Foreign Exchange Exposure
- The relationship between multinationality and financial hedging

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Abstract

This study investigates the interrelationship between financial hedging and multinationality, and how the use of financial hedging is affected by the given firms level of multinationality. In relation to this it is examined how these affect the risk profile of the firm and the FX exposure, and the following effects on firm value. A sample of 237 manufacturing UK firms was tested through descriptive statistics, univariate tests, a correlation matrix and finally various regression analyses.

The findings in this thesis indicate a bell-shaped relationship between a firm’s level of financial hedging and the level of multinationality. Thus, as firms become more multinational their use of financial hedging increases, until they reach a level of multinationality where they become operationally hedged and thus reduce their level of financial hedging firms. Concerning the risk of the firm and the FX exposure, financial hedging and multinationality have different effects. While financial hedging seems to be reducing both risk and FX exposure (insignificantly), multinationality seems to be reducing systematic risk while increasing both total risk and FX exposure. The explanation can be found in the correlation between size and multinationality and the increasing volatility of cash flow caused by operational hedging. Regarding firm value both financial hedging and multinationality lead to an increase in firm value, however only significantly within multinationality. Surprisingly it showed that as domestic firms initiate internationalization they will experience a decrease in firm value. After these initial costs the firm will be able to profit from increasing multinationality.
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- Distribution2
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- Descp.+Uni.
- Correlation
- NA+FV
- FX Exposure, basic
- FX Exposure, IM/EX
- Beta
- Volatility
- Fin.Hedge
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- MNC2 – alternative definition
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1. Introduction

It is the classical story of corporate life in today’s setting; the world is globalizing and the international markets are coming closer, marked by changing economic environments, complex management issues and a lurking of macroeconomic uncertainties. All of this leading to an increased risk exposure of the firm and creating a need for how to possibly manage these challenges. Though the stage is set, this is nothing new. Managers have always attempted to control and measure the risk within their firms. The enhancing globalization, however, has increased the number of firms going abroad and with the enormous growth within financial and electronic technologies; managers are navigating through increasing exchange rate risks with an enriched palette of risk management tools.

The term of a multinational company is widely and often used, and these firms are traditionally thought of, as successful firms that have grown over many years into large corporations – being international in operations, strategies and vision. This was also the case some years ago, as the prevailing technologies within communication and transport meant economies of scale that restrained the internationalization of SMEs. Recent developments have however removed these constraints and scale is no longer the crucial requirement to become multinational. Firms are increasingly operating across borders; exporting and importing raw materials and finished goods, employing foreign capital, people and processes and controlling their resources globally – opening up for the importance of currency fluctuations. Exchange rate movements affect both the cash flows of the firms operations and the discount rate employed to value these cash flows. Hence, measuring and controlling foreign exchange exposure is a central issue of international financial markets. One fundamental way of managing these currency risks is with the use of financial instruments, namely derivatives. For some the terms ‘risk management’ and ‘derivatives’, evoke thoughts of speculation and strategies that magnify risk. It is however also the preferred tool by which managers are able to reduce foreign exchange exposure. This leaves room for the debate of whether managers shall spend time and money on hedging this exposure, as investors are able to do so themselves through diversification, at least according to the theory of Modigliani and Miller (1958). Besides the method of financial hedging firms are also through
increasing scope of operations across borders, providing real options in managerial choices. These real options captures the flexibility in adapting decisions to evolving uncertainty in the environment, thereby reducing the downside risk while preserving upside opportunities. This flexibility is also known as operational hedging and is in many ways connected to the notion of multinationality as both terms span across countries.

The issues of multinationality and hedging have spawned a considerable amount of research. Some providing evidence that international diversification creates operational hedges, others trying to determine whether operational and financial hedging are substitutes or complements and others examining the relationship between risk and internationalization – and in the end does any of this create value? Most of the previous research focus on the relationship between operational and financial hedging and categorize both financial hedging and multinationality as dummy variables, neglecting to examine what happens to a firm’s use of e.g. financial hedging as it becomes more multinational.

1.1 Problem Statement
The purpose of this thesis is to examine the terms of multinationality and financial hedging both being on a continuum in order to see what happens as they increase. Based on a sample of 237 UK manufacturing firms listed on the London Stock exchange this thesis investigates and analyses:

*What is the relationship between a firm’s level of multinationality and its use of financial hedging?*

As this is the main focus within this study, it is also interesting to examine how this relates to the actual effects of multinationality on the risk profile of the firm being the total and systematic risk respectively. Furthermore how is the foreign exchange exposure affected, and does it increase firm value. Hence, some underlying questions:

*How is the firm’s total and systematic risk affected by its level of multinationality?*
What is the relationship between a firm’s foreign exchange exposure and its level of multinationality?

Do multinationality and the use of financial hedging add value to the firm?

1.2 Method
This thesis is an empirical study with the primary sources of theory and previous research. By studying the theory and the findings in previous research, hypotheses will be formed on what can be expected to find. The databases ORBIS and Bloomberg are used to retrieve some of the data material needed. Furthermore the annual reports of the sample will be manually examined in order to gather data that is not accessible through the available databases. All this data material will afterwards be treated in Excel to generate the required variables. Various regression analyses will be performed in both Excel and SPSS in order to answer the problem statement. Supplementary material from the databases and programs are enclosed in the appendix and on a CD.

1.3 Delimitations
This thesis is subject to some limitations, and these will be considered when concluding on the tests and the regressions.

As the focus of this thesis is multinationality and financial hedging, the underlying question of risk is also considered of interest. However, as risk is not the main focus, the subject will not be examined as thoroughly as the other two, both in terms of theory and empirical evidence. This thesis only deals with total risk and systematic risk in the analysis as these are suitable risk measures in this setting, thus delaminating from a further discussion of other risk terms such as idiosyncratic risk and an examination of such.

In order to narrow down the differences in currency exposure, it is of interest to examine one country with its own currency, and therefore not any of the European Monetary Union countries or those involved in the ERM2. This study is therefore limited to the chosen UK market, also relevant as it is considered the financial centre of Europe.

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1 Exchange Rate Mechanism 2 is an exchange rate mechanism with a certain fluctuation bound for the participating currencies in relation to the exchange rate of the Euro (e.g. Denmark, Estonia, Cyprus, Malta).
Furthermore, most previous research are based on the US market, and it is therefore interesting to examine the European market, which is also found more likely to use financial derivatives (see section 5.1 for further discussion). The sample is further limited to large and medium sized manufacturing firms. Size in terms of obtaining stability and liquidity in stocks, and manufacturing firms as these are assumed more capable of operational hedging in terms of shifting production site.

The hedging activity of the sample is obtained through the individual annual reports, thus not accounting for any hedging activity disclosed in possible timely reports (e.g. quarterly reports). Only annual reports are considered, in order to create some consistency between the individual firms, as not all produce timely reports. Furthermore, the analysis of annual reports is limited to one year, as it is assumed a good proxy for the general hedging activity of the firm, and it is also the method of most empirical research. It is not possible to retrieve the specific amounts used on each of the different derivatives, as many firms choose to record it as a total amount. This study therefore delimitates from further investigating the effects of the individual derivatives, as this would require too many assumptions. Within financial hedging many firms engage in three areas: currency, commodity and interest rate risk. As multinationality is of interest in this study the analysis is limited to cover the area of currency risk, and the two other areas are therefore not included in the obtained notional amounts of financial hedging. It is assumed that the sample of firms use financial derivatives as means of reducing risk and not as speculation, this is based on previous findings and that fact that most of the annual reports of the sample states that they do not use derivatives for speculation. Thereby delimitating from a further analysis of whether the financial derivatives are used for hedging or speculation.

The analysis of currency exposure covers the years from 2007 to 2012, thereby including a financial crisis and a time afterwards, which will be considered in the analysis.

1.4 Structure
In section 2 the perspective of this thesis is grounded by studying the theory and thus providing a theoretical background within risk management, hedging and incentives for such. Section 3 provides an overview of previous research and the results hereof.
These will together with the theory provide a frame of reference for the following sections.

In section 4 the hypothesis of this thesis is presented and the arguments for these will be based on section 2 and 3.

In section 5 the methodology of this study is constructed, presenting the process of sample selection and data selection and an outlining of the different variables included in the regressions. These different regressions will also be presented in the section.

In section 6 descriptive statistics and correlations coefficients will be treated and the results of the univariate tests and the multivariate regressions analyses will be analysed and compared to previous findings.

Section 7 and 8 includes limitations and the conclusion of the thesis.

Figure 1.1: Structure
2. Theory

2.1 Risk
Risk is a part of everyday life for investors and firms when doing business. Managers have always attempted to measure and control the risk within their firms, and they are increasingly becoming aware of how their firms are influenced by risk beyond their national borders. Fluctuations in economic and financial variables such as exchange rates, interest rates and commodity prices can have destabilizing effects on corporate performance and strategies. Thus, today more and more firms make use of derivatives in order to hedge certain risks. Risk is a broadly used term and most often perceived in a negative manner. Though, in relation to business it is important to note that risk can serve as both a positive and negative aspect, as it is also an opportunity for the firm to benefit from e.g. fluctuations in exchange rates. There is often both an upside and a downside of risk, leaving it up to the management’s abilities to manage these risks in the right direction for the business. (Froot, Scharfstein et al. 1994).

It can be difficult to get an exact overview of the various risks facing firms, as the different environments in which the firm operate influence these. Businesswise risks are therefore often categorized as strategic risk, financial risk, operational risk etc. – depending on the source of information. However, all risks will despite category be caused by factors considered as either internal or external. Internal risks being: production problems, human mistakes, system breakdown etc. These are also referred to as operational risks and constitute a large part of the risk facing a company. The external risk factors are more complicated to reduce, as these are caused by: changes in consumer preferences, technology developments, variations in financial markets, political changes etc. (Berk, DeMarzo 2011). The external risk factors are those of interest in this thesis, as they constitute the fluctuations within the exchange rate market.

2.1.1 Systematic and Unsystematic Risk
Financial theory distinguishes between two types of risk facing firms, systematic and unsystematic risk. The latter is also referred to as firm-specific risk or diversifiable risk and will appear when the firm’s stock-return fluctuates due to some firm-specific news, such as mergers and acquisitions, increase in company sales or perhaps a reali-
zation of the company not meeting this year’s targets. Investors are able to reduce the amount of unsystematic risk by diversifying their holdings without incurring any additional risks and they will therefore not receive any risk premium for their efforts.

Systematic risk, also known as market risk, un-diversifiable risk or beta, is the risk that remains after investors have fully utilized diversification. If diversification opportunities are available to investors, systematic risk is the only risk for which the investors are compensated with a risk premium. This risk is observed when the stock returns fluctuate due to market-specific news, which is not related to the specific firm. Systematic risk occurs when the entire markets faces a risk that affects all securities, this could be increasing interest rates or a natural disaster. By definition, diversification, by either the investors or the firm, cannot reduce systematic risk (Berk, DeMarzo 2011, Meulbroek 2002). Thus, it follows that the well-diversified investor is interested in the systematic risk, whereas the undiversified investor will be interested in the total risk of the firm.

2.2 Risk Management
Managers attempt to control the risk exposures within their firms, and the growth and development in financial and electronic technologies have enriched the palette of risk management techniques available to them. Meulbroek (2002) stress that this calls for integrated risk management, which is the identification and assessment of the collective risks that can affect the firm and importantly the implementation of a firm-wide strategy to manage those risks. Froot et al. (1994) further highlight that although many firms are involved in risk management, there is still no single well-accepted set of principles that applies to their hedging programs. Thus also advocating the need for a firm’s risk management strategy to be an integrated part of the overall strategy. The use of derivatives can even become dangerous without a clear set of risk management goals. Even though the best risk management programs will incur losses at some point, the lack of clear goals sets the firm at risk of losing a substantial sum of money, as the taken position within derivatives might not fit well with the corporate strategy (Froot, Scharfstein et al. 1994, Shapiro 2010). This leads Froot et al. (1994) to suggest that a risk management paradigm should rest on three basic premises:
The key to creating corporate value is making good investments.

The key to making good investments is generating enough cash internally to fund those investments; when companies don’t generate enough cash, they tend to cut investments more drastically than their competitors do.

Cash flow – so crucial to the investment process – can often be disrupted by movements in external factors such as exchange rates, commodity prices, and interest rates, potentially compromising a company’s ability to invest.

Leading Froot et al. (1994) to conclude that the overall goal of risk management is to ensure that the company has the cash available to make value-enhancing investments. Stulz (1996) and Taleb et al. (2009) choose to specify the ultimate goal of risk management in a different way, as they argue that risk management should try to reduce the impact of the threats we don’t understand, thus eliminating the costly lower-tail outcomes. These are also called Black Swan events, defined as being rare though rather costly, and they are increasingly dominating the environment. With the increasing globalization and use of the Internet, the complex world does not only increase the likelihood of such events, but it also makes the forecasting of ordinary events impossible. Instead of trying to predict the social and economic environment, which is utterly impossible, firms needs to reduce their vulnerability to these lower-tail outcomes. By doing so they will reduce the expected costs of financial trouble while preserving the ability to exploit any comparative advantage in risk-bearing they may have. It could also be described as the purchase of a well-out-of-the-money put option – eliminating the downside while preserving as much of the upside which can be justified by the principle of comparative advantage. (Stulz 1996, Taleb, Goldstein et al. 2009). Though not as detailed, Cater et al. (2003) reaches the same conclusion, with the ultimate goal being the ability to reduce risk while placing the firm in a position from which it can benefit from the opportunities that comes with exchange rate changes. In relation to this thesis it is risk management of foreign exchange exposure (FX exposure), which is of interest.
2.3 Foreign Exchange Exposure

To narrow down the broad term of risk facing firms, the focus of this thesis is foreign exchange exposure one of the many business risks multinational companies (MNCs) are exposed to – yet, its management has become one of the key factors in overall financial management.

There are commonly three different types of FX exposures discussed in the literature, translation, transaction and operating exposure. Yet, some confusion seems to exist, as some mention economic exposure instead of operating exposure, however others argue that transaction exposure is also a part of economic exposure (Shapiro 2010, Eiteman, Stonehill et al. 2010, Marshall 2000). Shapiro (2010) outlines the different exposures in a structured and intuitive way. In more broad terms he classifies that there are two types of exposures namely accounting and economic exposure. Accounting exposure divides the balances sheet’s assets and liabilities into those accounts that will be affected by exchange rate changes and those that will not. Whereas, economic exposure concentrates on the impact of an exchange rate change on future cash flows. That is, the extent to which the value of the firm, calculated as the present value of future cash flows, will change when exchange rates fluctuate. Within these two types of exposure we find the three, translation, transaction and operating exposure.

