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# FOREIGN CURRENCY DERIVATIVES AND FIRM MARKET VALUE: EVIDENCE FROM UNITED STATES – COMPARISON OF BEFORE, DURING AND AFTER FINANCIAL CRISIS

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## ABSTRACT

The latest financial crisis made markets more volatile and firms are associated with more risks globally. Firms have started to invest more resources in risk management and the use of foreign currency derivatives has grown during the last decades. Derivatives are used to protect firms cashflows and profitability. This thesis investigates the relation between foreign currency derivatives use and firm market value and compares the results in different economic cycles. The compared time periods are before the latest financial crisis (2004–2007) during the crisis (2008–2009) and after the crisis (2010–2013).

Motivation of this study is to clarify the inconsistent previous results and focus on the latest financial crisis. The study contains 894 firm year observations from big companies in US between years 2004 and 2013. Following Allayannis & Weston (2001) Tobin's Q is chosen to measure firm market value. The use of foreign currency derivatives is manually picked from firms annual and financial reports.

The results show that before the financial crisis, firms who used foreign currency derivatives had 10-15% higher market values than firms who did not use these derivatives. However, during and after financial crisis, the positive effect is not significant. Study finds strong evidence that leverage and firm market value have highly negative and significant relation during financial crisis. Firms who used a lot of debt during financial crisis faced the most problems.

KEYWORDS: foreign currency derivatives, firm market value, financial crisis

# 1. INTRODUCTION

The use of derivatives has grown radically during the last years, mainly because of growing interest on risk management and hedging. Nowdays there are more different derivative instruments than risks and professionals are developing new ones all the time. Almost all firms in this study used some kind of derivative instrument during the timeline 2004–2013.

In the year 2008 the wolrd faced the latest financial crisis. It shocked the world and made the market very volatile. The public talk about the use of derivatives drifted into storm. Some companies faced huge losses with derivatives and some of them were so exotic, that they were too complex to explain to ordinary people. The huge losses concerned especially financial firms. On the same time risk management became even more important during these difficult times. This is why it is very important to study about the relation between derivatives use and firm market value during different economical times.

The previous literature of derivative use is wide and contradictatory. Modigliani and Miller (1958) were one of the first to study hedging with derivatives. They argue that risk management is irrelevant to the firm, since shareholders can hedge their risks by themselves. Allayannis & Weston (2001) were the first to make empirical study about the relation of the use of foreign currency derivatives and firm market value. They found positive relation. On the other hand, Naito & Laux (2011) argue that derivatives use has a negative impact on firm market value. As you can see the results are contradictatory and the topic needs more research and perspective. Previous studies have studied distressful economical times considering derivatives use (Bartram, Brown & Conrad 2011), but the comparison of same firms between different economic cycle is a new perspective on the research.

## 1.1. Purpose of the study

The purpose of the study is to examine, how the use of foreign currency derivatives differs between economic cycles in the US market. The timeline for this study is from the year 2004 to 2013. The sample is divided in to three periods:

before crisis, financial crisis and after crisis. The results will show how the advantages or disadvantges of foreign currency derivatives use differ between these time periods and what was the role of derivatives usage during financial crisis. However, every economic crisis or upswing is different so generalization of the results is not possible.

Most of the previous studies have focused on the US markets, (Allayannis & Weston 2001; Guay & Kothari 2003; Jin & Jorion 2006.) but none of them compares the behavior of foreign currency derivatives during "normal" times and crisis. To make this study comparable to previous research, US markets are examined. The financial crisis started from the US markets and derivatives were a big reason why many firms collapsed during it. US markets are open markets and US firms do a lot of foreign trade. They face a lot of foreign currency risks and hedging with derivatives is common. According to Bartram, Brown and Fehle (2009) almost 38% of US firms use foreign currency derivatives. The portion seem to have grown radically, since 76% of the firm year observations from this study used foreign currency derivatives. The research topic seems to become more and more topical.

This study follows Allayannis & Weston (2001) research by using Tobin's Q as a measure for firm market value. According to Allayannis & Weston (2001) foreign currency derivatives are the most used derivatives, so the magnitude is wide enough to get the best results possible. Concentrating to foreign currency derivatives, the results are more comparable with previous studies who also focused on these derivatives. (Graham & Rodgers 1999; Allayannis & Weston 2001.)

## 1.2. Hypotheses

The hypotheses are formed based on previous studies and positive risk management, which means that firms are capable of manage their risks by themselves. Based on previous studies, the use of foreign currency derivatives is assumed to carry higher firm market values and during weak economic outlook hedging should be even more important. The hypotheses are divided in to two main hypotheses. The first hypothesis is based on the total sample and the second is based

on the financial crisis sample. Furthermore, financial crisis is compared to the total sample and the other subsamples.

The hypotheses of the thesis examine the premium of foreing currecy derivatives use during years 2004–2013 and furthermore, during financial crisis between years 2008 and 2009. When the firm value of derivatives users gets bigger than non-users, the hedging premium becomes larger. (see Allayannis & Weston 2001.)

*Hypothesis 1: Foreign currency derivatives users have higher market value.*

*Hypothesis 2: Foreign currency derivatives users have higher market value during financial crisis.*

Univariate and multivariate tests are examined to study these hypotheses. First univariate test compares the mean and median values of firms that use and do not use foreign currency derivatives. Furher univariate pooled OLS regression is estimated to see the percentile change in firm market values between hedgers and non-hedgers. Later in multivariate analysis, control variables are added to show what else than the use of foreign currency derivatives affect firm market values.

## 1.3. Structure of the study

This part presents the structure of the study and introduces the topics which are discussed. The study is divided in to seven sections and they all focus on specific part of the study. The references are presented at the end of this study.

First section introduces the topic and explains the hypotheses used in this thesis. The purpose is discussed and motivation behind the topic is revealed. Second section discusses the theories behind derivatives and introduces the most important ones. The history of derivatives is briefly introduced as well. Third section is about currency risk management. The section introduces the positions of foreign exchange risk and explains how firms can measure and manage these

risks. Firm market value is discussed in the fourth section. Tobin's Q is used as a measure for firm market value and the Q is introduced here.

Fifth section discusses the previous findigs about the use of foreign currency derivatives and firm market value. The findings are inconsistent and the most famous ones are introduced. Empirical calculations and results are presented in section six. Data and methods are introduced as well as foreign currency fluctuatitions considering US dollar. The regression tables are also presented in section six. Seventh section concludes the thesis and recapitulates the main findings. Overall, the results and conclusions are presented in the seventh section.

# 2. DERIVATIVE THEORY

The first derivative exchange, The Chicago Board of Trade, was opened in 1848 in Chicago (Hull 2012, 1-4). Derivatives are financial instruments, which are created for risk management purposes. They provide protection for the firm's investments, receivables and for the changes in prices, interest rates and exchange rates. (Niskanen & Niskanen 2000: 28.)

Most of the derivatives are traded on the OTC-market, but trades can also be traded on derivatives exchanges (Puttonen & Valtonen 1996: 33). Publicly traded derivatives are standardized, which increases their liquidity and transparency. In OTC-markets, the contracts are not standardized, which may cause credit risk. Credit risk refers to a situation in which the other party is unable to pay their debts. (Hull 2012: 1-4.)

The value of derivative is the underlying asset. The underlying asset can be, for example, a share, interest rate, index, currency or commodity. Growing awareness of the risks and the ability to manage them has led to an explosive growth in the use of derivatives since the 1970s. The low transaction costs have attracted users aswell. The most common derivative instruments are options, futures, forwards and swaps. In addition to these, trade is conducted with so called exotic derivatives, which can be very complicated and rare. Exotic derivatives can be, for example, weather and inflation derivatives. (Grinblatt & Titman 2001: 214–216; Hillier et al. 2012: 201; Hull 2012: 1-2.)

## 2.1. Options

The holder of an option has a right to purchase or sell the underlying asset at a predetermined time and price. On the other hand, the option seller, so-called writer is obligated to sell or buy the underlying asset at a pretermined price, even if it is not in his favor. They can be bought or sold in exchanges or in over-the-counter markets. The option holder may leave the option unused, but the option writer should always sell or buy if the holder so wishes. Option holder can't face losses more than the premium the holder has paid to purchase the option. On the

other hand, the profit the holder can have is unlimited. The option must be used within its maturity, or otherwise the option will lapse and become worthless. There are differences in the maturity of options, which are discussed later. (Hillier et al. 2012: 207-2011; Hull 2012: 7-9.)

There are a few ways of categorizing options. Firstly, options may be divided into European and American options. European options are more regulated, because they can be implemented only on the specific maturity-date. American options are more valuable, since they can be implemented at any time in the maturity. Both American and European options have more value, when the time to expiration increases. (Hull 2012: 7-9.)

Another way to categorize them is to divide them to call options and put options. With the call option, the holder has the right to purchase the underlying asset at a pretermined price in a pretermined time. With the put option, the holder has the right to sell the underlying asset at a certain price and a certain maturity. Call and put options can be in long or short positions. Writer of an option is in short position and buyer in long position. Table 1 presents the rights and obligations of options. (Hull 2012: 7-9.)

**Table 1.** Call and put options rights and obligations

| | **Buyer** | **Seller** |
|---|---|---|
| **Call Option** | Right to buy | Obligation to sell |
| **Put Option** | Right to sell | Obligation to buy |

The third general way of dividing options into different groups is to divide them into three groups, which are: in-the-money, at-the-money and out-of-the-money. The split is done by comparing the price of the share and the options exercise price. In-the-money call options share price, which is S is higher than the options exercise price, which is K. If the call option is at-the-money, the price of the share and the options exercise price are the same, which means S=K. When talking about put options, the opposite is true. (Hull 2012: 201.) Table 2 presents the comparison of share price and exercise price.

