 is a period of financial crisis and instability. Especially years 2007–2008 were the time of global financial crisis. The slow recovery from the crisis continued until the end of the observation period, and new financial hot spots emerged every now and then. The interest is in Finnish companies, and therefore companies listed in the Nasdaq OMX Helsinki are included in the sample. The total number of observations is 651. The amount of firms using foreign currency derivatives is 65.75 %.

Only a few previous studies of the effects of foreign currency derivatives use on market value of a firm in a smaller economy exist. The association between foreign currency derivatives use and stock returns is studied even less. Previous studies concentrate mostly in the U.S. market, but the effects may be different in a smaller economy where companies are forced to have foreign operations in order to expand. Thus, they are exposed to a foreign currency risk in a greater extent and therefore more likely to hedge.

First, a univariate context is examined between hedgers and non-hedgers. Comparing the mean and median Tobin's Q values, hedgers seem surprisingly to have lower market value than non-hedgers. Also, the univariate pooled OLS regression shows similar results. Hedging decreases market value. However, there exist many other factors that affect market value, and they have to be included in the model in order to obtain more reliable results. The results from the univariate mean and median tests and from the pooled OLS regression turn out to be insignificant for stock returns. However, these results show mainly positive association between foreign currency derivatives use and stock returns. The R-squares for the univariate regression models are extremely low. Therefore, the models do not explain almost any of the variability in Tobin's Q and stock returns.

In multivariate analysis control variables are added to the regression model to improve the fit of the model. The control variables for the Tobin's Q regression are size, profitability, leverage, growth opportunities, ability to access financial markets, geographical and industrial diversification, credit quality, sector, and time effect. An additional control variable, beta, is included in the stock return regression. First, a pooled OLS regression is estimated. The problem with the pooled OLS regression is

that it does not correct for autocorrelation, which is found in the data. Therefore, the standard errors and p-values are not valid. However, the model is still linear and unbiased. To correct for the autocorrelation a fixed effects regression is estimated. Same dependent variables, test variable, and control variables are used as in the pooled OLS regression. The idea in the fixed effects model is that it captures all unobserved, time-constant factors that affect Tobin's Q or stock returns. It is a more suitable regression for data where the number of cross sections is large compared to the number of time periods. Both the pooled OLS regression and the fixed effects regression should produce similar outcome, but unlike in the pooled OLS regression the standard errors and p-values are reliable in the fixed effects model.

After the multivariate pooled OLS regression foreign currency derivatives use seems slightly to decrease firm value in a period of financial downturn. However, these results are insignificant. Surprisingly, foreign currency derivatives use is associated with 41.58 % higher firm value for a sample of firms without foreign sales. However, the autocorrelation remains a problem in the pooled OLS regression, and therefore p-values may be biased. After the fixed effects regression the association between foreign currency derivatives use and firm market value is negative, but the results are insignificant. The fixed effects regression provides evidence that the significant p-value in the pooled OLS regression is not reliable. In addition, the R-square is fairly low for both regressions. Therefore, any further conclusions cannot be made.

The effect of foreign currency derivatives on stock returns seems to be positive also in multivariate tests. The coefficients obtained from the pooled OLS regression are positive but insignificant. The fixed effects regression provides positive association in the sample of firms without foreign sales. The premium of foreign currency derivatives use is as large as 90.59 %. The coefficients in the sample of all firms and in the sample of firms with foreign sales are insignificant. However, the R-squares in the stock return regressions are even smaller than in the Tobin's Q regressions.

Even though the insignificant results between foreign currency derivatives use and Tobin's Q are negative indicating that foreign currency derivatives use is value-destroying, the significant results show that foreign currency derivatives use seems to have a positive impact on both firm market value and stock returns during a period of financial crisis and instability. The value and stock return premiums seem to be especially large during a crisis period. The positive value premium is consistent with the majority of previous studies. However, the results should be considered with caution, as

the R-squares of the models are rather low. Therefore, the models should be improved to obtain more significant results and higher R-squares.

The problem in the methodology is that the extent of hedging is difficult to assess because there is no standard reporting policy of the amounts of derivatives use. The hedging exposure varies during the year, and the accuracy of accounting disclosure varies between firms. Also, the hedging actions are highly variable: hedging instruments, time horizons, nominal amounts, exercise prices, and hedging ratios change, and hedging instruments can be combined. Therefore, the hedging profile is difficult to model. Like most of the empirical studies, also this one classifies firms as hedgers or non-hedgers. However, this does not reveal the entire truth as a firm can hedge 50 % or 100 % of its cash flows, it can hedge only certain cash flows or also uncertain ones, or alternatively it can hedge its revenues. The dummy variable is only a rough measure of derivatives use, which shows if a firm has used foreign currency derivatives at least in some extent. It does not account how much a firm has hedged or what hedging instruments it has used. They may also have an effect on the functionality and effectiveness of derivatives hedging.

The extent of hedging will become easier to quantify after year 2014 when it becomes compulsory for firms to report all their derivatives trades to a special trade register. This concerns all European Union countries and is part of the European Market Infrastructure Regulation. It will be a considerable improvement for derivatives research when the amount of hedging can be more specifically identified. (Vanhanen 2013.)

The other problem of the study is that, in addition to the control variables used, many other factors affect the market value and stock returns of a firm. All these factors are not even known. Some of them are extremely difficult to measure, like the reputation and brand value. Several factors are so small that their inclusion in the regression models is not possible. Stock returns move randomly. Thus, modelling them perfectly has not yet been discovered, which impedes the formation of the regression. As a result, the smaller factors affecting firm market value and stock returns cannot be controlled in the regression model. For more significant results the model should be improved.

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