*Translation exposure* being a part of accounting exposure arises as there is a need for purposes of reporting and consolidation in order to convert the financial statements of foreign operations from the local currency involved to the home currency. If exchange rates have changed since the previous accounting period, the translation of those assets, liabilities, revenues and expenses that are denominated in foreign currency will result in foreign exchange gains or losses.

Transaction and operating exposure combined equals a firm’s economic exposure. *Transaction exposure* arises due to some contractually binding future foreign-currency-denominated cash inflows or outflows. As the exchange rate changes between now and when the transaction takes place, so does the value of the foreign currency cash flow, thus resulting in currency gains or losses. Though, even if a firm prices all its transactions in a certain currency or otherwise hedges its transaction exposure, there is still a longer-term operating exposure that remains.
This *operating exposure* stems from the extent to which currency fluctuations can change a firm’s future operating cash flows, that is, its future revenues and costs. Thus, this requires a longer-term perspective, viewing the firm as an on-going concern with operations subject to impact from exchange rate changes. Even a purely domestic corporation with all its cash flows denominated in home currency will be subject to operating exposure, as its competitors might be MNCs, thus the purely domestic firm is indirectly affected by exchange rate changes (see section 3.2 for further discussion). (Shapiro 2010).

There is no agreement within the literature as to which of these exposures are most important to manage; this is also due to the confusion of the overlapping and imprecise nature of these terms. Some empirical studies find that UK firms tend to manage transaction exposure more than the other two. This corresponds to Shapiro (2010), who presents the view that translation exposure should not be actively managed as it is purely accounting based not related to cash flows. Glaum (1990) and Grant & Soenen (2004) are of similar opinion, emphasizing that economic exposure is the most important and difficult concept within foreign exchange management. Economic exposure, compromising transaction and operating exposure, is also the one of interest in this thesis, as it is the cash flow exposure and it is also here that most hedging takes place.

### 2.4 Whether to Hedge

Hedging is investment positions facilitating the possibility of managing e.g. currency exposure. Risk management of FX exposure is aimed at protecting the firm against adverse effects of exchange rate fluctuations. As discussed earlier it can also be viewed more precisely as reducing the vulnerability to costly lower-tail outcomes. This implies that some firms will need to hedge all their financial risk, some only certain kinds of risk and others should not worry about risk at all. This raises the often-debated question of whether a firm should hedge or not? Within modern finance there are two pillars, the concept of efficient markets and diversification.

The idea of *efficient markets* states that the markets don’t leave money on the table. As all investors are assumed rational all information that is freely accessible will be
assimilated to the determination of asset prices and adjust prices accordingly. Hence, making it impossible to earn an abnormal return, as prices react instantly to new un-predicted information. Though the concept is well known, the business environment is full of managers convinced of their own abilities to predict future interest rates, exchange rates and commodity prices. (Berk, DeMarzo 2011, Stulz 1996). Strengthening the former argument of risk management’s ultimate goal; namely reducing vulnerability to lower-tail outcomes, as these cannot be predicted. The attempt to earn higher returns would most often mean bearing larger and unfamiliar risks. Thus the concept of efficient markets ought to discourage firms from hedging their FX exposure, as the forward contracts are priced properly and there are no excess returns from hedging (Stulz 1996). However, this reasoning misses the point of corporate hedging. Because managers do not hedge in order to earn excess return, but in order to achieve a level or pattern of risk and return, with which they are comfortable. By hedging the additional variability introduced by exchange rate changes is eliminated and what is left is due to fluctuations in business activity (Dufey, Srinivasulu 1983).

The companion pillar diversification should also discourage some firms from hedging their financial exposure. This is based within the theory of Modigliani and Miller (1958), as they stated that when there are no taxes and the capital market functions well, the market value of the firm does not depend on how the firm chooses to finance its investment whether through debt, equity or retained earnings. So according to them, what a firm does, investors can do for themselves, hence; there is no need for risk management of exchange rate risk. This also relates to the former section 2.1.1 on systematic and unsystematic risk. A firm’s cost of capital varies directly with its level of risk - the greater the risk, the higher the rate of return the shareholders will demand. The cost of capital is said only to depend on the systematic risk, and therefore depend on the firm’s ability to move with the broad market. Though diversification cannot reduce systematic risk, it is however possible for the shareholders to control their exposure to this risk. This is possible as they can adjust their combination of risky assets and safe cash holdings or hedge by the use of forwards, futures, options or swap contracts. By holding a larger fraction of cash or by hedging with derivatives shareholders are able to reduce their exposure to systematic risk, though at the cost of decreasing expected returns and provided that they know the firm’s risk exposure. (Meulbroek
In general the firm’s financial exposures such as, interest rate, currency and commodity price will not increase the risk of a well-diversified portfolio. Thus, these financial exposures represent unsystematic risk, which the shareholders are able to eliminate by holding a diversified portfolio (Stulz 1996).

The use of diversification should leave no incentive for the firms to try and reduce their earnings volatility by risk management, as the shareholders hold an in-expensive risk management tool at their disposal. Furthermore, as shareholders are also able to adjust their own exposure to systematic risk, there seems to be no need for firm-based risk management, as shareholders might be able to manage both types of risk. However, the latter one requires the shareholders to estimate the firm’s risk, which can be quite difficult. Though shareholders through the use of historical equity return volatility can estimate the systematic risk of the firm, they typically do not have the same information as the managers. Information about the current and future activities of the firm both in scale and scope are at the disposal of the managers, thus better equipped at estimating the systematic risk and thereby able to manage the risk in ways the shareholders cannot. As a result of this the classical notion of Modigliani and Miller does not always apply, as firms through risk management are able to lower the cost of capital, which the shareholders might not be able to do as easily or cheaply. (Meulbroek 2002). For this reason, shareholders are primarily left with the ability to manage the unsystematic risk, enclosing interest rate, currency and commodity price exposures. This also leads Stulz (1996) to conclude that it only makes sense for a firm to devote resources to reducing these exposures if the accompanied cash flow variability has potential to impose real costs on the corporation. Because real-world imperfections do exist within markets, firms are subject to foreign exchange rate risk. If a firm chooses not to hedge, there will be some variability in the cash flows which will be in either the money raised externally or in the amount of investment. Variability in investments is generally undesirable, to the extent that there is diminishing marginal returns to investments (Froot, Scharfstein et al. 1993). As mentioned earlier the variability arising from FX exposure has the potential of imposing real costs to the corporation, thus leaving them with incentives to hedge. These costs will be outlined in the following section.
2.4.1 Incentives for Hedging

In this section different incentives for hedging will be explained. In all of the situations below, the trigger for hedging is variability of cash flows, thus the degree of variance in the cash flow is an essential factor for the advantage of hedging. Firms with high exposure towards financial price risk experience greater variation of cash flows, than firms with a low financial price exposure. (Smith, Stulz 1985). Thus, the potential benefit of hedging is higher for firms with high financial price exposure.

2.4.1.1 Financial Distress

Smith and Stulz (1985) recognise that a bankruptcy comes with some exogenous transaction costs lowering firm value, therefore, firms in financial distress will benefit from a hedging policy that lowers the probability of bankruptcy.

The costs of a bankruptcy are direct costs of legal expenses and lawyer fees, though even before the bankruptcy occurs, the firm will face costs of employees demanding a premium for their risk of losing their job or some of their income, suppliers showing less willingness to co-operate and offering less attractive payment conditions. If a firm is in a state of financial distress, firm value will decrease by the costs of bankruptcy times the probability of bankruptcy. Therefore, initiatives that lower the probability of bankruptcy will increase firm value. Hedging of currency fluctuations will thus increase the firm value of firms in financial distress, as it lowers the variance of future cash flows, lowering the probability of the firm not being able to meet its future obligations. (Stulz 1996, Bartram 2000).

2.4.1.2 Underinvestment Costs

Another inconvenience of being in the state of financial distress is the problem of underinvestment costs. When the firm becomes weaker financially, it scores a lower credit rating. Nobody wants to lend money to a firm in financial distress, because of the chances that new funds are used to pay off old debt holders. Therefore, it becomes difficult to raise funds if at all possible, and management will have to pass up profitable investments, thus underinvesting (Froot, Scharfstein et al. 1994, Clark, Judge 2005). However, a high level of debt is not necessarily associated with underinvestment costs, the firm’s ability to meet its obligations, service the debt and pay it off at maturity is
the important factors concerning underinvestment costs (Judge 2006). By hedging, the firm will reduce the variance of its cash flow, making it more likely that it will be able to meet its obligations etc. Thus, Géczy et al. (1996) stress that hedging mitigates the problems of underinvestment by reducing the costs of obtaining external funds and increasing the possibilities of internal financing.

2.4.1.3 Tax
Smith and Stulz (1985) argue that convex tax structures can make it valuable for firms to use financial derivatives. Factors causing convexity are tax preference items such as tax loss carry-forwards, investment and foreign tax credits and most importantly progressivity in marginal tax rates. Under progressive tax structures, tax increases are smaller in situations where income would have been low, than the tax reduction in situations where income would have been high. Significant variance in income for longer periods will therefore lead to a higher tax burden than a more stable income. Thus, hedging will increase firm value by reducing expected taxes, since it lessens the variance of the firm’s taxable income, by decreasing the variability of cash flow. (Bartram 2000, Graham, Smith Jr. 1999, Judge 2002).

Judge (2006) stresses that this incentive for hedging is potentially rather weak for UK based firms, since the UK has a limited progressivity in the corporate tax structure. The tax rates are progressive on profits up until £1.5m and constant on profits beyond £1,5m (HM Revenue & Customs).

2.4.1.4 Managerial Incentives
Managers have incentives to hedge when they own a large number of firm shares. Bartram (2000) states that agency problems arise, when risk adverse managers having undiversified portfolios, act in their own interests instead of the shareholders. As mentioned earlier, shareholders are able to diversify their own portfolio making them indifferent to the amount of hedging activity undertaken. Though, when managers believe that it is less costly for the firm to hedge the risk, than it is for the managers themselves, they will direct the firm to hedge, even though it might not be in the interest of the shareholders (Bartram 2000, Géczy, Minton et al. 1997).
2.5 Financial and Operational Hedging
As mentioned earlier, this paper focuses on economic exposure, which consists of transaction and operating exposure. To minimize the firm’s exposure towards these risks, the managers can make use of both internal and external hedging strategies. The latter is known as financial hedging and is mostly recognized as a short term hedging method, whereas the former can be both short and long term. Short-term internal hedging consists of methods like matching, leading and lagging etc. These are not the focus of this paper and will not be further discussed. Long-term internal hedging is recognized as operational hedging which will be elaborated in the section below.

2.5.1 Operational Hedging
Kim et al. (2005) define operational hedging as the degree of geographic diversification. Operational hedging can either be used to reduce the probability of a risk occurring, or to reduce the risk’s impact on the given firm (Meulbroek 2002). Kogut and Kulatilaka (1994) stress that there exists to kinds of options; the “within-country” option, which is a growth option arising when a firm starts activities in a country, as it provides a platform for further involvement in the specific country. The second and most important option is the “across-country” option, which is provided by operating flexibility. The diversification of operations creates real options, as it allows the firm to shift value chain activities across its subsidiaries.

The firm can use these real options as operational hedging to manage FX exposure. The advantage of operational hedging is that firms are able to reduce the downside risk while exploiting the upside. A firm can for instance reduce downside risk, if it has several plants in different countries. If the currency, of a country where the firm has production, appreciates towards countries where the product is sold, the firm can shift production to another country with a more favourable exchange rate. Conversely would the firm also be able to shift production to a country with depreciating currency, and thereby exploit the upside risk. Thus, operational hedging increases firm value, if the firm make use of its real options, as it increases their cash flow.

Carter et al. (2003) further expand the potentials of operational hedging, and add the possibility of shifting input sources in extension to shifting production location. Furthermore, they recognize that MNCs have the opportunity of varying the level of pass-
through of changes in exchange rates and production costs to sales prices. Pass-through is when a firm for instance fixes the sales price to the exchange rate, transferring the variability of exchange rate changes to the customers depending on the elasticity of the given market. The final option is the possibility of abandoning a foreign market if factors such as increasing competition in the market, low prices on outputs or high costs of inputs make the market unprofitable for the firm.

Of the above-mentioned real options, the one most associated with operational hedging is the shift of production location. In theory, a risk neutral firm would prefer uncertainty in exchange rates, as it increases firm value when operationally hedged. Though, empirically factors like switching time and costs reduce some of the advantage of the option. (Capel 1997).

If a firm makes use of operational hedging to benefit from upside risk, its cash flow will be a function of exchange rate behaviour and with that more variable, the market value of the firm will therefore also become more variable. Thus, theory explains that managers may choose to give up the benefits of real options, in order to reduce variability of market value. Advantages of this are for instance a more stable level of profit in relation to the firm’s tax structure or manager’s private compensation scheme.

2.5.2 Financial Hedging

Financial hedging is the use of foreign currency derivatives (FC derivatives) such as forwards, futures, options and swaps. While operational hedging minimise operational exposure, financial hedging manage the risk of cash-flow exposures, thus minimizing the firm’s transaction exposure. The benefit of FC derivatives gives firms the ability to minimise a specific risk without interfering with its operations. On the other hand the ability to target a specific risk is also a limitation of FC derivatives, as they are effective only at the targeted risk exposure (Meulbroek 2002). Another drawback of the financial instruments is their fixed maturity that may be shorter than what is required in relation to the firm’s planning horizon of risk management (Capel 1997).

FC derivatives can also be used for speculative purposes, but will then increase the FX exposure instead of reducing it. The different FC derivatives will be discussed in the following sections.
Financial hedging is divided into linear and nonlinear derivatives. Linear derivatives (forwards, futures and swap agreements) remove both downside and upside risk, thus firms using linear derivatives avoid the downside risk but also terminate the possibility of upside risk. Therefore, nonlinear derivatives (options) are preferable as they only remove the downside risk, thus also come with a premium compared to the nonlinear. (Froot, Scharfstein et al. 1993).

In a forward contract, the firm enters into an agreement with a bank of exchanging a fixed amount of currency against another currency; the exchange rate is thus fixed at the time the contract is entered into. Hence, the firm can use a forward contract to hedge a future cash flow denominated in a foreign currency. Forward contracts, are unique private deals, where the firm chooses size and maturity, whereas futures are standardized contracts traded at an organized futures market with fixed size and maturity components. The firm will therefore have to enter into the future that fits best with the expected future cash flow. In addition to forwards and futures, firms can also hedge through currency swaps. Currency swaps can be used to transform either positive or negative cash flows into another currency, a firm can for instance swap foreign currency debt (FC debt) obligations into domestic debt or vice versa. Currency swaps are agreements between two parties, arranged through a swap dealer or swap bank. The two parties agree on exchanging debt-service obligations denominated in different currencies. Thus, the firm can transform its cash flows into a more desired currency by swapping it future cash-flow obligations. Consequently, the swap contract acts like a series of forward contracts in which the exchange rate is fixed once in for all. (Shapiro 2010).