**Table 2.** Share price and exercise price comparison

| | In-the-money | At-the money | Out-of-the-money |
|---|---|---|---|
| **Call Option** | S > K | S = K | S < K |
| **Put Option** | S < K | S = K | S > K |

2.1.1. Option Pricing

Option pricing is a very difficult task, especially because there is so many factors that has an effect on it. The six factors that affect on the price of an option are: stock price, strike price, expiration time, volatility, risk-free interest rate and dividends. (Hull 2012: 214.)

Black-Scholes-Merton model (1973) is the most used option pricing model. The model is based on assumption that, if options are priced correctly, profits can not be made by creating portfolios with options and their underlying stocks. In other words, arbitrage is not possible. Its basic principle is that it is possible to create momentarily a risk-free portfolio with an option and a share. The model is based on assumption that the market has "ideal conditions" for options and stocks. These conditions are that short-term interest rate and variance return of the stock are constant, no dividends are paid, options can't be American so they are exercised only at maturity date, there is no transaction costs, borrowing with risk-free rate is possible and that short selling is possible. However, it is recalled that in real life the aforementioned assumptions do not occur. (Black & Scholes 1973: 637-654; Merton 1973: 141-183.)

The pricing of foreign currency options was long considered very complicated and nearly impossible. However, Mark Garman and Steven Kohlhagen (1983) resolved it. They used the same formula as in the BSM model, but replaced the dividend with the exchange rate. The model can only be used for European options, as American are more complex due to more implementation times. The formulas for European currency options are defined as follows:

(1) $$c = S_0 e^{-rfT} \mathrm{N}(d_1) - K e^{-rT} N(d_2)$$

(2) $\mathrm{p} = Ke^{-rT}\mathrm{N}(-d_2) - S_0e^{-r_fT}N(-\mathrm{d}_1)$ ,

where,

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

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

In the formulas c is the price of a call option and p is the price of a put option. $S_0$ describes the spot price of the exchange rate and K is the subscription price. Letter T describes maturity in years. Foreign risk-free rate is $f_f$ and domestic risk-free rare is r. The symbol σ describes volatility, which calculations will be explained later. N(d) describes the cumulative standardized normal distribution of the function. (Hull 2012: 304-305.)

2.1.2. Volatility

Stock's volatility measures the changes in stock returns. It has a major role in option pricing. Implied volatility and historical volatility are the most used measures for uncertainty in stock return changes. Historical volatility is defined as follows:

(3) $\sigma = {}^{s}\sqrt{\tau}$

which can be derived from the formula:

$$\mathrm{s} = \sqrt{\frac{1}{n-1}\sum_{i-1}^{n}(u_1 - \bar{\mathrm{u}})^2}$$

where τ is the period in years and n+1 represents the number of observations. $u_1$ is the natural logarithm of interest rate change at the end of period i. $S_i$ describes the interest rate at the end of period i. Finally, it should be noted that i can get an integer value of 0, 1, 2 and so on.

Implied volatilities are detected from the option markets. They are the most used volatility measure to calculate option prices. While historical volatilies are based on past fluctuations, implied volatilities are forward looking and based on the future expectations. Investors are very facinated about option's implied volatility and they seem to be even more intrested about it than the price. Implied volatilites are even used to predict volatilites to other options. (Hull 2012: 318-320.)

## 2.2. Forwards

Forward contract is relatively straightforward agreement to sell or buy a specified asset at a predetermined price at a predetermined time. With forwards, investor can similarly as options have long or short position. Forward contracts differ from options, because the buyer is always required to buy and the seller to sell. Firms can not speculate as much with forwards than with options, because the price is sealed to specific level. There are no premiums for forward contracts. (Hillier et al. 2012: 203-206; Hull 2012: 5-7.)

The forward contracts are not standardized and traded mainly in the OTC market. Forward contracts are mostly used for hedging against currency risks, but they can also be used to hedge against interest rate risks. Because of simplicity and good liquidity, forward contracts are the most common derivative when hedging against foreign currency risks. (Hillier et al. 2012: 203-206; Hull 2012: 5-7.)

Forward contract can be executed by delivering the underlying asset or alternatively by paying the difference between the spot price and the exercise price. Buyer of the forward contract have a long position and seller have a short position. Forwards settlement date is called delivery date and that is when the contract gets setteled. At the time of contract, the difference is zero and the forward

is worthless. The value of the purchased forward contract is positive when the spot price is higher that the exercise price. When the spot price is lower than the exercise price, the forward gets a negative value. The sold forward contracts react on the opposite way, they get a positive value when the exercise price is higher than the spot price. (Bingham & Kielsel 1998: 3; Grinblatt & Titman 2001: 216–221; Hull 2012: 5-7.)

### 2.2.2 Forward pricing

In the currency forward, the underlying asset is the currency. The instrument used is the exchange rate between currencies. The purchased forward contract protects the company, when the company has debts in foreign currencies. If the company has income in foreign currency and the exchange rate is assumed to decline, it may be possible to hedge future revenue by buying a forward contract. This way, the forward protects the company against the risks and secures future revenue. Forward contracts are priced as follows:

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

where $F_0$ is the price of forward contract and $S_0$ is the spot price of the exchange rate. r describes the domestic risk-free interest rate and the foreign risk-free interest rate is represented by symbol $r_f$. T is the maturity by years. (Hull 2012: 114-117.)

The foreign currency owner is able to earn foreign risk-free interest ($rf$) by investing the currency for time T. The same income is obtained, when foreign currency is exchanged for domestic curerrency and invested at risk-free rate (r) for time T. This similarity is called interest rate parity. (Hull 2012: 114-116.)

## 2.3. Futures

Futures are very similar derivatives as forwards. Futures are accurately standardized and they are traded in derivatives markets. This make it possible to smaller buyers or sellers to take part on derivatives business. Underlying asset, volume and other terms of sale are agreed in advance. Futures are therefore more restrictive than forward contracts. It is possible to execute a future on a freely chosen day within the agreed time slot. In forward contracts, the exact date of implementation is usually defined. The future market is constantly informed and futures can be traded before the end of maturity at a valid price. Generally speaking, futures replace rigidity with cost-efiiciency (Hull 2012: 7; Bingham & Kielsel 1998: 4; Grinblatt & Titman 2001: 219–220.)

Forward's timing of the payments is different than with forwards. The earned interest rate need to be taken in to account and so the future hedge position is smaller than forward hedge position, when the situation is the same. Futures are therefore more complex derivatives than futures, as their implementation is wider. Theoretically the price of futures is calculated in the same way as forward contracts, but in practice especially long-maturity agreements are more complex. In addition, trading costs, credit risk, liquidity risk and interest rate fluctuations distinguish between futures and forward pricing. (Hull 2012: 111-114; Grinblatt & Titman 2001: 783-785.)

# 3. CURRENCY RISK MANAGEMENT

This section examines the theory of foreign exchange risk and also addresses some other important risk factors for understanding the entity. The theoretical part focuses on the effects and benefits of hedging. Due to the rapidly changing nature of the foreign exchange market, currency risk management has become an important process for business operations. The parties seek to trade in the domestic currency and thereby avoid the risk. However, this is often not profitable or even possible. (Aretz & Bartram 2010: 317-371.) Derivatives have emerged as very common way of hedging against foreign exchange risk. According to Bartram, Brown & Fehle (2009) 60% of non-financial firms use some kind of derivatives. These derivatives are, for example previously mentioned options, forwards and futures. Derivatives and combinations provide a very wide range of hedging instruments.

## 3.1. Foreign Exchange Risk

The exchange rate of a currency can be floating or fixed. In fixed exchange rates, the currency is usually tied to the currency of another bigger country or, in some cases, to the price of precious metal as gold. The exchange rate between two fixed currencies is continuos and remains practically the same. Exchange rates are determined by government currency systems. (Taylor 2003: 436-452; Hillier et al. 2012: 705-707.)

The floating currencies, such as euro, are based on market demand and supply. Currency risk arises when exchange rates fluctuate relative to another, for example when euro strenghtens against dollar. The difference between countries rate of interest is the main factor in the fluctuations in demand and supply in currencies. If Germany's interest rate is higher than the rate in United States, US investors want to swap their dollars into euros and invest them in Germany in order to gain bigger profits. The purpose is to protect yourself specifically from real exchange rate fluctuations and not to focus on inflation-induced discrepancies. If inflation differs in the aforementioned countries, it will cause changes in the demand and supply of currencies. However, it should be remembered that changes

in interest rates are the single biggest reason for changes in demand and supply in the currency. (Taylor 2003: 436-452; Hillier et al. 2012: 705-707.)

## 3.2. The Positions of Foreign Exchange Risk

Managing foreign exchange risk starts from identifying the risk and focusing it on the right parts (Buckley 1986: 94). Identifications are always an assesment, because the nature of the risk can rarely be identified advance. Risk identification can be considered as the most difficult task of managing foreign exchange risk. Especially in economically insecure times it is very difficult to predict the risk factors, which the company is facing. (Hillier et al. 2012: 703.) Foreign exchange risks are often divided into three sub-positions, which combined are the total foreign exchange risk of the company. These sub-positions are transaction risk, translation risk and economic risk. (Knüpfer & Puttonen 2009: 209-210.) Figure 1 divides total foreign exchange risk in to the positions.