The advantages of forward contracts are the adjustable size and maturity components, which results in the disadvantage of higher transaction costs compared to the standardized futures, which conversely lacks the possibility of adjustable contents. Compared to the currency swaps, the firm will have to continuously enter into new forward and future contracts with varying exchange rates, to keep a hedge against a continual foreign cash flow. Consequently the disadvantage of the swap is the risk of changing cash flows, when the amount hedged is constant. (Shapiro 2010).

Forwards, futures and currency swaps are linear contracts, and therefore lack the maximizing value possibility. An option on the other hand is a nonlinear financial instru-
ment as it eliminates the downside risk while preserving the upside. The reason for options being nonlinear is the nature of the option, which gives the buyer the right, not the obligation, to buy or sell. An option is a contract between a seller and a buyer, where the seller on request of buyer is obligated to realize the deal. There exist two kinds of options, put and call options. The latter gives the customer the right to purchase; the former conversely gives the right to sell. As a hedge, the firm will enter the contract as a buyer, where the size is the amount of currency the firm wishes to hedge. (Shapiro 2010).

In addition to FC derivatives, FC debt can also act as a hedge of foreign cash flows, e.g. to match a stream of revenue in a foreign country. The firm can take on debt in the same currency, so the cash inflow (revenue) matches the cash outflow (debt). FC debt can act both as short term, and long term hedge for instance when a firm has receivables in three months, it can take on a loan corresponding to the outstanding receivables, with repayment in three months. (Géczy, Minton et al. 1997).
3. Literature Review

The area of risk management is increasingly drawing the attention of corporate managers and more are using financial derivatives. In 2003 in a letter to the shareholders of Berkshire Hathaway, the successful investor Warren Buffet described derivatives as: “financial weapons of mass destruction, carrying dangers that, while now latent, are potentially lethal.” Despite this warning, evidence from the same year showed that corporate managers are making extensive use of these derivatives. Of the world’s 500 largest firms 92% reported use of derivatives, of these 85% used derivatives to manage currency risk. Thus, corporate managers appear to believe that derivatives are able to add value to the firm. From a perhaps more objective view, 84 academics from 42 institutions were also asked whether managing financial risk effectively could increase shareholder value – over 90% agreed. It therefore appears that both corporate managers and academics agree that risk management can add value to the firm. (Smithson, Simkins 2005). Despite this apparent agreement of derivatives being for the good, research continuous within the subject. Trying to document how the use of derivatives are related to the FX exposure of the firm, whether financial hedging and operational hedging are substitutes or complements and in the end does this really add value to the firm?

This section will provide an overview of the most important findings within the subject of this thesis. Most of the previous literature investigates US MNCs and their use of hedging, while this thesis focuses on UK firms. However, it is still possible to relate to the findings in the US, as the two markets are similar. Marshall (1999) studies the foreign exchange risk practise of large UK, US and Asia Pacific MNCs and finds that on the whole, UK and US MNCs have similar policies in general, as they in a large part of his survey state almost the same about hedging. Although, there are similarities between the two, Bodnar et al. (2003) find that European firms are more likely to use derivatives for hedging than comparable US firms. This is likely the cause of European firms relying more on overseas business, whereas US firms have a higher reliance on domestic business (Marshall 2000). This could give an implication that hedging considerations are more important for European firms than US firms. However, this is not considered as a potential complication within this study, as little is known about whether the pre-
dictions from corporate hedging literature are consistent with the risk management practises (Judge 2006).

3.1 Risk and Internationalization
Overall in the research of whether a firm experience more or less FX exposure when using financial hedging and thus whether they should hedge more or less as they become more international, is related to investigating how the overall relationship between risk and internationalization is.

The research of Huges et al. (1975) compares national firms with multinational firms and finds that US MNCs experience less systematic risk. By dividing firms into groups relating to their level of foreign sales, Agmon and Lessard (1977) reach the same conclusion, as they show a negative relationship between systematic risk and internationalization. These findings are supported by others studies that also find a declining systematic risk as internationalization increases (Brewer 1981, Fatemi 1984, Mathur, Hanagan 1983). Contrary, the studies of Reeb et al. (1998) and Olibe et al. (2008) find a positive relationship between systematic risk and internationalization. Thus, the empirical research does not reach the same conclusion, as to what happens to the risk profile of the firm as it becomes more international.

3.2 Hedging and Foreign Exchange Exposure
The early research on FX exposure goes back to the work of Adler and Dumas (1984), who defined FX exposure as the effect of unexpected changes in foreign exchange rates on cash flows, by extension, firm value. This section will concentrate primarily on FX exposure and the effects of operational and financial hedging, whereas firm value will be discussed later on.

Before looking into how hedging affects FX exposure, it has to be considered whether this exposure is of relevance at all for firms. Most studies on FX risk focus on MNCs, whereas Aggerwal and Harper (2010) focus on domestic firms. Perhaps counter-intuitively for most managers, they find that domestic firms face significant FX exposure – on average the exposure is not significantly different from the exposures faced by MNCs. Domestic firms are in fact experiencing FX exposure, because with the in-
creasing globalization of financial and product markets, domestic firms may face currency risk through interest rates and financial markets and through product markets such as: competitors, suppliers and customers may as well engage in cross-border transactions. Though, domestic firms face FX exposure, studies by Jorion (1990) and He and Ng (1998) suggest that FX exposure is positively related to their foreign sales variable. Thus, more export will be accompanied by a higher FX exposure. This could give the impression that the more a firm expands its international operations the more FX exposure it will encounter. However, research show that the FX exposure coefficients of MNCs are actually less significant than those of domestic firms, which disproves this notion. Lee and Suh (2012) reach the conclusion within their study, that the FX exposures of MNCs are weak, if at all significant. Jorion’s (1990) research shows similar results, as only 5,2% of the sample of MNCs experiences FX exposure.

The reason why it is possible that more export leads to more FX exposure, yet MNCs are not faced with significant FX exposure is due to the definition of MNCs and operational hedging, respectively. Within previous literature there does not seem to rest a common agreement on how to define the two terms. For most of it, the two terms overlap each other – namely, when a firm has foreign sales it is defined as being a MNC, however as they increase their foreign sales and perhaps enters into operations abroad, they will become more and more operationally hedged. Thus, when a firm is operationally hedged it is also defined as a MNC, yet a firm that sells to one foreign country will also be defined as a MNC, though to call them operationally hedged would be to an exaggeration. It is therefore possible for firms with increasing export to experience increasing FX exposure, as they encounter an increasing number of currencies. Though, at some point this will change, as the different currency fluctuations may cancel each other out, or if they have operations in various currency zones the FX exposure of their operating cash inflow and outflows in various countries may cancel out each other, causing a reduction in net exposure (Choi, Jiang 2009). This is the natural form of exposure netting – a method of operational hedging (Shapiro 2010).

As discussed above the evidence indicate that the FX exposures of MNCs are weak. Several studies investigate whether multinationality matters – namely, will operational hedging lead to more or less FX exposure. They find that MNCs often have the ability to shift production from one country to another in order to protect themselves from
the unexpected exchange rate fluctuations, which will reduce their currency exposure. 
Thus, as the internationalization of the firm increases, so do its operational hedging 
and the FX exposure lessens. (Choi, Jiang 2009, Bartram, Brown et al. 2010, Elango 
2010, Yi-Chein Chiang, Sheng-Wei Chen 2008). Contrary to these studies, which define 
MNCs as firms with a specific amount of foreign sales or by the use of a foreign sales 
ratio as proxy for the degree of firm’s international activity, Allen and Pantzalis (1996) 
take it a step further. They argue that in order to empirically measure the value of this 
operating flexibility, it requires a precise specification of the extensiveness of the 
MNC’s transnational network to measure the degree of multinationality. They find two 
characteristics which are significant in explaining the value of operating flexibility; 
breadth, number of foreign countries in which the MNC has operations and depth; the 
concentration of foreign subsidiaries in a few countries. The combination of these two 
variables measures the degree of flexibility provided by having an international net-
work. Their results suggest that the greatest value is realized when a firm expands the 
breadth of its international network across countries, but limits the depth of its opera-
tions in a particular country. Yet, it depends on the combination of the two, e.g. their 
results show that it can be an advantage to add a subsidiary to a concentrated network 
if breadth is low, however a disadvantage if the breadth is high. Using these character-
istics in relation to FX exposures Pantzalis et al. (2001) find that MNCs with greater 
breadth are less exposed to currency risk. Kim et al. (2006) also use the framework set 
out by Allen and Pantzalis (1996) and examine how operational hedging affects FX ex-
posure. While studying this, they use the methodology of He and Ng (1998), and use a 
dummy variable to indicate whether the firm has positive FX exposure (a net importing 
firm which will benefit from an appreciation of the home currency) or negative FX ex-
posure (a net exporting firm which will be hurt by an appreciation of the home curren-
cy). Overall they find that operational hedging is associated with less FX exposure. 
Though, the coefficients for the operational hedging variables are statistically insignifi-
cant. This supports the finding of Carter et al. (2003), they find evidence that opera-
tional hedging can effectively reduce FX exposure, though this effectiveness varies 
across ‘net importers’ and ‘net exporters’. ‘Net importers’, which they find to have 
MNC networks spread across a larger number of foreign countries, thus greater 
breadth, are able to implement operational hedging so it resembles real option hedg-
es. Hence, providing protection against downside risk, while preserving the ability to enjoy favourable currency movements. Whether significant or not in relation to net imports or exports, the mentioned studies indicate that operational hedging is negatively related to FX exposure. However the study of Allayannis et al. (2001) finds that the use of operational hedging does not lead to lower FX exposure.

When examining how financial hedging affects FX exposure, the empirical findings show similar results. They suggest that firms effectively use FC derivatives to reduce their FX exposure (Allayannis, Ihrig et al. 2001, Allayannis, Ofek 2001, Makar, Huffman 2008). In comparison to operational hedging, the study of Bartram et al. (2010) suggest that financial hedging is more effective in reducing the FX exposure, as they find that operational hedging reduces exposure by 10% to 15%, whereas the use of FC derivatives and FC debt accounts for about a further 40% reduction in exposure. When dividing firms into ‘net importers’ and ‘net exporters’ both Carter et al. (2003) Kim et al. (2006) find that financial hedging has negative effects on FX exposure, though Carter et al. (2003) lack significance within ‘net importers’. When examining whether corporations are reducing or taking risk with financial derivatives, Hentschel and Kothari (2001) find that although many of the firms in their sample description disclose sizeable derivative positions, these firms display risk characteristics that are similar to the risk characteristics of firms with few or no derivatives. Thus, firms are neither reducing nor taking risk with financial hedging. This also relates to the possibility that managers might use FC derivatives to take on additional risk. However, as the results of Hentschel and Kothari (2001) imply; so does the research of Géczy et al. (1997) and Allayannis and Ofek (2001) show that firms use FC derivatives, not to speculate in the foreign exchange markets, but as protection against exchange rate movements. Overall, the empirical findings suggest that both operational and financial hedging is associated with lower FX exposure.
3.3 Foreign Debt and Financial Derivatives

FC derivatives are well-known tools for managing FX exposure and are therefore also often misunderstood as adequate for the concept of hedging, leaving FC debt outside. This misunderstanding is also highlighted by Clark and Judge (2008), who argue that this misclassification is a probable reason as to why previous literature might have found contradicting evidence when investigating the corporate use of hedging. When defining hedgers it is important that they are divided into two groups: derivative users (forwards, futures, options and swaps) and non-derivative users (FC debt). Thus, the problem is related to the widespread use of FC debt as a hedging instrument, yet as it is not a derivative, the firms that use FC debt are sometimes misclassified as non-hedgers. This misclassification is also consistent with the interpretation put forward by Guay and Kothari (2003): “If hedging with derivatives is, in fact, only a small component of firms’ overall risk management activities, then derivatives use will be a noisy proxy for risk-management activities and the mixed results documented in the literature are understandable” (p. 427). FC debt act as a natural hedge, and if firms are using this method for reasons similar to those using FC derivatives for hedging then the broader definition of hedging should include both derivative users and non-derivative users. Surveys have shown that FC debt plays a significant role in the hedging activities of firms (Nydahl 1999, Kedia, Mozumdar 2003). Thus, firms are using FC debt in managing their FX exposure - as a firm with revenues denominated in foreign currencies (cash inflows) can issue foreign currency debt (cash outflows).

In a study by Makar and Huffman (2008) it shows that UK firms that are reporting exchange rate exposures reduce such principal currency risk effectively by the use of derivatives and FC debt. As several studies demonstrate that FC debt is used for hedging purposes, others investigate whether FC debt act as a substitute or a complement to FC derivatives hedging. By going through the accounting footnotes to the annual reports of large US industrial corporations, Géczy et al. (1997) investigate why firms use FC derivatives. The study shows as previous literature that FC debt is used for hedging firm’s FX exposure, and furthermore the results suggest that FC debt and FC derivatives act as substitutes for hedging foreign operations. Allayannis and Ofek (2001) reach the same conclusion, their results show that exposure through foreign sales is positively and significantly related to a firm’s decision to issue foreign debt and to the
level of foreign debt. They interpret this as being consistent with the notion that firms use FC debt as a hedging tool. Their sample only contains firms that exports or have operations abroad, since importers represent a cash outflow, which cannot be hedged through FC debt. Furthermore, they also find that larger firms are more prone to use FC debt and those firms that only have exports and no operations abroad prefer the use of FC derivatives over the use of FC debt. In relation, the study of Géczy et al. (1997) also finds evidence suggesting that FC debt and FC derivatives act as substitutes for hedging foreign operations.

Bartram et al. (2010) find the same pattern as the previous studies, showing that firms use FC debt in order to reduce exposure, thus using this as a hedge. Furthermore, the results suggest that hedging with FC debt will have a larger effect on exposure than the use of FC derivatives. However, contrary to Géczy et al. (1997) and Allayannis and Ofek (2001), their results show that those firms experiencing the largest hedging effect use both FC debt and FC derivatives indicating that these two hedging methods are complements. With these contradicting findings it is however important to note, that when the two methods are found to be substitutes, FC debt does not necessarily substitute for all FC derivative activities. Allayannis and Ofek (2001) find that exporters prefer FC derivatives to the use of FC debt. Thus, Clark and Judge (2008) stress that when testing for whether these are substitutes or complements it is necessary to distinguish between derivatives appropriate for hedging short-term transaction exposure, such as forwards, futures and options and those appropriate for hedging long-term such as swaps. The study by Clark and Judge (2008) further shows that FC debt might be a preferred tool for hedging exposures arising from foreign operations. Indicating that FC debt is more long term, as operating exposure requires a longer-term perspective (see section 2.5). Opposed to using FC debt to reduce FC exposure, it can also create exposure. Bartram et al. (2009) find that derivatives use is positively related to the use of FC debt, which they then argue is consistent with FC debt creating FC exposure.

In summary the empirical evidence indicate that it is important to note that FC debt seems to be used as a hedge, though non-derivative. However, it is suggested that FC debt can act as both a substitute and a complement to FC derivatives hedging. Furthermore, some firms seem to be using FC debt for speculation, although the majority
use it in order to reduce the FC exposure. Overall, the results indicate that firms using
FC derivatives will also be using FC debt.

3.4 Financial and Operational Hedging
As it seems that both operating flexibility and financial hedging can reduce FX expo-
sure it would intuitively make sense that the two are substitutes – alternative ways of
achieving the same objective. It appears rational that a firm with flexible operations,
thus ability to source its production abroad in response to sharp movements in the
exchange rate, has less need to hedge its foreign currency. The rational for this, is that
flexibility leads to a lower cost structure and so firm value increases. This increase in
value will make default less likely and lower the accompanying costs of bankruptcy,
consequently the value of hedging declines. (Mello, Parsons 1995).
However the empirical evidence this far indicates that the two forms of hedging are
complements and not substitutes. Mello et al. (1995) studies the link between a firm’s
need for hedging and the degree of flexibility and find that firms with greater flexibility
hedge more. When examining the value of flexibility they do so by a production possi-
bility frontier analysis. Namely, the value of a firm is decomposed into the value of two
subsidiaries located in two different countries. Increasing flexibility is able to shift the
frontier outward, while financial hedging moves the firm onto the given frontier – cre-
ating an efficient hedge. This is in line with the theory, as the two types of hedges aim
at different types of exposures; financial hedging is for short-term exposure and opera-
tional hedging for long-term exposure. It is therefore misleading to view these as sub-
stitutes. Operating flexibility is essentially to do with the technology facing the firm
and shapes the possible cost structure. Whereas financial hedging constitutes the task
of designing the firm’s liability structure so as to align the interest of the equity holders
with those of the firm as a whole (Mello, Parsons 1995). Kim et al. (2006) also exa-
mines whether operational hedging can substitute financial hedging, and identify a
strong positive relation between operational hedging and financial hedging, which
supports the complementary nature of both hedging strategies. These findings are also
in accordance with Carter et al. (2003) who find that the combination of operational
and financial hedging will more effectively reduce exposure to FX risk, as it addresses
the firm’s overall exposure both the short- and long-term, respectively. Guay and Kothari (2003) also argue that much of the previous literature only examines the relationship between derivatives use and e.g. firm value, neglecting to see whether the sample firms’ derivatives positions are sufficiently large to produce such potential benefits. Their results show that the substantial increases in firm value documented in the previous studies are either driven by other risk management activities, such as operational hedging, or that the results are false. They therefore argue for the importance of not only focusing on financial hedging, but operational hedging as well, as they both contribute to various findings, though with different contributions. This also shows in the work of Allayannis et al. (2001). Their results suggest that a geographically dispersed firm is more likely to use financial hedging to protect themselves from exchange rate changes. Where Guay and Kothari (2003) stress the importance of also incorporating operational hedging, Allayannis et al. (2001) show it the other way around. They find that while firms’ operational hedging is not associated with higher firm value, the use of operational hedging in conjunction with FC derivatives improves firm value. Hence, firms that rely exclusively on operational hedging may not maximise shareholder value. The empirical evidence agree that when examining the relationship between operational and financial hedging it shows that the two are complements and a combination of these is the best solution.

3.5 Hedging and Firm Value
Whether or not to use risk management tools, such as operational and financial hedging and whether these two are substitutes or complements and are able to decrease FX exposure, comes down to one simple question - is it value enhancing? The ultimate goal of managers is to maximise the shareholders return. Consequently many studies have examined whether the use of hedging will increase firm value. Mello et al. (1995) argues two distinct sources as to how hedging can increase firm value. First, operational hedging enables managers to shift production between countries at critical exchange rates. This can be compared with the general choice of alternative projects with different risk and returns. Second, an efficient financial hedge decreases the probability of default, thus reducing the deadweight costs incurred in
bankruptcy. Bartram (2008) chooses to reason a bit differently, arguing that firms with foreign currency based activities, such as imports and exports, have corporate cash flows and thus firm values, which are a function of exchange rates, rendering the management of such exchange rate risk an important activity. From a third perspective, Allayannis and Ofek (2001) found that on average, firms use FC derivatives to reduce FX exposure rather than to speculate, it follows that firms use of derivatives for hedging, may be a value enhancing strategy. Despite these arguments, the research of Griffin and Stulz (2001) and Bartram (2008) have come to conclude that the effect of exchange rate changes on firm value is economically and statistically small. Through a model of firm valuation to examine the exchange rate sensitivity of firm value, Choi and Prasad (1995) find that exchange rate fluctuations do in fact affect firm value. However, they do not document whether this impact is economically small or big. The suggestions of exchange rate changes only having a small economically effect on firm value advocate that it is perhaps not worthwhile for firms to engage in hedging. However this contradicts the findings of several studies. By employing Tobin’s Q as a proxy for firm value the research of Allayannis and Weston (2001) and Kim et al. (2006) report that hedging with financial derivatives increase firm value by approximately 5% in US firms. This premium is smaller than the around 12% reported by Clark and Judge (2009) and the 14.5% found by Allayannis et al. (2004) for UK firms. The study of Clark and Judge (2009) further shows that this value creation might depend on how firms decide to hedge their FX exposure. More specifically they find that the use of FC derivatives increases value, but there is no premium associated with FC debt, except when combined with FC derivatives. Individually, FC swaps is the derivatives that generates most value. Overall these percentage increases suggest that corporate managers should use financial derivatives, as these increases are not economically small. When focusing on operational hedging, Allayannis et al. (2001) find that operational hedging increases firm value only when combined with financial hedging. The study of Denis et al. (2002) indicates that the costs of global diversification outweigh the benefits, as global diversification results in average valuation discounts. This cost of global diversification could imply that operational hedging is not worthwhile. Though Gande et al. (2009) find otherwise, as they document through the use of Tobin’s Q, that global diversification enhances firm value. This conforms to the findings of Creal et al. (2011),
as they find that on average multinational operations are valued at a premium – thus maintaining operations in multiple countries enhances firm value. Allen and Pantzalis (1996) also find that the returns of multinationality increases as the firm expands its holdings of real options. As the frontrunner within these are Kim et al. (2006) - their results show that operational hedging generates up to five times more value than financial hedging.

In summary, though some research has found the effects of exchange rate changes to be economically small, the majority find that with the use of financial and operational hedging firms are able to increase firm value, some up to 14.5%.
4 Hypotheses Development

The following section will present the hypotheses of this thesis. The primary interest of this study is to examine the non-linear relationship between multinationality and financial hedging. However, before examining this, it is interesting to see how multinationality and financial hedging affect the risk profile of the firm and in relation to this, examine how these variables affect the foreign exchange exposure of the firm. And in the end does it add value to the firm. The development of the hypotheses is based on the review of the theory and literature review in the previous sections – the arguments will be explained below. The majority of previous studies have focused on the US market; it is therefore in the interest of this paper to examine how this corresponds to the UK market. The following hypotheses will therefore be based on firms from the UK. However, it is not deemed a complication to draw on the evidence from the US, as the two countries have similar policies in general (Marshall 2000).

4.1 Risk

In theory it seems sensible that a firm involved in all markets will experience more or less the same movements in its stock price as the overall market. Regarding the use of financial hedging it also seems rational that as financial hedging is expected to decrease the firm’s FX exposure, it will also decrease the risk profile of the firm. Within the previous research some have examined the relationship between systematic risk and multinationality, though the findings are contradicting. As the primary interest is to examine whether there is a possible bell-shaped relationship between financial hedging and multinationality (see section 4.3) it is also interesting to see whether the same goes for the risk profile. Thus first examine how multinationality actually affects the risk profile of the firm and then later on examine how it compares to the firms use of financial hedging as they become more multinational. It could be hypothesized that as a firm becomes more multinational the risk of the firm will increase, as going from domestic to foreign countries involve risk and the firm becomes more exposed. Though at some level of multinationality the risk will begin to decrease again, as truly multinational firms are more diversified and thereby not as
exposed. Based on these considerations and the previous empirical findings the following is hypothesized:

*Hypothesis I: Financial hedging is negatively correlated with risk.*

*Hypothesis II: The non-linear relationship between multinationality and the risk profile of the firm is somewhat bell-shaped.*

**4.2 Foreign Exchange Exposure**

Theory predicts that MNCs will be exposed to both transaction and operating exposure. A way to minimize this is through the use of hedging. Several empirical studies have also made an effort in finding out how operational and financial hedging affects the FX exposure of firms. Within the empirical research included in this paper, all except for one (Allayannis, Ihrig et al. 2001), find evidence suggesting that with the use of operational hedging it is possible to reduce the FX exposure of the firm (Allen, Pantzalis 1996, Bartram, Brown et al. 2010, Carter, Panzalis et al. 2003, Choi, Jiang 2009, Elango 2010, Jia, Lilian 1998, Kim, Mathur et al. 2006, Pantzalis, Simkins et al. 2001, Yi-Chein Chiang, Sheng-Wei Chen 2008). The empirical evidence within financial hedging is strikingly similar to that of operational hedging, as all except for one (Hentschel, Kothari 2001), find that financial hedging is a possible mean to reduce FX exposure (Allayannis, Ihrig et al. 2001, Carter, Panzalis et al. 2003, Kim, Mathur et al. 2006, Allayannis, Ofek 2001, Makar, Huffman 2008). The study of Bartram et al. (2009) even suggests that financial hedging is more effective in reducing FX exposure than operational hedging. Within this study the focus is not on operational hedging, but on the level of multinationality, which will be discussed further in section 5.3.1.2. As with the risk profile of the firm, it is also interesting to examine whether there exists a bell-shaped relationship between multinationality and FX exposure, with the same rationale as in the previous section.

Based on these considerations and empirical findings, the following is hypothesized:

*Hypothesis III: Financial hedging is negatively correlated with FX exposure.*
Hypothesis IV: The non-linear relationship between multinationality and FX exposure is somewhat bell-shaped.

4.3 Financial Hedging
According to theory financial and operational hedging aim at two different types of exposure, transaction and operational exposure, respectively. Explained differently, these can also be viewed as financial hedging pursuing short-term exposure and operational hedging pursuing the more long-term exposure. This suggests that the two types of hedging are complements, which is also what most of the empirical findings show.

Mello et al. (1995) argue with the use of a production possibility frontier that as theory suggests the two types of hedging pursue different tasks. Through regression analyses it also shows that there is a positive correlation between the two types of hedging and the best results in reducing FX exposure are accomplished by combining the two. (Al-layannis, Ihrig et al. 2001, Carter, Panzalis et al. 2003, Kim, Mathur et al. 2006, Guay, Kothari 2003).

The theory and empirical findings are seemingly agreeing that financial and operational hedging are complements. However, it also appears sensible that a firm able to shift production in response to critical exchange rates, thus operationally hedged, has less need to hedge its foreign currency. This is also in accordance with the findings of Lee and Suh (2012) and Jorion (1990) as they find that MNCs are only weakly exposed to foreign currency movements. The fact that MNCs in various degrees have operational flexibility (see section 5.3.1.2) will assumingly lead to lower cost structures, thus increasing firm value. By extension this lowers the risk of default and consequently the value of financial hedging declines. This is not to say that the two types of hedging are substitutes. But if a firm becomes a truly global firm, thus very operationally hedged with operations in several countries, is it then possible that fluctuations in exchange rates become an opportunity instead of a threat? From another point of view it can also seem rational that as a firm becomes more and more multinational, and exposed to more and more currencies, at some point the fluctuations in different exchange rates will offset each other. Hence, the more multinational a firm becomes the less FX
exposure (Jorion 1990, Lee, Suh 2012) and the less need for financial hedging. The empirical research have this far investigated the linear relationship between financial and operational hedging. However, it is interesting to examine the non-linear relationship in order to see whether multinationality and financial hedging might have a bell shaped relationship. The rational for this can be seen in three steps: first, firms that are not multinational will perhaps not make use of financial hedging, as they do not perceive themselves as exposed. Though, Aggarwal and Harper (2010) find that domestic firms are indeed exposed, the literature has ignored investigating whether domestic firms use derivatives. Second, as firms become increasingly multinational, they will make more extensive use of financial hedging, as they are exposed to more currencies and through the use of derivatives they can reduce this exposure. Third, firms that are becoming truly multinational will to a lesser extent make use of financial hedging, because they have operational flexibility. Though, this in principal contradicts theory, as the two hedging types pursue different exposures, it is interesting to examine the non-linear relationship as it has been ignored in the literature.

Based on the above reasoning, the following is hypothesised:

**Hypothesis V:** The non-linear relationship between multinationality and financial hedging is somewhat bell-shaped.

### 4.4 Firm Value

The fundamental objective of managers is to increase firm value for the benefit of the shareholders. Hence, firms should only engage in hedging activities if it contributes to the firm value. Among incentives for hedging are financial distress and tax benefits (section 2.4.1). Furthermore operational hedging and non-linear FC derivatives give the possibility of profiting on the upside and thus increase the firm’s cash flow and with that firm value. Except for Denis et al. (2002) who find that the costs of global diversification outweigh the benefits, all the previous studies included in this paper find that firm value to some extent is improved. Clark and Judge (2009) and Allayannis et al. (2004) that examines the UK market, finds respectively extreme values at 12% and
14.5% increases in firm value due to hedging. Based on theory and previous literature the following is hypothesized:

*Hypothesis VI: Multinationality and financial hedging increases firm value.*
5. Research Methodology

The empirical research helped form the hypotheses of this thesis, and the objective of this section is to describe how each of these is tested. Section 5.1 outlines the sample selection and section 5.2 specifies the objective of regression analysis. Before going through the different regression models, it is however important to narrow down and define the two main components of this thesis, namely financial hedging and multinationality. Thus, section 5.3 covers how this thesis defines financial hedging and multinationality and the related control variables (appendix 2). Section 5.4 describes the different regression models.