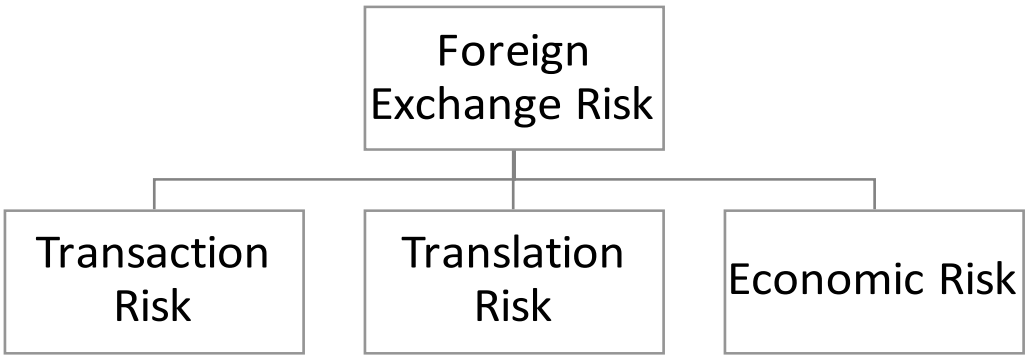


**Figure 1.** The positions of Foreign Exchange Risk

### 3.2.1. Transaction Risk

The most important risk in risk management is transaction risk. It occurs as the exchange rates change between the dates when the contract is made and payment. It is usually sudden and short-term event in foreign currency exchange

rate, in which the company has cash flows. Unforseeable changes in the company's cashflow will occur if the contract denominates in foreign currencies. Transaction risk is easy to notice, but exchange rate fluctuations are very difficult to forecast. (Grinblatt & Titman 2001: 761–762; Hagelin 2003: 55-69; Hagelin & Pramborg 2004: 1-20; Hillier et al. 2012: 703-704).

The nature of the transaction risk is short-term, usually less than one year. Profit distribution in transaction risk is symmetric, as the gains on the depreciations of the foreign currency is equal to the losses in foreign currency revaluations. Short-term transaction risk can be effectively hedged. The hedge can improve the company's market value by reducing the fluctuation of cash flows and thus reduce costs associated with financial uncertainty. Shubita, Harris, Malindretos (2011) argue that forwards, options and money market instruments are the most used ways to hedge transaction risk. (Hagelin 2003: 55-69; Hagelin & Pramborg 2004: 1-20; Hillier et al. 2012: 703-704; Shubita et al. 2011).

### 3.2.2. Translation Risk

Translation risk (also known as accounting exposure) usually occurs as part of the financial statements, when foreign currencies are converted into domestic currency. The risk may cause significant exchange rate losses or gains that may affect the company's earnings. (Bodnar & Gebhardt 1999: 167; Niskanen & Niskanen 2002: 404.)

The risk is typical for international companies whose subsidiaries operate in different currency areas than the parent company. Income statements and balance sheets of subsidiaries and parent company must be made in the same currency in the financial statements. Balance sheet hedging, money market hedging and forward hedging are usually used to reduce translation risk. Derivatives usually work better when hedging translation risk than transaction risk. Hagelin (2003) argue that hedging of foreign exchange risks should focus on translation risk, because it has positive effect on firm market value and hedging translation risk does not. (Grinblatt & Titman 2001; 763; Hagelin 2003: 55-69; Shubita et al. 2011: 172-173.)

### 3.2.3. Economic Risk

Economic risk means the effect of exchange rate changes on the company's competitiveness. The changes are affected on the firm's fundamentals. The economic risk is related to the location of the competitors, the currency they use and the distance between the production and sales points of the company. Firms do not usually hedge economic risk, since it requires firms to react current and future exchange rate fluctuations. These fluctuations then affect on firm's cash flows. (Grinblatt & Titman 2001: 763; Shubita et al. 2011: 175-176; Moffett & Karlsen 1994: 157.175; Hillier et al. 2012: 704-705.)

Companies that operate only in domestic market are not safe from economic risk, because they are exposed by foreign competitors. Over-appreciated domestic currency weakens the competitiveness of domestic companies, that operate domestic in foreign markets. Foreign imports products and foreign competitor's products are then cheaper than domestic ones. For example, if dollar appreciates against euro and the renminbi-euro exchange rate remains the same, firms in US would lose competiveness in the eurozone against Chinese firms. (Moffett & Karlsen 1994: 157-175; Hillier et al. 2012: 704-705.)

Economic risk is very difficult to measure, because it is strategic in nature. At the same time, the risk is very powerful and therefore very important to manage. The company should conduct comprehensive analysis of its competitors and investigate the effects of currency fluctuations over the long term to get the risk management effective. It requires a forecast of company's future business and financial cash flows and competitor's actions. It is more usual that firms hedge against transaction or translation risks than economic risk. (Grinblatt & Titman 2001: 763; Shubita et al. 2011: 175-176; Moffett & Karlsen 1994: 157-175; Hillier et al. 2012: 704-705.)

# 4. FIRM MARKET VALUE

The firm market value is equal to the sum of all the firm's shares. Market value serves as a measure when measuring the company's perfomance. Productivity and increased positive opportunities increase the company's market value, but losses and weakened credit ratings decreases it. When examining the market value, estimates can be made about fims assets and liabilities. The market value and book value are often different. (Brealey, Myers & Marcus 2007: 52-53.)

Comparison of the market values of companies is often difficult, because the factors that influence them can be quite different. Measurements generally ignore the effects of different industries, geographic locations and eras. The ability to use financial markets also affects the firm market value. If the company does not have the opportunity to participate in the capital market, it will have a negative effect on the market value, because the credit and financial services are limited. (Allayannis & Weston 2001: 243-276: Brealey et al. 2007: 52-53.)

There are many different methods to measure firm market value. The most used methods are the price-earnings ratio (P/E ratio), the dividend yield model and the market-to-book ratio. Tobin's Q is also common method to measure firm market value and it is used in this thesis. In P/E ratio, the share price is divided by the return of the share. High P/E ratio often predicts strong growth expectations or safe returns, but it may be temporary high because of poor returns. (Brealey & Myers 2000: 829-830.)

The dividend yield model is calculated by dividing the dividend per share with the price of the share. High dividend can be a sign that investors require relatively high returns. The lack of sales profits and rapid dividend growth may also lead to high dividend yield. The market-to-book ratio calculates the ratio between the price of a share and the book value of one share. The value of the share is thus divided by the book value of the share. Ratio tells how valuable a company is, when its book value is taken into account. If the market-to-book value is one, the current share price corresponds to the book value. A high market-to-book ratio can be a sign of a company's rapid growth and appreciation, or it may indicate that the company's share is overvalued. (Brealey & Myers 2000: 829-830.)

## 4.1. Tobin's Q

In this study, Tobin's Q is used to examine the effects of the use of derivatives on the firm market value. Tobin's Q was developed by James Tobin in 1969. Its task is to compare the value of the company's market value to its capital stock. The theory is based on the assumption that stock prices are market estimations of the company's future and current profits. Tobin (1969) also assumes that the value of the capital stock and the value of the share stock can differ from one another. For example, a strong brand or excellent intellectual capital may increase the company's market value. (Brealey & Myers 2000: 831; Tobin 1969: 15-29.) Tobin (1969) defines Q as follows:

(4) Tobin's Q = Market value of a company / Company's total assets

If the value of Tobin Q falls below one, then a portion of the capital stock should be sold. If the value of Q is one or more, the company should invest more in the capital. Tobin's Q also indicates if the firm's stock is overvalued or not. High Q's usually indicates that the firm's share is overvalued. Continuous consideration of future expectations is one of Tobin's Q features. Changes in capital productivity will get Q to change, so the market value will also change. Tobin Q is negatively dependent on interest rates. The rise in interest rate will cause Q to fall, which means that the market value will decrease. (Brealey & Myers 2000: 821; Tobin 1969: 15-29.)

# 5. IMPACT OF DERIVATIVES USE ON FIRM MARKET VALUE

This section focuses on the studies conducted about the use of derivatives. Derivatives are a well-studied topic, but only recently the focus have been on the relationship between foreign currency derivatives and the company's market value. Until the 1990s, companies did not release information on the use of derivatives as it was considered to be strategically sensitive. (Allayannis & Weston 2001; 243-276). After the latest financial crisis, where derivatives played a major role, this topic has become even more topical. Table 3 presents the summary of previous studies used in this thesis.

**Table 3.** Summary of the previous studies

| Authors | Year | Market | Time period | Sample | Benefit | Type of the hedge |
|---|---|---|---|---|---|---|
| Modigliani & Miller | 1958 | | | | No | All hedges |
| Graham & Rodgers | 1999 | US | 1995 | 531 firms | 2.2%-3.5% | FE and IR derivatives |
| Allayannis & Weston | 2001 | US | 1990-1995 | 720 big firms | 4.9% | FE derivatives |
| Guay & Kothrari | 2003 | US | 1995-1997 | 234 big firms | Minimal | All derivatives |
| Jin & Jorion | 2006 | US | 1998-2001 | 119 oil and gas producers | No | Price derivatives |
| Naito & Laux | 2011 | US | 2011 | 434 big firms | -12.8% | All derivatives |
| Belghitar et al. | 2013 | France | 2002-2005 | 211 big firms | No | FE derivatives |

## 5.1. No effect on market value

Miller & Modigliani (1958) were among the first to do research on hedging. They were particularly interested in its impact on the company's market value. According to the research, the company's hedging policy has no impact on market value, because shareholder can afford the same costs to protect themselves from the risks. They argue that if the capital markets are perfect, risk management should be irrelevant and hedging does not create value.

Miller & Modigliani (1958) assume the market to be effective, so the study is not entirely realistic. In reality, the market is ineffective because it involves information asymmetry, taxes and transaction costs. The futility of a company's hedging policy can thus be established if all the assumptions on an effective market are implemented. Despite their unrealism, Miller & Modigliani (1958) began a

discussion about how risk management adds value and studies about the topic increased.