5.1 Sample Selection

The sample of firms for the studies conducted in this paper is extracted in Orbis. The sample is selected by the use of 6 criteria, which are shown in the table below, which will be elaborated on in the following section. The selection criteria reduce the sample from 83,742,390 to 253 firms; screenshots are included in appendix 1.

<table>
<thead>
<tr>
<th>Orbis selection criteria</th>
<th>Step result</th>
<th>Search result</th>
</tr>
</thead>
<tbody>
<tr>
<td>All active companies and companies with unknown situation</td>
<td>83,742,390</td>
<td>83,742,390</td>
</tr>
<tr>
<td>World region/Country/Region in country: United Kingdom</td>
<td>5,690,321</td>
<td>3,000,710</td>
</tr>
<tr>
<td>NACE Rev. 2 main sections: Manufacturing</td>
<td>6,580,046</td>
<td>109,298</td>
</tr>
<tr>
<td>Operating revenue (Turnover) (th. EUR): Last available year, min=10,000</td>
<td>672,787</td>
<td>6,784</td>
</tr>
<tr>
<td>Number of employees: Last available year; min=50</td>
<td>1,452,513</td>
<td>5,868</td>
</tr>
<tr>
<td>Listed/unlisted companies: Publicly listed companies</td>
<td>62,176</td>
<td>253</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>253</td>
</tr>
</tbody>
</table>

*Table 1.1 Orbis selection criteria.*

**UK Market**

Most of the empirical research has this far focused on US firms and their use of hedging. The interest of this thesis is to focus on a country within the European market. The UK market was chosen, as it is the financial centre of Europe. The UK also provides a particular valuable focus for empirical research, as it has a large and sophisticated corporate sector with widespread hedging activity. Due to UK's free floating status of its
pound contrary to countries within the European currency mechanism it can also be argued that UK firms to a larger extent are facing a continuous currency risk. Though, a study of Olugbode et al. (2011) observes that the introduction of the euro has led to a net reduction in FX exposure, particularly for importers. When compared to the US market, the study of Bodnar et al. (2003) shows that European firms are more likely to use derivatives. This is also expected as UK firms rely on a high degree of overseas business, whereas the US firms have a higher reliance on domestic business.

Industry
Since multinationality and thus operational hedging are some of the key issues of this thesis, it is important that the firms in the sample have the possibility of obtaining operational hedging. Operational hedging is as mentioned earlier the diversification and flexibility of the firms operations, where the most common is the possibility of shifting production across currencies. The mentioned operational hedging methods are by nature more prevalent among production firms and thus it is assumed that manufacturing firms to a greater extent are able to obtain operational hedging than for instance firms in the service industry. Therefore, only manufacturing firms are chosen in the sample.

Size
The sample is limited to large and medium sized firms, to avoid problems with instability and illiquidity of the firms stocks, and to obtain an acceptable degree of standardization and quality of the annual reports.
The criterion follows the definition by the European Commission, with a medium sized firm having a minimum of 50 employees and revenue above 10 million euros. (European Commission 2012).

Listed
All firms in the sample must be listed on the London stock exchange, providing the possibility to obtain the risk measures volatility and beta. Furthermore it is important for the data collection that the annual reports of the sample firms are accessible.
Data Collection

All of the data for the variables are collected from Orbis, Bloomberg, Datastream and the annual reports of the firms. All data are available in the excel documents on the enclosed CD. The data collection started in Orbis and the list of firms that met the selection criteria was downloaded\(^2\). Name and ISIN-number from Orbis have since been used as identification on the specific firm between the different databases. When extracting the data from Orbis, two of the 253 firms did not meet the selection criteria as they had revenue below 10,000 Euros. Therefore, these two firms were deleted from the sample. All data were if possible, collected from Orbis. Data that were not available on Orbis are specified below.

The use of financial hedging and foreign debt has been collected in the individual annual reports\(^3\). Foreign debt is in notional amount; financial hedging was registered in both notional amount and fair value since some firms only stated fair value in their notes. Furthermore it was registered what kind of different derivatives the firms used to hedge their FX exposure. As it was not possible to find the annual reports for four of the 251 firms, these firms were deleted from the sample.

From Thomson and Reuters Bloomberg, the amount of UK sales and the numbers of regions in which the firms had sales in, in the given year, was extracted. Bloomberg did not have UK sales for eight of the 247 firms, two of these were instead collected from Orbis\(^4\), and the remaining six were deleted from the sample.

Market data was collected via Datastream and the Bank of England. Stock returns, market returns and beta values were processed via Datastream, the broad effective exchange rate index was downloaded from the Bank of England.

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\(^2\) All data from Orbis is the latest available year and was downloaded on the 19th of marts 2012. Therefore, all data collected from other sources has same date as cutting point. The numbers of subsidiaries are available on Orbis in up until 10 levels. Level 1 is the subsidiaries owned by the company in our sample. Level 2 is also the subsidiaries owned by the subsidiary from level 1. Since firms have different firm structures, subsidiaries are collected at level 10 in order to get the full picture.

\(^3\) According to IAS (international accounting standards) 39, listed firms shall measure and recognize their financial instruments according to certain regulations (IFRS). IAS 39 is legally binding for listed firms in the EU (European Commission 2004).

\(^4\) UK sales were collected from Orbis for Mulberry and Oxford Biomedica. None of these were outliers in the multivariate regressions.
5.2 Regression Analysis

A regression analysis is a tool to test the relationship between a dependent variable and a number of independent variables. The regression analysis shows how changes in one of the independent variables affect the dependent variable, while the others are held constant. In this thesis, the regression analyses are used in answering the hypotheses stated in section 4. In order for the estimates to provide a good approximation, the design criteria must be fulfilled, if so, the regression analysis will be the Best Linear Unbiased Estimates (BLUE). The design criteria’s are as follows (Verbeek 2008):

D1 Zero mean: \( E(\varepsilon_i) = 0 \) for all \( i \)

D2 Homoscedasticity: \( \text{var}(\varepsilon_i) = \sigma^2 \) for all \( i \)

D3 Mutually uncorrelated: \( \varepsilon_i \) and \( \varepsilon_j \) uncorrelated for all \( i \neq j \)

D4 Normality: \( \varepsilon_i \sim i.i.d. - N(0, \sigma^2) \) for all \( i \)

D5 No multicollinearity

Design criteria D1, Zero mean, says that the expected value of the error term is zero, this criterion is always satisfied with a constant term in the model. D4 states that the coefficient estimates are normally distributed. According to the Central Limit Theorem, sufficiently large samples (more than 30 observations) are approximately normally distributed. With a sample of 241 firms in this thesis, the normality criterion is not expected violated. D2 are fulfilled if the variance of standard errors is not varying. D3 refers to autocorrelation and is only a problem when dealing with times series data, most of the data for this thesis rely on cross sectional data, why this criterion is assumed fulfilled. The last criterion is the undesired multicollinearity between the independent variables. The design criteria will be thoroughly outlined in the first regression and in the later only be accentuated if they are not fulfilled.
5.3 Definition of Variables

5.3.1 Main Variables

5.3.1.1 Financial Hedging and Foreign Debt
Most of the previous research that investigates financial hedging chooses to define it as a dummy variable, as to whether or not the firm make use of financial derivatives. However, as discussed earlier Clark and Judge (2008) argue that there is a misclassification problem, as financial hedging covers both derivatives (forwards, futures, swaps and options) and non-derivatives use (FC debt). In order to test whether there is a somewhat bell-shaped relationship between the use of financial hedging and the level of multinationality it is not enough with a dummy variable indicating whether or not the firm use financial hedging. Thus, financial hedging is defined as the notional amount of currency derivatives divided by total revenue (Fin.Hedge); this is also done by Carter et al. (2003), Guay and Kothari (2003) and Kim et al. (2006). The notional amount of currency derivatives is obtained from the individual annual reports, however approximately 13% of the annual reports did not provide the notional amount but the fair value\(^5\) of the financial derivatives. Instead of excluding these 13% from the sample, it is tested trough regression analysis whether there is a significant correlation between the two amounts. If so the fair value is calculated as a proxy for the notional amount (see section 6.4.1).

Within the aspect of currency derivatives, it is possible to distinguish between those appropriate for hedging short-term exposure, such as forwards, futures and options and those appropriate for the long-term exposure, such as swaps. FC debt (FD) is to be found within the same category as swaps as a possible mean to hedge the more long-term exposures. Though, FC debt is somewhat the joker in this setting, as it is not sure whether it is used to diminish or create exposure, thus acting as a hedge or a speculative tool. For the outline of this research, it is therefore not certain as to whether FC debt will be placed within the category of financial hedging, thus investigating whether the use of financial derivatives + FC debt have a bell-shaped relationship with the level of multinationality. Most of the previous research includes FC debt as a dummy variable, whereas Moles and Bradley (2002) and Choi and Jiang (2009) calculate is as a ratio

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\(^5\) “Fair value is the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm’s length transaction.” (IFRS)
to total debt. As FC debt is possibly to be placed within the same category of currency derivatives, it is calculated by dividing FC debt with total revenue, also done by Gande et al. (2009). Through the regression analyses the role of FC debt will analysed.

5.3.1.2 Multinationality
Within the previous literature there are many approaches to the concept of multinationality. The main focus of this thesis is the use of hedging and multinationality. Within hedging there is both financial and operational hedging. The concept of operational hedging is related to the breadth and depth of a firm’s foreign operations, though not to be confused the same as multinationality, yet the two concepts are connected and overlap each other. As a firm becomes more multinational, hence increases its sales and/or operations abroad, it becomes more diversified and flexible. The increase of foreign sales to different countries will create diversification and can perhaps help to level out some of the FC exposure, as more currency fluctuations may cancel each other out. With regards to flexibility, it can be argued that sales to different countries will create a kind of real option, as to whether which countries the firm chooses to sell to. However, the firm cannot personally choose this, as they are depended on whether the consumers want to buy the product. Therefore, foreign sales are not assumed to create flexibility only diversification.
Whereas, operations abroad in different countries creates a real option, as the firm personally chooses where to produce and whether to change production site. In addition to this flexibility, having operations in different countries also diversifies the firm, as they have cash outflows to different currencies. This combination of diversification and flexibility creates operationally hedging. Operational hedging is therefore to be found within the notion of multinationality, and is to do with both foreign sales and operations. Though having only foreign sales will not generate a true operationally hedge, as it mainly creates diversification, whereas foreign operations generate both diversification and flexibility. Hence, the notion of multinationality is argued to be a bit broader than operationally hedging, as it embraces both foreign sales and operations. However, within the outline in this thesis it will not be possible to distinguish whether a firms level of multinationality is due to mainly foreign sales or foreign operations, as
it has not been possible to categorize the specific subsidiaries as being either sale or operating. Many of the previous studies have chosen to define multinationality as a dummy variable, as to whether or not a firm has foreign sales. Again as it is interesting to examine if there is a bell-shaped relationship between multinationality and certain other variables, it is not enough with a dummy variable. A continuum is need; ranging from purely domestic firms to the completely multinational firms. As it has not been possible to find a common agreement within previous literature on how to define such a continuum, three different approaches are used:

**MNC1**: The first approach is outlined by Aggarwal et al. (2011) and the design is kept reasonably simple as they stress that multidimensional classification schemes ‘blow up’ when dimensions are added. This classification scheme captures the widely used characteristics of: breadth, the extent of geographical spread of operations and depth, the degree of engagement with and exposure to each geographic unit. Again it is to be noted, that breadth will be the geographical spread of subsidiaries, without categorisation of it being sale or operating, however anticipating some kind of correlation between the two. Breadth builds on four broad categories of geographic spread: domestic, regional, trans-regional and global. To calibrate this, the world is divided into six regions: Africa, Asia, Europe, North and Central America, South America and Oceania (appendix 3 provides a list of the countries in each region). Aggarwal et al. (2011) states that there are many ways to define depth, which depends a lot on the availability of data. The example of Aggarwal et al. (2011) is followed and depth is thus divided into two dimensions: foreign sales and investment in subsidiaries. By combining breadth and depth a 2 X 4 matrix is derived, in which the first letter refers to depth and the second to the breadth of multinationality. This creates a continuum ranging from purely domestic firms (SD-ID) with no export or foreign subsidiaries, to deeply global firms (SG-IG) with export and subsidiaries in all six regions – in all 16 types of firms (appendix 4 provides an overview of the 16 firm types).
There are however limitations to this classification scheme, as it supposedly requires more of a firm to go from domestic to regional or from their own region to a foreign region, than from e.g. four to five regions – thus not the same ‘distance’ between the four classifications. The same limitation goes for the definition of the 16 firm types, as they are ordinal scaled, which is an obstacle within regression analysis, instead of being interval scaled. Despite these limitations, the approach is still applied, as it is interesting to see which results such a simplified categorization of multinationality will generate, and furthermore it will be used as a robustness check to the other definitions of multinationality within this thesis. When interpreting the results, the limitations will be kept in mind. Aggarwal et al. (2011) also highlight the advantage of a simplified model, as it is better to have solid findings about a narrow population than marginal findings of questionable generalizability to a broadly defined population.

In classifying each firm within the sample, it was registered in which of the six regions a firm has sales. Furthermore, combined the sample has 22,391 subsidiaries and each of these was assigned to their respective region (appendix 3) in order to classify the firm’s breadth of investments.

In addition to the variable MNC1 the variable Tot.For (explained in the following section) is also included in the regressions in order to account for the total foreign sales, as MNC1 only covers countries in which there are sales and not total amount of foreign sales.