Guay & Kothari (2003) research is about the cash flow of derivative portfolios and the sensitivity of the market value to the extreme changes in the prices of underlying assets. They argue that the firms in US do not use much enough derivatives to show a positive relation to firm market value. Guay & Kothari (2003) also show that median company hedges currency and interest rate risk with derivatives only from three to six percent. According to them, the use of derivatives is so marginal that it can not have a direct impact on the market value of the company. The results discussed further in this study suggest that the use of at least foreign currency derivatives has grown substantially.

Jin & Jorion (2006) also found evidence that hedging does not add value when examining oil and gas companies. Their research work consisted of 119 US companies during years 1998–2001. They compared the market values in active hedging companies as well as companies that did not hedge. The conclusion of this study was similar to Miller & Modigliani (1958). The company's internal hedging policy does not add value to the company's market value, because investors are able to hedge their risks at the same cost. They argue that firms own hedging policies are irrelevant. According to Jin & Jorion (2006) hedging for an independent investor may cause problems because foreign exchange risk is difficult to protect and its hedging mechanisms are complicated. Therefore, it may be more sensible for companies to hedge against foreign exchange risk than other risks. However, Jin & Jorion (2006) research can be considered a bit biased, as it concentrates only in oil and gas companies and there is no variation between industries.

Belghitar, Clark & Mefteh (2013) studied 211 non-financial large French firms between years 2002 and 2005. The study investigates how foreign currency derivatives use effect on shareholder value and firm market value. They argue that foreign currency exposure can be reduced by derivatives, but because of the difficulties of exploiting "good" exposures, there is no evidence of value creation. They follow Allayannis & Weston (2001) and use Tobin's Q as a measure for firm market value. They show evidence that foreign currency derivative use is not effective enough to cover the costs of using them to add firm value.

## 5.2. Positive effect on market value

Theories of hedging, which are based on the ineffiencies of the market, generally believe that hedging increases company's market value (Smith & Stulz 1985: 391-405; Allayannis & Weston 2001: 273-296; Mackay & Moeller 2007: 1349-1419). According to Smith & Stulz (1985) the market is inefficient due to transaction costs, taxes and incomplete information. They argue that higher bankruptcy costs and progressive taxation companies can increase the company's market value by hedging.

Allayannis & Weston (2001) made an empirical research of the effects of derivatives on the firm market value. They studied the effects of the use of currency derivatives on the market value of 720 large US companies between years 1990 and 1995. Allayannis & Weston (2001) used Tobin's Q to compare hedged and unhedged companies with univariate test. Later they added control variables as size, productivity, growth opportuinities, access to financial markets and etc. to run a multivariate test. The research also includes sensitivity and time series analyzes. The first analysis is to examine the assurance of results against company's other valuation models. With time series analysis Allayannis & Weston (2001) seek to review the inverse relationship of the research. This is to eliminate the possibility that high market value is the reason to hedge.

According to Allayannis & Weston (2001), the results are not dependent on the measurement technique. The premium of the hedge is statistically and economically significant for companies exposed to foreign exchange risk. According to the research, hedger companies with foreign exchange risk have a market value of 4.87 percent higher than those that do not use currency derivatives to hedge. Companies with foreign trade have a significantly higher positive impact, because only domestic companies do not have as much currency risk and they experince only economic risk. However, according to Allayannis & Weston (2001), its rare that company who have only domestic business uses currency derivatives.

Allayannis & Weston (2001) argue that the positive effects of hedging on market value were particularly high in the years, when the dollar strenghtened. The research also provided evidence that the termination of hedging would lower the company's market value. This proves that hedging increases company's market

value and rejects the argument that only companies with high market value are hedging.

Graham & Rogers (2002) research if firms use derivatives to execute risk management because of tax incentives. Their sample consists 531 firms from US markets. They argue that hedging increases the company's market value by increasing debt capacity and cutting interest expenses. The increase in value due to convexity of taxes is lower than the tax benefit generated by the increase in debt capacity. They argue that there is a link between capital structure and hedging. According to Graham & Rogers (2002), the positive tax benefit of hedging can therefore increase the firm market value.

### 5.3. Negative effect on market value

Naito & Laux (2011) study examines if the use of derivatives is associated with higher firm market value. They use 434 non-financial big firms from S&P500. The research was carried out very similar than Allayannis & Weston (2001). They also used univariate and multivariate tests. Both fair values and notional values of firms derivates contracts were used. According to Naito & Laux (2011), non-hedging companies have on average higher market value than those who are hedging. They argue that mean Tobin's Q for the non-hedgers is 2.11. In turn, mean for Tobin's Q for hedgers is only 1.84.

Mean test for Tobin's Q is just a single variable test. According to Naito & Laux (2011), even multivariate tests can not prove the use of derivatives to improve company's market value. They argue that the use of derivatives can not be shown to have significant impact on the company's market value. 1% significant rate resulted a negative link between hedging and company's market value. The research shows that the use of derivatives is not always as useful as it is generally assumed. However, the results of this study are relatively insignificant, so larger conclusions can not be made on this basis.

# 6. EMPIRICAL

This part focuses on the empirical results of the study. The main goal of the study is to examine if the foreign currency derivatives add value to firm's market value or not. Tobin's Q used as a measure for firm market value. The study examines US. Market from 2004 to 2013. The timeline is picked to cover times before and after the latest financial crisis.

The section starts with brief overview about the currency movements of the most important currencies for US. Next is data description and a chapter where the regression variables are presented. Methodology discusses about the empirical tests that are used in the study. The study uses both univariate and multivariate tests. Univariate tests cover mean and median tests, where Tobin's Q is the dependent variable. Univariate pooled OLS is also examined. Control variables are added in multivariate regressions. At the end, the results are presented and examined.

## 6.1. Foreign currency movements

United States is an open market and their currency is the most traded currency in the world. The movements of currencies affect on the firms who does not hedge their foreign currency positions. The most important foreign currencies for United States are European euro (EUR), Chinese renminbi (CNY), Canadien dollar (CND), Mexican peso (MEX), Japanese yen (JPY), South Korean won (KRW), British sterling (GBP) and Indian rupee (INR). The exchange rate movements to US dollar from 2004 to 2013 are presented in figure 2. Hedging can be very useful to firms, who encounter foreign currency risk. With a proper hedge, firm can avoid the losses from decreasing revenue or increasing expenditure in foreign currencies. On the other hand, a weak hedge can backfire and make losses many times larger. Figure 2 presents the movements for the most important foreign currencies of United States.

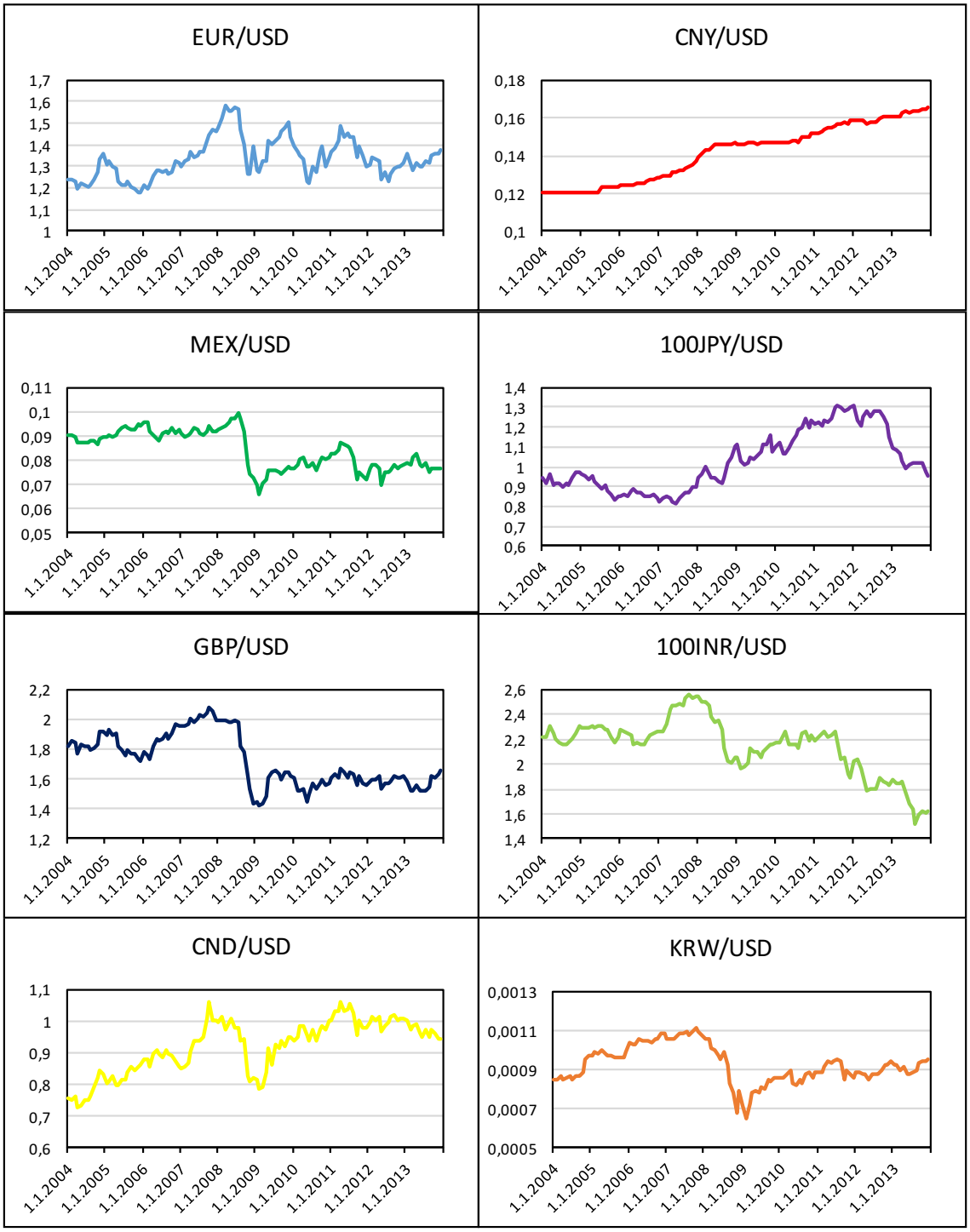


**Figure 2.** Exchange rate movements.

Most of the USD currency exchange rates were affected by the financial crisis, which led that most of the currencies depreciated strongly against USD during years 2008 and 2009. MEX/USD, GBP/USD, CND/USD, INR/USD and KRW/USD depreciated strongly during years 2008 and 2009. USD is the most

traded currency and assets were liquadized around the world during the crises, which increased the demand of USD. Budgets were ruin with firms who did not hedge their positions and the currency risks increased with the uncertainty of future incomes and expenses. Only Chinese renminbi and Japanese yen appreciated against US Dollar during those years. Even though the financial crisis were world wide, it did not hit Asia as hard as Europe and North-America.

The trend in EUR/USD exchange rate has been up-and-down since the financial crisis. This has made hedging important, because when dollar is appreciated the revenues from Europe tend to be lower. The reason for this is that the products from US tend to be too expensive. On the other hand, when the dollar is depreciated, products from US are cheaper and the revenue is higher. The appreciation of USD against EUR during year 2011 and early 2012 was mainly because of the euro crisis. Firms can prepare for these kind of changes, by hedging their foreign currency risk position.

The USD/CNY exchange rate is another story. During the period used in this study, dollar has steadily appreciated. During the financial crisis, the appreciation became slower, but other than that the rise of the renminbi has been slow but steady. Renminbi is still considered a bit undervalued. It is good for China, because they can keep their exports cheap. Before the financial crises the JPY/USD exchange rate used to be pretty steady, but during the crisis USD started to depreciate against JPY and continued to do so until the year 2012. After 2012 JPY starter to depreciate, which can be a consequence from the long recession they have been struggling.

## 6.2. Data

The data used in this thesis consist random 100 firms from S&P 500 index between years 2004 and 2013. The total sample included 1000 firm year observations, but 106 firm years were deleted based on the unavailable data of some needed variable. The final total sample is 894 firm year observations. The firms have all been in the top 500 largest firms in US in some point during the observation period and they operate on several different industrial segments. There are no firms operating in the financial sector in the final sample, because most of them are market-makers in the derivative markets. The actions in derivatives

markets are very different with firms operating in financial sector than firms in other industry sectors. The sample period is divided in three periods: before crisis period with 347 observations, financial crisis period with 169 observations and after crises period with 378 observations. The timeline for financial crisis is defined following Dutta (2017) from 2008 to 2009. Whole calendar years are used to make the division clearer.

The financial variables excluding foreign currency derivatives usage were collected from Datastream database. The dummy variable of foreign currency derivatives usage was manually collected from firms annual and financial reports. Firms were classified as hedgers and non-hedgers based on the information from the reports. If firm's report did not have the needed information, another firm was randomly chosen. The firm year observation is chategorized as hedger, if the firm used foreign currency options, futures, forwards or swaps during that year.

The portion of hedgers are shown in Figure 3 for each year. The table shows that in SP500 the use of foreign currency derivatives has been between 70 percent and 80 percent during the time period. The portion of hedgers has slowly increased, but the increase is not so significant. Between years 2012 and 2013 the use of foreign currency derivates has decreased, but it remains unclear if the trend is permanent.

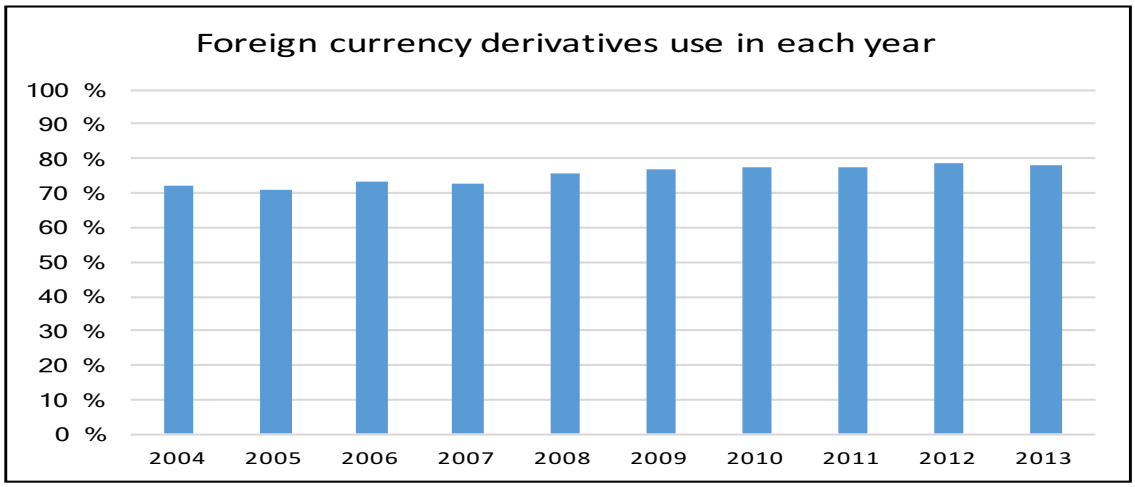


**Figure 3.** Foreign currency derivatives use.

### 6.2.1. Variables

Following previous studies (Allayannis & Weston 2001; Naito & Laux 2011) Tobins Q is selected as a dependent variable to describe firms market value. It standardizes firms with differences in size. It is calculated by dividing the sum of firm's market value of equity and total liabilities with firm's total assets. Tobin's Q is calculated for each firm and each year separately. Table 5 shows evidence that the meadian value of Tobin's Q is smaller than its mean value. This means that the distribution of the variable is skewed. Following Allayannis & Weston (2001) natural logarithm of Tobin's Q is used to control the skewness.

The use of foreign currency derivatives is used as an independent variable. Firms usually do not report the scale of hedging foreign currency risk, so dummy variable used. Value of one is given to the variable, if a firm has used foreign currency derivatives during the year. The variable gets value of zero, if the firm has not used these derivatives during the year. Each year gets its own value depending on the use of foreing currency derivatives. The data is manually collected from annual reports, which are available in the world wide web. If the data is not clearly available, another firm is randomly picked.

Control variables are chosen by following Allayannis & Weston (2001) research. Control variables control factors that may affect on firm market value besides the independent variable. The control variables are: size, profitability, leverage, access to financial markets and geographical diversification. Allayannis & Weston (2001) used also some other control variables, but the data for these variables is not available or the quality of the data is too low. These five control variables are all used in several previous studies. (Allayannis & Weston 2001; Jin & Jorion 2011; Naito & Laux 2011; Allayannis et al. 2012.)

*Size*: Following Allayannis & Weston (2001), size is measured with natural logarithm of book value of firm's total assets. Previous studies show evidence that big firms use more derivatives than small firms. (Bartram et. al 2009; Brunzell et. al 2011.) As mentioned before, Tobin's Q standardizes the firm sizes and makes the firms easier to compare. Allayannis & Weston (2001) argue that big firms tend to have lower Tobin's Q than small firms. Based on these previous studies, size is chosen to be one of the control variables.

*Leverage*: Following Allayannis & Weston (2001) leverage is calculated by dividing long term debt with total equity. It shows the capital structure of a firm at the end of each year. Allayannis & Weston (2001) found evidence that high leverage has negative impact on firm market value. Graham & Rodgers (2002) argue that high leverage firms tend to use more derivatives than low leverage firms. Leverage is chosen to be one of the control variables, because previous studies imply that firms with high leverage have lower market values and they are more active with hedging.

*Profitability*: Allayannis & Weston (2001) argue that more profitable firms have higher market value. This is common sense, if a firm is able to make more money with less assets, it is more valuable. Following Allayannis & Weston (2001) profitability is measured with return on assets ratio (ROA), which is one of the most common measures for profitability. It is calculated by dividing firm's net income with total assets. ROA shows how well firm can use their assets to create value. Profitability is assumed to have high positive relation with firm market value, so it is chosen to be one of the control variables.

*Access to financial markets*: It is measured with a dummy variable, which gets value of one if firm paid dividend during that year. Variable gets value of zero if dividend was not paid. According to Allayannis & Weston (2001) firms who pay dividend usually are not capital constrained, which leads lower market values. Jin & Jorion (2006) argue dividends have positive impact on market value, because it is a positive signal from the management and usually is an outcome from good results. Access to financial markets is added to control variables to settle inconsistent previous results.

*Geographical diverisification*: Following Allayannis & Weston (2001) geographical diversification is calculated with the ratio of foreign sales to total sales. Bodnar et. al. (1997) argue that multinationality increases firm market value by outgrowing agency problems. On the other hand, firms who operate in foreign countries may face higher currency risks, so they should hedge more. Supposedly firms, who are diversificated globally have higher firm market value and use more foreing currency derivatives. For these reasons, geographical diversification is added to control variables. Summary of the variables used in this study are presented in table 4.