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6 Several firms in the sample listed sales to the category Rest of the world. In each case where sales to ‘rest of world’ could change the classification of breadth the annual report was checked to see which specific countries it sells to. Some firms recorded sales to Americas, as it was not possible to find a general definition of which countries that is, about a quarter of these firms annual reports was checked. All showed that Americas cover both North and South America, thus the rest was recorded accordingly. Those firms that recorded sales to Asia Pacific were recorded as having sales to both Asia and Oceania.
**MNC2**: The second approach is a combination of the approach outlined by Allen and Pantzalis (1996) and total foreign sales. As proposed by Allen and Pantzalis (1996) and used by Allayannis et al. (2001), Carter et al. (2003) and Kim et al. (2006), they use four proxies for operational hedging: (1) **breadth**, the log number of countries in which a firm operates; (2) **depth** is a concentration measure, calculated as the sum of the subsidiaries in the two countries with the largest number of subsidiaries divided by the MNCs total number of foreign subsidiaries; (3) **dispersion index I**, the geographic dispersion of the firm’s subsidiaries across different countries; (4) **dispersion index II**, the geographic dispersion of the firm’s subsidiaries across regions. Dispersion indices I and II are calculated as follows:

\[
\text{Dispersion index I} = \text{Hirschman Herfindahl concentration index} \\
= 1 - \left\{ \frac{\sum (#\text{ of countries})^2}{\left[ \sum (#\text{ of countries}) \right]^2} \right\}
\]

\[
\text{Dispersion index II} = 1 - \left\{ \frac{\sum (#\text{ of regions})^2}{\left[ \sum (#\text{ of regions}) \right]^2} \right\}
\]

Where: # of countries is the number of foreign subsidiaries in country i, and # of regions is the number of foreign subsidiaries in geographic region j. These dispersion indices will therefore be close to zero if the firm has subsidiaries in one country or region and close to one if the firm has subsidiaries in many countries or regions. Thus indicating how operationally diversified a firm is, as the higher the index the more operationally hedged. These four proxies for operationally hedging are within the literature kept apart in order to see how they each relate to the dependent variables. Hence, the results of Allen and Pantzalis (1996) indicate that MNCs with greater breadth of operations are better equipped to effectively manage their FX exposure. However, the focus within this thesis is not to examine the different indices separately but the concept of multinationality as a whole. It is therefore desirable to be able to add the four proxies together, thus requiring them to be ratios. This approach is also used by Elango (2007), as he defines multinationality as the summation of five different ratios: foreign sales, foreign assets, international diversification, country breadth

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7 Some firms had a few subsidiaries recorded as n.a., these subsidiaries are deleted as it is not possible to count them in when calculating dispersion index I and II.
and country depth. In order to add the four together breadth has to be changed into a ratio. Elango (2007) chooses to divide the number of countries in which a firm operates with 100. Though the rational for dividing by 100 is not explained, and doing so would result in some companies having a value higher than one, as there are 193 countries in the world, which excludes it from being a ratio. Hence, breadth is calculated as the number of countries in which a firm has subsidiaries divided by 193. With these four proxies for operationally hedging, the one area within multinationality: foreign operations, is covered. In order to get the full notion of multinationality, a foreign sales ratio (Tot.For) is calculated by dividing foreign sales with total revenue. These five items are expressed as ratios and each are assigned equal weight, the highest score a firm can potentially receive is therefore 5. Though the first four ratios are defined within the area of operational hedging and only one ratio is within foreign sales, there is no knowledge of whether these first four ratios are concerning production or sales subsidiaries. The five items are therefore assigned equal weight, as it is assumed that sales would otherwise weigh too much, and operational hedging is somewhat the important variable as it provides both diversification and flexibility.\(^8\) It is also the method of Elango (2010).

**MNC3:** The third approach is somewhat the same as the one in MNC2. However, within this approach the before mentioned four proxies for operational hedging and foreign sales are kept apart. Hence the four proxies for operational hedging are labelled MNC3 and foreign sales are labelled Tot.For. These are kept apart as they to some extent relates to the two areas within multinationality and it is interesting to see how they separately relate to the variables. Though, as it is not certain whether the subsidiaries are sale or operating, the four proxies are labelled MNC3 instead of e.g. OPERH (operational hedging).

\(^8\) It could also have been a possibility to assign the four ratios within operational hedging 50% and Tot.For 50%, thereby the highest score a firm could receive would be 2.5. Though this is not considered the appropriate way to do it (see argumentation in text above), the results are enclosed on the CD.
5.3.1.3 Risk
When examining how the risk profile of a firm is affected by e.g. financial hedging and the level of multinationality it is interesting to look at two types of risk: total risk and systematic risk. Total risk is of interest for the investor, who is not well-diversified, whereas systematic risk is of interest for the well-diversified investor. Stock return volatility (Volatility) will be used as a proxy for total risk. For each firm in the sample the stock return volatility is calculated for the year 21st of March 2011 to 19th of March 2012, based on daily stock returns. The distribution of volatility is skewed and to correct for this the natural log of volatility is used. Beta (Beta) is used as a proxy for the systematic risk, and is based on the same time period as the stock return volatility. 

5.3.1.4 Foreign Exchange Exposure
Originally Adler and Dumas (1984) defined the exposure elasticity as the change in the market value of the firm resulting from a unit change in the exchange rate. This definition of exposure is of interest for the investor and might also be for the risk manager in the firm, if the change in firm value is directly related to the change in the firm’s expected cash flow. They propose the following regression for total exposure elasticity:

\[ R_i = \alpha_i + \delta_i XR + \varepsilon_i \] (1)

Where \( R_i \) is the stock return for firm \( i \), XR is the percentage change in an exchange rate variable, defined as the home currency price of foreign currency (HC/FC), and \( \delta_i \) is the elasticity of firm value to the exchange rate change. Without going into further details, the model has however met some limitations, due to macroeconomic factors. To control for these macroeconomic influences on realized returns a return to a market portfolio can be included in the model (Bodnar, Wong 2003), thus looking like:

\[ R_i = \alpha_i + \beta_i R_m + \gamma_i F X_t + \varepsilon_i \] (2)

Where \( R_i \) is the stock return on firm \( i \), \( R_m \) is the return on the equally weighted market portfolio, and \( F X_t \) is the rate of return on the broad trade weighted foreign exchange rate index, \( \gamma_i \) is the exchange rate exposure elasticity of firm \( i \), \( \beta_i \) is the beta of

---

9 Beta is retrieved from Datastream.
the firm with respect to the market portfolio. It is important to note that there are now a difference between equations (1) and (2). Because the new exposure coefficient $\gamma_i$ measures the exchange rate exposure elasticity of the firm as the difference between the market’s exposure elasticity adjusted by the firm’s market beta and the firm’s total exposure elasticity. Thus measuring a kind of extra exposure, as the market return in the model also controls for the market’s own exchange rate exposure. Despite this limitation, equation (2) is used in this thesis to obtain foreign exchange rate exposure, as it is also generally preferred by researchers (e.g. Jorion (1990), Allayannis and Ofek (2001), Carter et al. (2003) and Kim et al. (2006)). Though previous research such as Kim et al. (2006) and Carter et al. (2003) chooses to use monthly rate of return for five years, daily rate of returns are chosen for this thesis, as they give a more precise estimate of the foreign exchange rate exposure ($\gamma$). The period is from 20th of March 2007 to 19th of March 2012. When extracting stock returns for these five years there are however some firms for which this is not possible as they became listed within this period. Three different time periods are therefore set up: 1 year (2011-2012), 3 years (2009-2012) and 5 years (2007-2012), creating samples of: 236, 233, 219 firms respectively. Examining how many years back generates the most significant results. The daily rate of return on an equally weighted market portfolio is drawn from LSE100.

5.3.1.5 Firm value
In order to measure the effect of financial hedging, multinationality etc. on firm value, Tobin’s Q is used as a proxy for firm value, also generally preferred by researchers (e.g. Allen and Pantzalis (1996), Allayannis and Weston (2001), Kim et al. (2006), Clark and Judge (2009), Gande et al. (2009)). Previous research by e.g. Allayannis and Weston (2001) and Kim et al. (2006) calculate an industry adjusted Tobin’s Q, in order to control for some firms being in high-Q industries, thus hedgers will have higher values, not due to their use of derivatives, but because of the industry they belong to. However, this is not assumed a problem within this setting, as the sample is limited to manufacturing firms, and the difference within these are not considered to be of importance. However, three different industry dummies are included in the regressions to capture possible differences between industries.
5.3.2 Control Variables

Within the regressions certain control variables are included based on theory and previous empirical findings:

**Size**: A common explanation for the relationship between size and hedging is the economies of scale. Size is considered and important control variable as it affects many facets of a firm, most of the previous research also include this control variable (e.g. He and Ng (1998), Allayannis and Weston (2001), Judge (2002), Clark and Judge (2003), Kim et al. (2006), Markar and Huffman (2008), Choi and Jiang (2009), Bartram et al. (2010)). A proxy for firm size is the number of assets, and as the distribution of this is skewed the natural log to assets is used.

**Financial distress**: Smith and Stulz (1985) argue that the cost of financial distress can induce firms to hedge price risks as the probability of incurring these costs is reduced. Many studies use leverage as an indicator of the likelihood of financial distress to measure expected costs of distress (Allayannis and Weston (2001), Hentschel and Kothari (2001), Clark and Judge (2009), Bartram et al. (2010)). However, leverage may not be an indicator of a firm’s financial distress. On the theoretical side leverage can actually be a signal of financial health. On the empirical side Allayannis and Ofek (2001) report multivariate findings indicating that firms with higher levels of FC debt have greater overall leverage. Under these circumstances it follows that leverage is not indicative of the likelihood of financial distress, as it will be biased by FC debt users. Leverage (**Leverage**) is however included as a control variable for financial distress, though mostly as a possible robustness check to the following. As a proxy for financial distress\(^\text{10}\) the quick ratio (**QR**) is included, to measure the availability of internal funds (He and Ng (1998), Kim et al. (2006), Judge (2006), Clark and Judge (2008)). The QR is calculated as current assets less inventories divided by current liabilities, and as the distribution of the QR is skewed the natural log of QR is used. Furthermore, when examin-

\(^{10}\) Some research (e.g. Judge (2006), Kim et al. (2006), Clark and Judge (2008)) also use credit ratings and tax loss carry forwards as proxies for financial distress. These are however not included in this setting due to limitation of the available databases and not considered important enough to find by manually going through the annual reports. Furthermore as the majority of UK listed firms have pre-tax profits beyond the progressive tax region, thus face a more linear effective tax function, implies that for UK firms this tax based motive for hedging is potentially rather weak (see section 2.4.1.3).
ing UK firms compared to the results of research on US firms (most of the previous research in on the US market), it can be expected to find a statistically stronger correlation between financial distress and the use of hedging, as there is a difference in bankruptcy codes. The UK code provides creditors with stronger legal protection than that offered by the US code. This could endanger greater expected bankruptcy cost, which could indicate that hedging is more valuable in a UK setting.

**Underinvestment costs:** Underinvestment costs or also known as growth options may serve as an incentive to hedge, as hedging helps to ensure that the firm has sufficient internal funds and can thereby avoid fluctuations in investments or costly external financing and so increases firm value (section 2.4.1.2). Proxies for these growth opportunities are therefore important to include as they might indicate whether firms undertake a hedging programme. This study employs three proxies for underinvestment cost, these are also preferred by researchers\(^\text{11}\) (e.g. Clark and Judge (2005), Judge (2006), Clark and Judge (2008), Elango (2010)) and they will serve each other as robustness check. These are: research and development divided by total revenue (\(\text{RnD}\))\(^\text{12}\), market-to-book value of equity ratio (\(\text{MtB}\)) and the price earnings ratio (\(\text{PE}\)).

**Profitability:** According to the Pecking Order Theory\(^\text{13}\) firms with higher profitability should have lower debt levels and lower pay-out controlling for investment opportunities. Though, highly profitable firms might also pay out high dividends as a costly credible signal. The proxy used for profitability is return on assets (\(\text{ROA}\)). The argument for including ROA is seemingly similar to the one for including the proxies for underinvestment cost. Both are however included in the regression analyses as previous research keep them under separate headings – underinvestment cost and profitability (e.g. Clark and Judge (2005), Allayannis and Weston (2001), Aggarwal and Kyaw

\(^{11}\) Some studies (e.g. Clark and Judge (2005), Judge (2006)) also employ the proxy of capital expenditure deflated by total sales. This proxy is however not used in this study due to limitations of databases and not considered important enough to find by manually going through the annual reports.

\(^{12}\) Out of the 237 firms 93 have RnD recorded as n.a., as the study by Allayannis and Weston (2001), these RnDs are assumed 0. Robustness check will be performed in order to check whether this is liable solution.

\(^{13}\) Companies will prioritize their sources of financing according to what requires the least effort. Thus preferring to use internal funds first, then debt and when not sensible to issue more debt, equity is issued as a means of last resort (Aggarwal, Kyaw 2010).
The study of Kim et al. (2006) also chooses to include both variables. Attention will be given to these two variables during the regressions.

**Industry:** Other studies account for industry effects by calculating an industry adjusted Tobin’s Q or an industry adjusted gearing ratio, as their samples constitute all types of firms but non-financials. As this sample only constitutes manufacturing firms, it is not assumed of relevance to adjust the variables; instead industry dummies are included to account for variations across industries based on one-digit NACE codes\(^{14}\), creating 3 industry dummies (\textit{Indu1}, \textit{Indu2}, \textit{Indu3}).

**Liquidity:** Some studies examine the relationship between a firm’s liquidity and the use of hedging. Though, the issue of whether the firm’s stock is liquid, hence traded on a regular basis, seems rather ignored within the literature. It is however included in this study as the stocks liquidity affects the risk measures. There does not seem to be a general definition on how to determine whether a stock is liquid or not. Using daily stock returns, this study examines the importance of liquidity by running five different regressions as robustness check, the number of weeks indicate how many weeks a year the stock is not traded: (1) 40 weeks\(^{15}\), (2) 30 weeks, (3) 25 weeks, (4) 20 weeks, (5) 15 weeks. Besides running these different regressions a liquidity ratio (\textit{Liquidity}) is included to capture possible effects of liquidity. Liquidity is calculated as days traded a year divided by yearly trading days.

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\(^{14}\) 1000-1999: Manufactures of household goods, such as foods, beverages, paper etc. 2000-2999: Manufactures of machinery and hardware products. 3000-3999: Manufactures of furniture, transport equipment and others.

\(^{15}\) Those stocks that are not traded in more than 40 weeks a year are considered highly illiquid and removed from the sample.
5.4 Regressions
In this section of the paper, the regressions used to answer the hypotheses will be presented together with the expectations for the variables not included in the hypotheses.

Figure 5.1: Regressions

5.4.1 Risk Regression
In the risk regression, the impact of financial hedging, foreign debt and multinationality is examined in relation to the risk of the firm. The control variables are included to capture other effects on risk. The risk regression is performed both with Beta and Volatility as dependent variables.

\[ \text{Beta or Volatility} = \alpha + \beta_1 \text{Fin.Hedge}_i + \beta_2 \times FD_i + \beta_3 \times MNC_i + \beta_4 \times MNC_i^2 + \beta_5 \times \text{Tot.for}_i + \beta_6 \times \text{Tot.for}_i^2 + \beta_7 \times \text{Size}_i + \beta_8 \times QR_i + \beta_9 \times ROA_i + \beta_{10} \times MtB_i + \beta_{11} \times \text{Indu1}_i + \beta_{12} \times \text{Indu2}_i + \beta_{13} \times \text{Indu3}_i + \beta_{14} \times \text{Liquidity}_i + \epsilon_i \]  

(R1 and R2)

The relationship between Fin.Hedge and risk seems to have been somewhat neglected in previous literature. Therefore, any expectations to the findings in this thesis will have to rely on theory and rational. Theory predicts that firms choose to hedge as a mean off decreasing their FX exposure. The relationship between FX exposure and risk are positive, thus a decrease in FX exposure will result in a decrease in risk. It is therefore expected that Fin.Hedge has a negative correlation to risk, as it seems sensible to
assume that it will reduce risk. The empirical findings for FD is somewhat contradicting in relation to exposure, hence the expectations for the relationship between FD and risk are mixed.