**Table 4:** Summary of variables.

| Variable | Prediction | Definition |
|---|---|---|
| Tobin's Q | | Sum of firm's market value of equity and total liabilities divided with firm's total assets |
| FCD use | + | Dummy variable if firm uses foreign currency derivatives |
| Size | - | Natural logarithm of firm's total assets |
| Leverage | - | Ratio of firms's long term debt to total assets |
| Profitability | + | Ratio of firms's net income to total assets (ROA) |
| Access to financial markets | +/- | Dummy variable if firm paid dividend |
| Geographical diverisification | + | Ratio of firm's foreign sales to total sales |

### 6.2.2. Summary statistics

The total sample used in this thesis containts 894 firm year observations between years 2004 and 2013. 347 observations are categorized in before crisis sample, 169 in financial crisis sample and 378 in after crisis sample. Table 5 shows the statistics for the main variables in these samples. Panel A denotes the statistics for total sample. Panel B, C and D further investigates statistics around the financial crisis. In all samples mean of Tobin's Q is bigger than its median, which means that the distribution is skewed. Natural logarithm is used to control the skewness later in the regressions. Mean and median values of Tobin's Q varys between the sample. As excpected, mean value of Q is lowest during financial crisis (1.93) and highest before the crisis (2.23). After crisis period shows recovery in the Q values (2.04).

Table 5 shows that 76% of total sample uses foreign currency derivatives. This is much more than in the previous findings. Allayannis & Weston (2011) argue that only 32 to 40 percent of firms used foreign currency derivatives between years 1990-1995. On the other hand, Bartram et al. (2009) argue that around 45% of non-financial firms use foreign currency derivatives. This still shows that the use of foreign currency derivatives has increased considerably during the years. Table 5 shows also evidence, that financial crisis did not reduce the use of foreign currency derivatives. The use of these instruments has continued to grow and Aater crisis period has the biggest portion of foreign currency derivatives users.

The variation in variables between samples is especially large with ROA and leverage. ROA's standard deviation is considerably high in financial crisis period

(10.01), which means that variation in profitability within sample was high. The performance of some companies was really weak during the crisis, which has made the differences in profitability larger. On the other hand, leverage seem to be especially high during after crisis period (1.54). Standard deviation is also remarkably high (7.23), which means that especially some firms leverage has increased significantly. This must be a consequence of the financial crisis. During the crisis, many firms faced problems and they had to liquid equity to finance their operations. Some firms faced huge problems and some firms had more minor ones. When firms own assets ran out, they had to borrow money elsewhere. Table 5 shows results that firms started to use more loan money after the crisis in order to keep business going despite the difficult period they just faced.

Noteworthy is also the large growth in firm size variables after the financial crisis, which is a consequence from improved economical conditions and from economical growth. However, the results indicate that after the crisis growth is financed more and more with loan money. As expected, less firms paid dividends during the financial crisis. During difficult times, firms don't have much profits to share with shareholders. The growth of foreign sales can be explained with growing globalization. Reduction of regulations and customs has made foreign sales easier and more attractive to firms.

**Table 5**. Summary statistics

| Variable | Obs. | Mean | Meadian | Std. | Min | Max |
|---|---|---|---|---|---|---|
| **Panel A: Total sample** | | | | | | |
| Tobin's Q | 894 | 2.23 | 1.90 | 1.18 | 0.47 | 8.70 |
| FDD dummy | 894 | 0.76 | 1.00 | 0.43 | 0.00 | 1.00 |
| Market value of equity | 894 | 34300000 | 15500000 | 54400000 | 400000 | 504500000 |
| Total assets | 894 | 25400000 | 12800000 | 40300000 | 600000 | 277800000 |
| Return on Assets (ROA)(%) | 894 | 9.02 | 8.88 | 7.47 | -40.32 | 79.06 |
| Leverage | 894 | 0.97 | 0.41 | 4.76 | 0.00 | 93.91 |
| Dividend dummy | 894 | 0.79 | 1.00 | 0.41 | 0.00 | 1.00 |
| Foreign sales to total sales ratio | 894 | 0.35 | 0.39 | 0.25 | 0.00 | 1.00 |
| **Panel B: Before Crisis** | | | | | | |
| Tobin's Q | 347 | 2.59 | 2.23 | 1.43 | 0.84 | 8.70 |
| FDD dummy | 347 | 0.72 | 1.00 | 0.45 | 0.00 | 1.00 |
| Market value of equity | 347 | 32700000 | 15600000 | 49800000 | 400000 | 333900000 |
| Total assets | 347 | 20700000 | 10100000 | 34000000 | 600000 | 275600000 |
| Return on Assets (ROA)(%) | 347 | 10.16 | 10.04 | 6.82 | -31.46 | 47.48 |
| Leverage | 347 | 0.53 | 0.33 | 0.83 | 0.00 | 8.55 |
| Dividend dummy | 347 | 0.78 | 1.00 | 0.41 | 0.00 | 1.00 |
| Foreign sales to total sales ratio | 347 | 0.33 | 0.36 | 0.23 | 0.00 | 0.92 |
| **Panel C: Financial Crisis** | | | | | | |
| Tobin's Q | 169 | 1.93 | 1.71 | 0.89 | 0.47 | 7.26 |
| FDD dummy | 169 | 0.76 | 1.00 | 0.43 | 0.00 | 1.00 |
| Market value of equity | 169 | 28900000 | 12500000 | 44700000 | 900000 | 271500000 |
| Total assets | 169 | 23000000 | 13000000 | 35400000 | 1200000 | 268800000 |
| Return on Assets (ROA)(%) | 169 | 8.32 | 8.47 | 10.01 | -33.63 | 79.06 |
| Leverage | 169 | 0.56 | 0.43 | 0.69 | 0.00 | 6.92 |
| Dividend dummy | 169 | 0.76 | 1.00 | 0.43 | 0.00 | 1.00 |
| Foreign sales to total sales ratio | 169 | 0.37 | 0.41 | 0.25 | 0.00 | 1.00 |
| **Panel D: After Crisis** | | | | | | |
| Tobin's Q | 378 | 2.04 | 1.84 | 0.93 | 0.75 | 7.91 |
| FDD dummy | 378 | 0.78 | 1.00 | 0.41 | 0.00 | 1.00 |
| Market value of equity | 378 | 38100000 | 16600000 | 61700000 | 1500000 | 504500000 |
| Total assets | 378 | 30800000 | 15300000 | 46700000 | 1700000 | 277800000 |
| Return on Assets (ROA)(%) | 378 | 8.29 | 8.20 | 6.54 | -40.32 | 28.54 |
| Leverage | 378 | 1.54 | 0.48 | 7.23 | 0.00 | 93.91 |
| Dividend dummy | 378 | 0.80 | 1.00 | 0.40 | 0.00 | 1.00 |
| Foreign sales to total sales ratio | 378 | 0.37 | 0.41 | 0.26 | 0.00 | 1.00 |

## 6.3. Methodology

First the impact of foreign currency derivatives on firm market value is examined with univariate tests. These tests contain only one variable, which is the use of foreign currency derivatives. Univariate tests do not consider other variables that

could affect firm market value. Univariate tests are examinded by comparing hedgers and non-hedgers Tobin's Qs. Further in multivariate tests control variables are added to the regression. Control variables are firm size, profitability, leverage, access to financial markets and geographical diversification. Firm market value is supposedly affected by all these control variables so they are added to the regressions to control the results.

### 6.3.1. Univariate tests

Following Allayannis & Weston (2001) mean and median values for Tobin's Q are used to compare firms who use foreign currency derivatives and who does not. Both mean and median values are used, because previous findings in this study suggest that the distributions are skewed. Other variables than foreign currency derivatives use are not included to compare Tobin's Qs. All three time periods are compared. Previous studies found evidence that during financial crisis, hedging premiums are higher for derivatives users. (Allayannis & Weston 2001; Bartram et al. 2011.) Previous studies also found evidence that in general, firms who use foreign currency derievatives should have higher market values (Allayannis & Weston 2001; Belghitar et al. 2008; Allayannis et al. 2012). T-test is used to prove the significance of the results in means comparison. For median values, Wilcoxon ranks sum test is executed. Table 7 presents the result from mean and median comparison. T-values of 1.645 (10%), 1.96 (5%) and 2.58 (1%) are used as significance level factors through this study.

To extend univariate analysis, basic pooled OLS regression is examined. Equation 5 shows the regression model for univariate pooled OLS. Natural logarithms of Tobin's Qs are used based on previous findigs in this study that the distributions are skewed. Intercept is denoted with $\beta_0$. Foreign currency derivatives use is rerpresented with $\beta_1 FCD$ and error term is denoted with u. Control variables are further added in the regression in multivariate analysis. Table 8 shows the results for univariate pooled regression.

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

### 6.3.2. Multivariate tests

Multivariate analysis adds control variables to the regressions. Control variables are variables, which are expected to affect on firm market value besides the use of foreign currency derivatives. By adding them to the regressions, they can be excluded from the results, when foreign currency derivatives use is under investigation. The control variables are size, profitability, leverage, access to financial markets and geographical diversification. Measurement of these variables are shown in table 4. Two multivariate regressions are implemented. First pooled OLS regression is examined. It is the same regression as in univariate analysis, except now it is with control variables. Later random effect regression is executed.

Pooled OLS regressions produces the best estimates if the regression is so called BLUE (best linear unbiased estimators). To became BLUE, five assumption needs to hold in the regression. Firstly, the alpha and beta need to be linear. This is investigated by testing the linearity of dependent and independent variables. Second assumption is that the expected value of the error term is zero. This is proved to hold, when the residuals are distributed evenly around zero. Constancy of the conditional variance is the third assumption. This so called homoscedasticy is examined with Breusch-Bagan test. Fourth is that no multicollinearity occurs between variables and fifth, the last one, is that error terms are not correlated over time. Multicollinearity is tested in the next paragraph and correlation of error terms, so called autocorrelation is tested with Durbin-Watson test. If model is not autocorrelated, Durbin-Watson test will give a value close to 2. If the value is under 2, model is positively autocorrelated. Negative autocorrelation occurs, when the value is over 2. (Wooldridge 2003; Verbeek 2004.)

Table 6 shows the correlations of the regression variables. Coefficients vary from -0.34 to 1.00. Perfect correlation exists, when the coefficient is the value of 1.00. Table 6. shows that perfect correlation exists only between each variable itself. None on the correlaitons are significant and the correlations are rather low. The highest positive coefficient between different variables is 0.48, which is between natural logarithm of Tobin's Q and profitability. More profitable firms usually have higher market values, which makes perfect sense. Table 6 shows evidence that firms with high profits and less assets are associated with high market values. On the other hand, the highest negative coefficient is -0.34, which occurs

between size and natural logarithm of Tobin's Q. Big firms seem to be associated with lower firm market value. Overally multicollinearity do not exist, since the ceofficients are rather low and insignificant.

Big firms seem to be associated with more dividend payments. The correlation coefficient between these variables is substantially high 0.30, but with p-value of 9.56 it remains insignificant. Table 6 also shows evidence that geographically diversified firms are associated with more foreign currency derivatives use. Firms operating multiple countries face more foreign currency risks and so it is natural that they use more foreign currency derivatives to hedge their position. Suprising result is the negative coefficient between geographical diversification and firm size. The results suggest that smaller firms are associated more with foreign sales than big firms.

**Table 6.** Correlation coefficients.

| | ln(Tobin's Q) | FCD use | Size | Profitability | Leverage | Dividends | Geo. Div. |
|---|---|---|---|---|---|---|---|
| **ln(Tobin's Q)** | 1.00 | | | | | | |
| **FCD use** | 0.11 | 1.00 | | | | | |
| | (3.33) | | | | | | |
| **Size** | -0.34 | 0.11 | 1.00 | | | | |
| | (-10.87) | (3.34) | | | | | |
| **Profitability** | 0.48 | 0.06 | -0.11 | 1.00 | | | |
| | (16.39) | (1.92) | (-3.39) | | | | |
| **Leverage** | -0.02 | -0.08 | 0.01 | -0.03 | 1.00 | | |
| | (-0.59) | (-2.28) | (0.41) | (-0.89) | | | |
| **Dividends** | -0.11 | 0.09 | 0.30 | 0.00 | 0.03 | 1.00 | |
| | (-3.34) | (2.71) | (9.56) | (0.14) | (0.97) | | |
| **Geo. Div.** | 0.30 | 0.30 | -0.25 | 0.17 | -0.10 | -0.11 | |
| | (9.46) | (9.35) | (-7.70) | (5.05) | (-2.89) | (-3.40) | 1.00 |

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

After examining all previously mentioned assumptions, the regression is found to be BLUE. Regression is run separately with total sample, before crisis sample, crisis sample and after crisis sample. Results from multivariate pooled OLS are presented in table 9. Equation 6. shows the regression model for multivariate pooled OLS regression. Similarly, as in univariate regression Ln(Q) denotes the

natural logarithm for Tobin's Q, $\beta_0$ is the intercept and $\beta_1 FCD$ the foreign currency derivatives use. The control variables are represented with $\beta_{2-6}$. The error term is still denoted with u.

(6) $$\ln(Q) = \beta_0 + \beta_1 FCD + \beta_2 Size + \beta_3 Profitability + \beta_4 Leverage + \beta_5 Access\ to\ Financial\ markets + \beta_6 Geo.diversification + u$$

Random effects model is estimated similarly as pooled OLS. Natural logarithm is the dependent variable and the use of foreign currency derivatives is the independent variable. Control variables are still size, profitability, leverage, access to financial markets and geographical diversification. Random effects model's assumptions are similar than in pooled OLS. Strict exogeneity between explanatory variables is added to assumptions, but otherwise they are same as in pooled OLS. (Wooldridge 2011.) Results from Random effect regression are presented in table 10.

## 6.4. Results

Tables 7 and 8 present the results from univariate tests. Table 7 shows the comparison of mean and median of Tobin's Q between hedgers and non-hedgers. Basic t-test is applied to check the significance of the results.

Panel A shows the results for total sample. It presents clear and expected evidence that firms who use foreign currency derivatives have higher market values than firms, who do not hedge foreign currency risk with derivatives. Panel B presents results for before crisis sample. The evidence is even more clear. Before financial crisis, the firms who used foreing currency derivatives, had clearly and significantly larger firm market value than firms, who did not use these derivatives. Panel C shows results for financial crisis sample. The results are still the same. Firms, who used foreign currency derivatives during financial crisis period seem to have higher firm market value than firms, who did not use these derivatives. The difference is clear and significant, but smaller than before crisis sample. The effect of foreign currency derivatives to firm market value seem to de-

crease when financial crisis started. After financial crisis sample's results are presented in panel D. The difference is positive for hedgers, but much smaller. The results for after crisis period are not significant.

It seems that when controlling only foreign currency derivatives use, the positive effect of foreign currency derivatives to firm market value seems to decrease during time. Table 7 shows clear evidence that foreign currency derivatives use was much more effective to reach high firm market values before the financial crisis than after.

Table 8 presents the result of univatiate pooled OLS regression. The results are similar with the mean and median comparison. During the total sample period, hedgers seem to have 11.6% higher firm market values than non-hedgers. This result is in line with Allayannis & Weston (2001), who also found positive evidence of the use of foreign currency derivatives. Before crisis period show strong evidence that hedgers had almost 18% higher firm market value during years 2004-2007. The difference in results between table 7 and 8 is that while financial crisis period showed clear positive evidence of foreign currency derivatives use in both models, comparing to before crisis period, it has now grown during financial crisis in the univariate pooled regression. During financial crisis hedgers seem to have 20.3% higher firm market values than non-hedgers. However as in table 7, after crisis period does not have significant results. Hedgers have still higher market values, but much less and the results are insignificant. R-squares in univariate OLS regression are relaitively small, so the model does not explain the relation between foreign currency derivatives use and Tobin's Q very well.

**Table 7.** Mean and median tests

| | Mean | Median | Observations |
|---|---|---|---|
| **Panel A:** | | | |
| **Total Sample** | 2.2321 | 1.9022 | 894 |
| Hedgers | 2.3018 | 1.9940 | 675 |
| Non-hedgers | 2.0172 | 1.7275 | 219 |
| Difference | 0.2846*** | 0.2665*** | |
| t-stat | 3.4393 | 3.5259 | |
| p-value | 0.0006 | 0.0002 | |
| **Panel B:** | | | |
| **Before Crisis Sample** | 2.5881 | 2.2343 | 347 |
| Hedgers | 2.7321 | 2.3389 | 251 |
| Non-hedgers | 2.2115 | 2.0301 | 96 |
| Difference | 0.6171*** | 0.3088*** | |
| t-stat | 3.6338 | 3.0146 | |
| p-value | 0.0003 | 0.0013 | |
| **Panel C:** | | | |
| **Crisis Sample** | 1.9338 | 1.7069 | 169 |
| Hedgers | 2.0252 | 1.8261 | 129 |
| Non-hedgers | 1.6390 | 1.5254 | 40 |
| Difference | 0.3862*** | 0.3007*** | |
| t-stat | 2.749 | 2.8036 | |
| p-value | 0.0074 | 0.0025 | |
| **Panel D:** | | | |
| **After Crisis Sample** | 2.0387 | 1.8378 | 378 |
| Hedgers | 2.0566 | 1.8578 | 295 |
| Non-hedgers | 1.9748 | 1.6973 | 83 |
| Difference | 0.0818 | 0.1605 | |
| t-stat | 0.6502 | 1.3561 | |
| p-value | 0.5168 | 0.0875 | |

*,** and *** presents 10%, 5% and 1% significance levels respectively

**Table 8.** Univariate pooled OLS

| | Constant | FCD Dummy | R-Square | Observations |
|---|---|---|---|---|
| **Total Sample** | 0.6069*** | 0.1159*** | 0.0123 | 894 |
| | (0.000) | (0.000) | | |
| **Before Crisis Sample** | 0.6987*** | 0.1796*** | 0.0282 | 347 |
| | (0.001) | (0.002) | | |
| **Crisis Sample** | 0.4165*** | 0.2032*** | 0.0442 | 169 |
| | (0.000) | (0.006) | | |
| **After Crisis Sample** | 0.5924*** | 0.0431 | 0.0020 | 378 |
| | (0.000) | (0.392) | | |

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

Tables 9 and 10 present the results from multivariate analysis. Table 9 shows results from multivariate pooled OLS regression and table 10 shows results from random effect regression. Regressions are implemented on total sample, before crisis sample, financial crisis sample and after crisis sample. Size, leverage, profitability, access to financial markets and geographical diversification are added as control variables.

Results from multivariate pooled OLS regression are presented in table 9. Results show that considering total sample, firms who use foreign currency derivatives seem to have around 8.7% higher firm market value than firms, who does not use these derivatives. This result indicates same conclusions as Allayannis & Weston (2001), who found positive relation with the use of foreign currency derivatives and firm market value. On the other hand, the significant result on total sample is mainly based on before crisis sample, where the positive and significant effect is around 15.2%. During and after financial crisis hedging seems to have less positive effect on firm market value with insignificant p-values. Other control variables seem to have more important effect on firm market value than the use of foreign currency derivatives during and after financial crisis.

Firm size seems to have significant negative relation to firm market value in every sample. The most negative effect is during the after crisis period, where increase of one in size leads 0.11 decrease in firm market value. Result is similar

as previous studies, which also found negative and significant relation between firm size and firm market value. (Lang & Stulz 1994; Allayannis & Weston 2001.) Leverage seem to have interesting results. During the whole sample the effect of leverage is very close to zero, but during financial crisis it is higly negative (-17.5%) and very significant. During financial crisis, firms with high leverage seem to face more problems than firms who do not finance their business as much with debt. Periods not included financial crisis, leverage seem to have minimal and insignificant effects on firm market value. As espected, profitabily has positive and significant relation with firm market value in every sample. The relation is steady and there is not much fluctuations between samples.