The expectations for the correlation between risk and the control variables are based on previous literature. MtB is expected to have a positive effect of risk, thus firms with high market to book ratios face relatively higher risk since unexpected earnings from growth opportunities are riskier than “normal” earnings. Size and QR are expected to have a negative effect on risk, thus larger firms are less risky than small firms, and firms with a high liquidity are less risky than firms in financial distress. ROA is not included as control variable in previous studies of risk and thus no expectations exists for the correlation between risk and ROA. All though, on the face of it, it seems that ROA should not have a significant impact on risk, it is however included as it is in the portfolio of control variables. The three industry dummies are expected to capture any industry effect on risk.

5.4.2 Foreign Exchange Exposure Regression

The second regression for this thesis is to measure the impact between hedging and FX exposure. The calculations for this regression are a two-step procedure as the FX exposure values are not accessible from databases. The first step is to obtain the FX exposure value from the regression shown in equation 2. In the second step, the absolute value of FX exposure is tested against Fin.Hedge, FD, MNC and Tot.For and the portfolio of control variables as can be seen in R3 below.

\[
\text{Absolute value of FX exposure} = \alpha + \beta_1 \text{Fin.Hedge}_i + \beta_2 \text{FD}_i + \beta_3 \text{MNC}_i + \beta_4 \text{MNC}_i^2 + \beta_5 \text{Tot.for}_i + \beta_6 \text{Tot.for}_i^2 + \beta_7 \text{Size}_i + \beta_8 \text{QR}_i + \beta_9 \text{ROA}_i + \beta_{10} \text{MtB}_i + \beta_{11} \text{Indu1}_i + \beta_{12} \text{Indu2}_i + \beta_{13} \text{Indu3}_i + \beta_{14} \text{Liquidity}_i + \varepsilon_i \tag{R3}
\]
Based on previous literature it is expected that there is negative relationship between FX exposure and Fin.Hedge as the use of financial hedging reduces FX exposure\(^{16}\). The expectations for the correlation between FD and FX exposure are contradicting as in the risk regression above. Among the control variables it is expected, based on the previous literature that the regression will show a positive relation between FX exposure and Size and MtB.

FX exposure can take up either a negative or a positive sign. To test whether the sign has an effect on the correlation to the hedging variables, another regression is performed where the sample of firms is divided into two groups following the methodology of He and Ng (1998) Kim et al. (2006) and Carter (2003). Firms with positive FX exposure coefficients are classified as “net importers” and firms with negative FX exposure coefficients are classified as “net exporters”. The regression can be seen below.

\[
\text{Absolute value of FX exposure } = \beta_0 D_i + \beta_1 D*\text{Fin.Hedge}_i + \beta_2 D*FD_i + \beta_3 D*MNC_i + \beta_4 D*\text{MNC}_i^2 + \beta_5 D*\text{Tot.For}_i + \beta_6 D*\text{Tot.for}_i^2 + \beta_7 \text{Size}_i + \beta_8 D*\text{QR}_i + \beta_9 D*\text{ROA}_i + \beta_{10} D*\text{MtB}_i + \beta_{11} D*\text{Indu1}_i + \beta_{12} D*\text{Indu2}_i + \beta_{13} D*\text{Indu3}_i + \beta_{14} D* \text{Liquidity}_i + \beta_{0d} (1-D)_i + \beta_{1d} (1-D)*\text{Fin.Hedge}_i + \beta_{2d} (1-D)*\text{FD}_i + \beta_{3d} (1-D)*\text{MNC}_i + \beta_{4d} (1-D)*\text{MNC}_i^2 + \beta_{5d} (1-D)*\text{Tot.For}_i + \beta_{6d} (1-D)*\text{Tot.for}_i^2 + \beta_{7d} (1-D)* \text{Size}_i + \beta_{8d} (1-D)*\text{QR}_i + \beta_{9d} (1-D)*\text{ROA}_i + \beta_{10d} (1-D)*\text{MtB}_i + \beta_{11d} (1-D)*\text{Indu1}_i + \beta_{12d} (1-D)*\text{Indu2}_i + \beta_{13d} (1-D)*\text{Indu3}_i + \beta_{14d} (1-D)* \text{Liquidity}_i + \epsilon_i \tag{R4}
\]

When accounting for net importers and net exporters, it is expected that FD is positively correlated to FX exposure for net importers and negatively correlated for net exporters.

\(^{16}\) Some articles stress the possible endogeneity between firms hedging policy and their FX exposure. Endogeneity is when there exists a correlation between the two variables that creates a loop effect; the use of hedging is decided based on the current FX exposure, which is then effected by the hedging strategy. While some articles use WLS, 2SLS and 3SLS to control for endogeneity others ignore the possible problems of endogeneity. Carter (2003) finds that his results are consistent also when using 3SLS to control for endogeneity.
5.4.3 Financial Hedging Regression

The regression to test whether there is a bell shaped relationship between multinationality and the use of financial hedging is as follows:

\[
\text{FinHedge} = \alpha + \beta_1 \cdot FD_i + \beta_2 \cdot MNC_i + \beta_3 \cdot MNC_i^2 + \beta_4 \cdot \text{Tot. for}_i + \beta_5 \cdot \text{Tot. for}_i^2 + \\
\beta_6 \cdot \text{Size}_i + \beta_7 \cdot QR_i + \beta_8 \cdot \text{ROA}_i + \beta_9 \cdot \text{MtB}_i + \beta_{10} \cdot \text{Indu1}_i + \beta_{11} \cdot \text{Indu2}_i + \\
\beta_{12} \cdot \text{Indu3}_i + \beta_{13} \cdot \text{Liquidity}_i + \varepsilon_i
\]  

(R5)

Concerning the relationship between Fin.Hedge and FD most of the previous studies find that they act as substitutes, thus the expectation within this study is to find a positive relationship. Since FD also can be used as a hedge of FX exposure, it will be tested whether it improves the results of the regression if both FD and Fin.Hedge are included in the dependent variable.

The expectations within the control variables for the regression are to find a positive correlation between Size, MtB, and the use of derivatives, and conversely a negative relationship between QR and Fin.Hedge.

5.4.4 Firm Value Regression

In the last regression it is tested whether hedging and multinationality have an effect on the value of the firm. As a proxy for firm value, Tobin’s Q is used as the dependent variable. The independent variables are the same as in the previous regressions. The regression is shown in the equation below:

\[
\text{TobinsQ} = \alpha + \beta_1 \cdot \text{Fin.Hedge}_i + \beta_2 \cdot FD_i + \beta_3 \cdot MNC_i + \beta_4 \cdot MNC_i^2 + \beta_5 \cdot \text{Tot. for}_i + \\
\beta_6 \cdot \text{Tot. for}_i^2 + \beta_7 \cdot \text{Size}_i + \beta_8 \cdot QR_i + \beta_9 \cdot \text{ROA}_i + \beta_{10} \cdot \text{MtB}_i + \beta_{11} \cdot \text{Indu1}_i + \beta_{12} \cdot \\
\text{Indu2}_i + \beta_{13} \cdot \text{Indu3}_i + \beta_{14} \cdot \text{Liquidity}_i + \varepsilon_i
\]  

(R6)

Based on previous literature, Fin.Hedge and a combination of Fin.Hedge and FD is expected to show a positive correlation to Tobin’s Q and thus indicating that hedging increase firm value.

Among the control variables, Size, QR, MtB and ROA are all expected to positively correlate to Tobin’s Q.
6. Results

6.1 Descriptive Statistics
This section will present the descriptive statistics of the sample, thus providing an overview of the firms and outline the main features of the sample quantitatively before proceeding to the univariate and multivariate regression tests. The descriptive statistics are primarily based on the sample of 241 UK firms (see section 5.1) and the statistics are outlined in three different ways: (1) descriptive statistics for the full sample of raw data, (2) descriptive statistics for ‘users only’ of the raw data, (3) descriptive statistics for the full sample of the calculated variables (see appendix 5 for full overview).

Multinationality
Table 6.1 presents summary statistics for the data and variables used to measure multinationality. It shows that the average asset size of the total sample is approximately £2.2 billion. When focusing on those firms that have subsidiaries outside national borders, it shows that on average they have 66 foreign subsidiaries and these are dispersed over 12 countries. When comparing this to previous findings from the US; Kim et al. (2006) find that the average number of foreign subsidiaries is 11 dispersed over 7 countries, for Allen and Pantzalis (1996) the numbers are 19 and 10 respectively. Comparing these numbers could indicate that UK firms tend to have more foreign activity, thus more multinational than the average US firm. It is not possible to compare breadth to previous findings as this study calculates it as a ratio (section 5.3.1.2). Though with depth it also shows that compared to Allen and Pantzalis (1996), the average firm of this UK sample is rooted deeper within foreign countries. The same tendency shows for the two dispersion indices, when compared to Kim et al. (2006), Carter et al. (2003) and Allen and Pantzalis (1996) - again indicating a higher multinationality within UK firms. This also corresponds to the fact that UK firms rely on a high degree of overseas business, whereas the US firms have a higher reliance on domestic business. The comparison of Tot.For to the previous research also supports this notion. From the three multinationality measures it shows for MNC1 that some of the categories are rather unpopulated (see appendix 4) and most of the firms fall within the category of being trans-regional in both sales and subsidiaries, this corresponds to the find-
ings of Aggerwal et al. (2011). Contrary to MNC1, which show that some have a value of 16, indicating a deeply global firm, the maximum numbers for MNC2 and 3 are not reaching the possible values of 5 and 4 respectively. Thus, according to the approach of these two no firm from the sample is truly global.

<table>
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<th>No. of obs.</th>
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<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Median</th>
</tr>
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<tr>
<td>Revenue (mio. GBP)</td>
<td>241</td>
<td>10,68</td>
<td>190000</td>
<td>12751,93</td>
<td>121,35</td>
</tr>
<tr>
<td>Total Assets (mio. GBP)</td>
<td>241</td>
<td>5,39</td>
<td>174000</td>
<td>12328,07</td>
<td>112,42</td>
</tr>
<tr>
<td>No. of foreign Sub.</td>
<td>197</td>
<td>1,00</td>
<td>891,00</td>
<td>155,59</td>
<td>10,00</td>
</tr>
<tr>
<td>No. of foreign Countries</td>
<td>197</td>
<td>1,00</td>
<td>121,00</td>
<td>16,46</td>
<td>5,00</td>
</tr>
<tr>
<td>Breadth</td>
<td>197</td>
<td>0,01</td>
<td>0,63</td>
<td>0,0607</td>
<td>0,09</td>
</tr>
<tr>
<td>Depth</td>
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<td>0,14</td>
<td>1,00</td>
<td>0,6694</td>
<td>0,26</td>
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<tr>
<td>Dispersion I</td>
<td>197</td>
<td>0,00</td>
<td>0,96</td>
<td>0,5243</td>
<td>0,36</td>
</tr>
<tr>
<td>Dispersion II</td>
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<td>0,00</td>
<td>0,78</td>
<td>0,3415</td>
<td>0,27</td>
</tr>
<tr>
<td>Foreign Sales (mio. GBP)</td>
<td>221</td>
<td>0,00</td>
<td>138,94</td>
<td>9,85</td>
<td>0,05</td>
</tr>
</tbody>
</table>

Variables:

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<th>Std. Deviation</th>
<th>Median</th>
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<tbody>
<tr>
<td>Tot.For</td>
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<td>0,00</td>
<td>1,00</td>
<td>0,656</td>
<td>0,33</td>
<td>0,80</td>
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<td>8,22</td>
<td>3,65</td>
<td>9,00</td>
</tr>
<tr>
<td>MNC2</td>
<td>241</td>
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<td>3,52</td>
<td>2,00</td>
<td>0,98</td>
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<td>MNC3</td>
<td>241</td>
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<td>2,53</td>
<td>1,40</td>
<td>0,74</td>
<td>1,76</td>
</tr>
</tbody>
</table>

Table 6.1: Descriptive statistics for multinationality measures

Financial hedging

Table 6.2 presents the summary statistics for the data and variables used to measure financial hedging. On average the firms that disclose notional amounts use £657 million on financial derivatives. Within the previous research only Kim et al. (2006) reports the notional amount used on derivatives, and as their sample is from 1998, it is does not make sense to compare. Focusing on FC debt it shows that on average the firms use £443 million on such. From the annual reports it was also obtained which derivatives the firms use, though the amount used on the specific derivatives was not possible to obtain for all derivatives users. From these derivatives it clearly shows that forwards are the most widely used (matches previous findings of Kim et al. (2006), Clark and Judge (2009), Allayannis and Ofek (2001)) – of the 138 derivative users 132 make use of forwards, 3 firms only use swaps and 2 firms only use options. When analysing the numbers further it shows that none of the firms use all four kinds of derivatives
and only 4% use three kinds of derivatives, whereas 15% of the firms use two kinds of derivatives with forwards and swaps being the most popular combination (matches the sample of Clark and Judge (2009)). It is possible for firms to swap their foreign debt into domestic debt or the other way around, though the sample does not support this as of the 137 FC debt users, only 31 use swaps. This could indicate that FC debt does not increase exposure and is used as a hedge.

For firms that use only FC derivatives or FC debt the distribution is almost the same, though 65% of the FC derivatives users also use FC debt, which also corresponds to previous studies (Géczy et al. (1997), Allayannis and Ofek (2001), Clark and Judge (2008)). Table 6.2 also shows that 57% of firms report the use of FC debt. This level is similar to the 63,3% found by Clark and Judge (2009), though almost more than double the FC debt amount reported by Allayannis and Ofek (2001). If looking at only derivatives use it shows that 57% of the firms use derivatives, which is similar to the 56% found by Kim et al. (2006). Tough as discussed earlier, Clark and Judge (2008) argue the misclassification in not including FC debt, though a non-derivative, within financial hedging. So when combining the two under the category of hedgers it shows that 76% of the sample hedge their FX exposure, supporting the findings of Clark and Judge (2008).