Access to financial markets has overally negative effect on firm market value. The negative relation is significant in all other periods except during financial crisis. The results with access to financial markets are similar as Allayannis & Weston (2001) results. They argue that firms who pay dividend usually are not capital constrained, which leads lower market values. On the other hand, results during financial crisis considering access to financial markets are not significant. This makes the conclusion stronger that leverage is the main reason for negative effects on firm market values during the financial crisis. Geographical diversification seems to have highly positive relation with firm market value as espected. Suprisingly after the crisis, the positive relation between geographical diversification and firm market value is much smaller and insignificant.

Results from random effect regression are presented in table 10. The number of firm year observations is the same as in multivariate pooled OLS model. Results show a bit suprising result considering the use of foreign currency derivatives. The relation is overally positive with 1.7% increase in firm market value, but after the crisis the relation turns negative. However, the results are significant only before the crisis with the significance level of 10%. This result is much different than Bartram et al. (2011), who argue that derivative use is especially useful during economical downturn. Before the crisis, firms who use foreign currency derivatives had 9.9% higher firm market values. R-square of the model is however considerably smaller, which means that multivariate pooled OLS is more realiable method to estimate these results.

Random effect regression shows similar results considering firm size relation to firm market value. The negative effect however is higher and during financial

crisis, the result is not significant. However, leverage shows highly negative and significant relation to firm market value during the financial crisis. This again proves that high leverage is the main reason for weakening firm market values during the latest financial crisis. Profitability shows again positive and significant effects on firm market value during every sample. The positive relation is a bit lower than in multivariate pooled OLS model, but still very similar.

Access to financial markets show again negative relation to firm market value, but the results are not significant in any significance level. Results considering geographical diversification are also similar as in multivariate pooled OLS model. However, after crisis sample is so insignificant that total sample turns out to be insignificant as well. Before and during financial crisis results are still highly positive and strongly significant. As mentioned earlier, R-square is lower in the random effect model, which makes multivariate pooled OLS more reliable of these two models.

**Table 9.** Multivariate Pooled OLS

| ln(Tobin's Q) | Total Sample | Before Crisis | Financial Crisis | After Crisis |
|---|---|---|---|---|
| **Constant** | 2.0313*** | 1.5968*** | 1.1197*** | 2.311*** |
| **(p-value)** | (0.0000) | (0.0000) | (0.0098) | (0.0000) |
| **FCD dummy** | 0.0866*** | 0.1515*** | 0.0877 | 0.0036 |
| | (0.0004) | (0.0012) | (0.1424) | (0.9368) |
| **Size** | -0.0980*** | -0.0678*** | -0.0510** | -0.1117*** |
| | (0.0000) | (0.0005) | (0.0467) | (0.0000) |
| **Leverage** | 0.0001 | -0.0354 | -0.1751*** | -0.0004 |
| | (0.9067) | (0.1403) | (0.0000) | (0.8664) |
| **Profitability** | 0.0257*** | 0.0284*** | 0.0212*** | 0.02892*** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| **Access to fin. markets** | -0.1367*** | -0.2459*** | -0.0113 | -0.1043** |
| | (0.0000) | (0.0000) | (0.8502) | (0.0248) |
| **Geo Diversification** | 0.2216*** | 0.4235*** | 0.4133*** | 0.0271 |
| | (0.0001) | (0.0000) | (0.0003) | (0.7178) |
| **Observations** | 894 | 347 | 169 | 378 |
| **R2** | 0.3601 | 0.4703 | 0.4339 | 0.3143 |

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

**Table 10.** Random Effect regression

| ln(Tobin's Q) | Total Sample | Before Crisis | Financial Crisis | After Crisis |
|---|---|---|---|---|
| **Constant** | 4.3066*** | 2.5919*** | 1.0253** | 2.1831*** |
| **(p-value)** | (0.0000) | (0.0000) | (0.0379) | (0.0000) |
| **FCD dummy** | 0.0170 | 0.0987* | 0.1067 | -0.0083 |
| | (0.6262) | (0.0058) | (0.1076) | (0.8700) |
| **Size** | -0.2269*** | -0.1235*** | -0.0428 | -0.0998*** |
| | (0.0000) | (0.0000) | (0.1464) | (0.0002) |
| **Leverage** | 0.0003 | -0.0238 | -0.1042*** | -0.0024 |
| | (0.6511) | (0.1693) | (0.0076) | (0.1915) |
| **Profitability** | 0.0114*** | 0.0103*** | 0.0100*** | 0.0102*** |
| | (0.0000) | (0.0000) | (0.0001) | (0.0000) |
| **Access to fin. markets** | -0.0545 | -0.0766 | -0.0394 | -0.0344 |
| | (0.1413) | (0.2392) | (0.5635) | (0.4328) |
| **Geo Diversification** | 0.0858 | 0.4139*** | 0.4720*** | 0.1420 |
| | (0.2652) | (0.0018) | (0.0001) | (0.1614) |
| **Observations** | 894 | 347 | 169 | 378 |
| **R2** | 0.2447 | 0.2126 | 0.2151 | 0.1027 |

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

# 7. CONCLUSIONS

The purpose of this study is to extend and clarify the inconsisten previous literature of the relation between foreign currency derivatives use and firm market value. Previous studies have found different results on how derivatives use affect firm market value. The debate started when Modigliani & Miller (1958) argue that firms hedging themselves does not add value, because shareholders can hedge themselves with the same costs. Later Allayannis & Weston (2001) found a positive and significant relation between foreign currency derivatives use and firm market value. They argue that the positive results with foreign currency derivatives were especially high during the years when US dollar depreciated. To make this topic even more complex, Naito & Laux (2011) argue that derivatives use is associated with lower firm market values. Their results suggest that firms, who do not hedge with derivatives have higher market values than firms, who do hedge.

None of the previous studies have compared different economical cycles with the same sample. This study concentrates to ten years time period where the latest financial crisis is in the middle. The total sample is divided in to three subsamples, which are before financial crisis period (2004-2007), financial crisis period (2008-2009) and after financial crisis period (2010-2013). The results of these periods are compared to see how different effects the use of foreign currency derivatives use has on firm market value in different economic cycles. The study is based on US market to make it more comparable with previous studies. 100 non-financial firms are randomly selected from S&P500 index to get 1000 firm year obervations. Because of unavailable data, 106 firm year observations are deleted. The total sample consists 894 firm year observations.

The difficulty of this study is to get the data of foreign currency derivatives use. The data is manually picked from annual and financial reports. Most of the firms do not report the magnitude of foreign currency derivatives use. They do not report if the firm has bought one forward contract or they have hedged all their cash flows. For these reasons dummy variable is used to define a firm year observation as hedger or non-hedger. This narutally distort the results a bit, because all hedgers are defined the same, even if their hedging policy is totally different.

Following Allayannis & Weston (2001), the results are first examined with univariate analysis and further with multivariate analysis. Univariate analysis does not include any other variables that could affect firm market value than the use of foreign currency derivatives. This view is of course very simplified and later in multivariate analysis other variables are added to control the results. Univariate analysis examines the differences of mean and median values between hedgers and non-hedgers. Also, basic pooled OLS regression is examined. The results show that when controlling only foreing currency derivatives use hedgers have higher market values than non-hedgers in all periods. However, in both models the results after crisis are much lower and not significant. Univariate analysis suggests that before and during financial crisis the use of foreign currency derivatives adds firm market value, but after the crisis not so much. The differences between before and during crisis are inconsistent between models, but the hedgers seem to have 18%-30% significantly higher market values than non-hedgers during these times.

In multivariate analysis control variables are added to control other factors effects than foreing currency derivatives use on firm market value. Control variables are size, profitability, leverage, access to financial markets and geographical diversisfication. These control variables are supposed to affect firm market value as well. There are of course other factors, which can affect on firm market value, but most of them are so small or hard to measure that they are excluded from the study. Both multivariate pooled OLS and random effect regressions includes these control variables.

Both multivariate models show evidence that before crisis firms who used foreign currency derivatives had 10%-15% higher firm market values than firms who did not hedge. During and after financial crisis multivariate pooled OLS model shows positive but insignificant results. On the other hand, random effect model shows positive relation during financial crisis, but after the crisis the relation turns negative. Both of these results are insignificant. Considering total sample, multivariate pooled OLS model shows significant evidence that hedgers had almost 9% higher firm market values than non-hedgers. Random effect model shows lower and positive relation, but the result is not significant. Multivariate pooled OLS model has clearly higher r-squares, which means that the model explains relations on firm market value better than random effect model. For these

reasons results suggests that overally firms who use foreign currency derivatives have higher market values than firms who do not use.

Size seem to have negative and significant relation to firm market value in all samples and both models, except with random effect model during financial crisis when the result is insignificant. The results considering leverage are intresting. Leverage seem to have higly negative and significant relation to firm market value during financial crisis. It seems that firms with a lot of debt faced more problems during financial crisis than firms who did not finance their operations as much with debt. Results suggest that leverage is clearly the biggest negative reason for lower firm market values during the financial crisis. Profitability and geographical diversification has positive and significant relation to firm market value. After controlling other variables, foreign currency derivatives use does not have significant relation to firm market value during financial crisis. Results from multivariate analysis suggests that before the crisis period is the only period used in this study when firms who used foreign currency derivatives has significantly higher firm market values. The benefit is around 10 to 15 percent.

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