For the variables it shows that the firms on average have a FC debt ratio of 0,31. Most of the previous researches employ FC debt as a dummy, those who examine the notional amount of FC debt calculate the ratio by dividing by total assets, instead for total revenue as in this study, which makes them difficult to compare. Fin.Hedge indicates that the average ratio is 0,18, which is somewhat less than the 0,47 reported by Kim et al. (2006). However Kim et al. (2006) choose to divide the notional amount of derivatives with total foreign sales, whereas this study divides by total sales, as this sample also includes domestic companies. Dividing by total sales will none the less give a smaller ratio, though oddly enough Carter et al. (2003) reports a derivative ratio calculated the same way as Kim et al. (2006) of only 0,12.
Table 6.2: Descriptive statistics for financial hedging measures

<table>
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<th>Variables</th>
<th>No. Of obs.</th>
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<th>Max.</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin.Hedge.NA (mio GBP)</td>
<td>107</td>
<td>0,25</td>
<td>15736</td>
<td>656,86</td>
<td>2046,05</td>
<td>27,14</td>
</tr>
<tr>
<td>Fin.Hedge.FV (mio. GBP)</td>
<td>118</td>
<td>0</td>
<td>1166</td>
<td>45,29</td>
<td>167,18</td>
<td>1,15</td>
</tr>
<tr>
<td>FD (mio. GBP)</td>
<td>137</td>
<td>0,05</td>
<td>7439</td>
<td>442,76</td>
<td>1360,11</td>
<td>20,41</td>
</tr>
<tr>
<td>Forwards</td>
<td>132</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Futures</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Options</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Swaps</td>
<td>34</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FC derivatives users</td>
<td>138</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FC debt users</td>
<td>137</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FC derivatives only</td>
<td>47</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FC debt only</td>
<td>46</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Both FC derivatives + FC debt</td>
<td>91</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hedgers either FC der. or debt</td>
<td>184</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non hedgers</td>
<td>57</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Variables:

FD                                        | 137 | 0   | 9,51  | 0,307 | 1,135          | 0,104  |
Fin.Hedge                                   | 138 | 0   | 2,75  | 0,176 | 0,296          | 0,106  |

Table 6.2: Descriptive statistics for financial hedging measures

**Other Variables**

Table 6.3 provides summary statistics for the rest of the variables used in the regressions, both dependent and independent variables. When comparing these to previous studies (e.g. Kim et al. (2006), Carter et al. (2003), Clark and Judge (2008)) it shows that they are fairly similar, though there are some deviations with e.g. Tobin’s Q. This sample is found on average to have a smaller Tobin’s Q, though this is probably caused by previous studies examining only large firms on the US market, whereas this focus on large and medium sized firms on the UK market. The average beta of the firms is 0,83, thus slightly lower than the market; however it ranges from 0,02 to the more risky at 2,28. The table also shows that on average the firms stocks are traded 66% of trading days a year, again with quite a range in % of trading days.
<table>
<thead>
<tr>
<th>No. Of obs.</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>QR</td>
<td>241</td>
<td>0,14</td>
<td>27,10</td>
<td>1,39</td>
<td>1,01</td>
</tr>
<tr>
<td>Leverage</td>
<td>241</td>
<td>-0,95</td>
<td>0,96</td>
<td>0,49</td>
<td>0,23</td>
</tr>
<tr>
<td>Indu1</td>
<td>67</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Indu2</td>
<td>154</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Indu3</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ROA</td>
<td>241</td>
<td>-45,4</td>
<td>28,3</td>
<td>4,4</td>
<td>9,2</td>
</tr>
<tr>
<td>RnD</td>
<td>241</td>
<td>-0,01</td>
<td>1,78</td>
<td>0,04</td>
<td>0,17</td>
</tr>
<tr>
<td>Beta</td>
<td>241</td>
<td>0,02</td>
<td>2,28</td>
<td>0,83</td>
<td>0,40</td>
</tr>
<tr>
<td>Volatility</td>
<td>241</td>
<td>0,00</td>
<td>2513329,8</td>
<td>35759</td>
<td>180701,4</td>
</tr>
<tr>
<td>TobinsQ</td>
<td>241</td>
<td>0,08</td>
<td>2,43</td>
<td>0,65</td>
<td>0,29</td>
</tr>
<tr>
<td>PE</td>
<td>241</td>
<td>-108</td>
<td>119</td>
<td>3,423</td>
<td>14,64</td>
</tr>
<tr>
<td>MtB</td>
<td>241</td>
<td>-1,02</td>
<td>6,94</td>
<td>0,356</td>
<td>0,756</td>
</tr>
<tr>
<td>Exposure</td>
<td>219</td>
<td>-0,95</td>
<td>0,38</td>
<td>-0,02</td>
<td>0,11</td>
</tr>
<tr>
<td>Exposure Absolute</td>
<td>219</td>
<td>0,00</td>
<td>0,95</td>
<td>0,03</td>
<td>0,11</td>
</tr>
<tr>
<td>Liquidity</td>
<td>241</td>
<td>0,04</td>
<td>0,98</td>
<td>0,66</td>
<td>0,28</td>
</tr>
</tbody>
</table>

Table 6.3: Descriptive statistics for dependent and independent variables.

From the table above when comparing the mean values and the medians it gives an indication as to whether the distributions of the variables are skewed. To further check for this, a histogram was made for each variable. It showed that the distribution of Assets, QR and Volatility are skewed; to correct for this the natural log is used for each variable

6.2 Univariate Tests

To further describe the sample used for this study different univariate tests are performed. By dividing the sample into two different samples it is possible to compare these and possibly highlight some key differences within the sample, which are important in order to understand some differences between e.g. firms that hedge and firms that do not. Table 6.4 shows univariate tests of firm characteristics by quartiles whereas table 6.5 is of firm characteristics by hedgers and non-hedgers. As it within...

---

17 The distribution of FD, Fin.Hedge and Tot.For was somewhat also skewed which was due to a proportion of the sample having a bit more extreme values. Removing these diminish the skewness, though it also creates a bias. It was, however, tested for some of the regressions, if removing these would improve the significance. This was not the case and they are therefore included in the sample.
these univariate tests also are of interest to examine the differences in exposure, the sample consists of 219 firms\textsuperscript{18}.

\textit{Multinationality}

It is of interest to examine differences between firms with different levels of multinationality; comparing the domestic/least multinational firms with those that are highly multinational. In order to do so the sample is sorted by the variable MNC2 and afterwards divided into quartiles, approximately 55 firms in each quartile, enabling comparison of the first (1Q) and the fourth quartile (4Q). Another univariate test for multinationality was also performed, though due to large differences in sample size, it was much less significant than the one by quartiles\textsuperscript{19}. Though generally the two tests show the same differences.

From table 6.4 it shows that there is not a big difference between how much FC debt the two quartiles employ, though this is not significant. It is obvious that there is a large significant difference in Tot.For, as 17 of the 55 firms in 1Q are domestic and thus have no foreign sales. The amount used on financial hedging also significantly increases from 1Q to 4Q. This is opposite the findings of Kim et al. (2006), which is possibly due to their sample not containing domestic firms\textsuperscript{20}. This indicates that domestic firms or those with a low level of multinationality do not hedge significantly, which is not in line with Aggarwal and Harper (2010) reporting significant FX exposure for domestic firms. Their findings indicate that domestic firms ought to hedge; however the results of this univariate test does not support their findings, though not significantly. The hypothesis of a possible bell-shaped relationship between multinationality and financial hedging, would roughly speaking, indicate that there should not be that big a dif-

\textsuperscript{18} For the last 22 firms, it is not possible to calculate exposure for the last 5 years, as they became listed within this period (see section 5.3.1.4). Going back 5 years are more conservative than 3 or 1 year, though chosen for now, as it has not yet been tested whether it is enough to go back e.g. 3 years. This will be tested later.

\textsuperscript{19} To examine the differences between multinationality, a univariate test was also performed; dividing the sample into domestic and non-domestic firms. This was done according to the approach by Aggarwal et al. (2011), thus all the firms with the MNC1 value of 1 being domestic. By doing so the domestic sample consisted of 17 firms and the non-domestic 202 firms. The test is enclosed in appendix 6.

\textsuperscript{20} A univariate test of quartiles was also performed excluding domestic firms, in order to see whether the findings for Fin.Hedge would be significantly different, as the domestic firms would not disturb. However, this was not the case; the findings are quite similar, see appendix 7.
ference between the Fin.Hedge in 1Q and 4Q. This is however not the case and it will be interesting to further examine this in the multivariate regression analyses.

It was also expected to find that for all three measures of multinationality the level increases from 1Q to 4Q, as the quartiles are based on the multinationality level.

<table>
<thead>
<tr>
<th>Firm characteristics by quartiles</th>
<th>1Q = 55 firms</th>
<th>4Q = 55 firms</th>
<th>t-statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>FD</td>
<td>0.17</td>
<td>1.12</td>
<td>0.15</td>
</tr>
<tr>
<td>Tot.For</td>
<td>0.22</td>
<td>0.32</td>
<td>0.92</td>
</tr>
<tr>
<td>Fin.Hedge</td>
<td>0.04</td>
<td>0.14</td>
<td>0.17</td>
</tr>
<tr>
<td>MNC1</td>
<td>4.38</td>
<td>2.78</td>
<td>11.53</td>
</tr>
<tr>
<td>MNC2</td>
<td>0.56</td>
<td>0.51</td>
<td>2.97</td>
</tr>
<tr>
<td>MNC3</td>
<td>0.34</td>
<td>0.49</td>
<td>2.04</td>
</tr>
<tr>
<td>QR</td>
<td>0.03</td>
<td>0.79</td>
<td>0.11</td>
</tr>
<tr>
<td>Leverage</td>
<td>0.52</td>
<td>0.18</td>
<td>0.46</td>
</tr>
<tr>
<td>Size</td>
<td>10.99</td>
<td>1.59</td>
<td>13.73</td>
</tr>
<tr>
<td>ROA</td>
<td>3.36</td>
<td>8.89</td>
<td>7.48</td>
</tr>
<tr>
<td>RnD</td>
<td>0.05</td>
<td>0.23</td>
<td>0.04</td>
</tr>
<tr>
<td>Beta</td>
<td>0.69</td>
<td>0.31</td>
<td>1.05</td>
</tr>
<tr>
<td>Volatility</td>
<td>6.28</td>
<td>2.88</td>
<td>8.45</td>
</tr>
<tr>
<td>TobinsQ</td>
<td>0.62</td>
<td>0.29</td>
<td>0.68</td>
</tr>
<tr>
<td>PE</td>
<td>2.63</td>
<td>5.47</td>
<td>4.52</td>
</tr>
<tr>
<td>MtB</td>
<td>0.31</td>
<td>0.61</td>
<td>0.31</td>
</tr>
<tr>
<td>Exposure</td>
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<td>0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>Exposure Abs.</td>
<td>0.01</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Liquidity</td>
<td>0.50</td>
<td>0.28</td>
<td>0.85</td>
</tr>
</tbody>
</table>

*Table 6.4: Univariate test by firm characteristics of multinationality*

The test also shows that on a 10% significance level, the 4Q is less leveraged than the 1Q. Furthermore, the 4Q is also quite more profitable (ROA) than the 1Q, this should be seen in relation to the fact that it also shows that the 4Q is significantly larger than the 1Q. Often larger firms are more profitable than smaller firms due to both economies of scale and in this setting perhaps also the fact that they are more operationally hedged, and thus able to profit from these real options. When looking at the risk measures both are significant at a 1% level and indicate that as the firm becomes more international, the risk of the firm also increases both the total and the systematic risk. There is not a large difference in firm value between the two quartiles, though the
finding is not significant. There is a seemingly large significant difference in liquidity between the two, indicating that the more multinational firms have more liquid stocks than the less multinational, however this is also to be seen in relation to the significant difference in size, as size is the probable cause of this difference.

Financial Hedging
The other area of interest in this study is the use of financial hedging and how hedgers differ from non-hedgers. A univariate test is therefore performed, where the sample is divided into hedgers and non-hedgers. According to theory and most of the previous literature, FC debt can and are often used to hedge FX exposure. Hence, FC debt ought to fall within the category of financial hedgers, though as some of the previous research indicates FC debt increases FX exposure; two different univariate tests for firm characteristics of financial hedging are performed. One, dividing the sample into hedgers (both FC derivatives and FC debt users) and non-hedgers, the other dividing the sample into derivative users and non-derivative users. Both tests show similar results, which are also expected, as most of the FC derivative users are also those who employ FC debt. However, the test by financial derivatives usage show more significant results and are therefore the one included below (see appendix 8).

From table 6.5 it shows that derivatives users have slightly more FC debt than non-users, however this is not significant. It is however significant that derivatives users have higher foreign sales, thus they experience a greater need for hedging as their foreign sales increases. It is obvious that derivative users have a significantly higher Fin.Hedge than the non-users, as this is the basis for how the two samples are constructed. It is however interesting to find that firms using derivatives is significantly at a higher multinationality level. The rationale seems obvious, as firms become more international they are exposed to more foreign currencies and the need for hedging increase, which are also the findings of Kim et al. (2006). Though again, this is not in line with the findings of Aggarwal and Harper (2010), as they suggest that it is indeed also the domestic firms that need to hedge.
Firm characteristics by financial derivatives usage

<table>
<thead>
<tr>
<th></th>
<th>Derivatives users = 128</th>
<th>Non-derivatives users = 91</th>
<th>t-statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Std. Deviation</td>
<td>Mean Std. Deviation</td>
<td>t</td>
</tr>
<tr>
<td>FD</td>
<td>0.21 0.94</td>
<td>0.15 0.87</td>
<td>0.55 0.58</td>
</tr>
<tr>
<td>Tot.For</td>
<td>0.65 0.34</td>
<td>0.51 0.40</td>
<td>2.73 0.01</td>
</tr>
<tr>
<td>Fin.Hedge</td>
<td>0.18 0.31</td>
<td>0.00 0.00</td>
<td>5.66 0.00</td>
</tr>
<tr>
<td>MNC1</td>
<td>9.61 3.55</td>
<td>6.82 3.04</td>
<td>6.07 0.00</td>
</tr>
<tr>
<td>MNC2</td>
<td>2.28 0.87</td>
<td>1.64 1.02</td>
<td>5.01 0.00</td>
</tr>
<tr>
<td>MNC3</td>
<td>1.64 0.63</td>
<td>1.13 0.80</td>
<td>5.25 0.00</td>
</tr>
<tr>
<td>QR</td>
<td>0.04 0.53</td>
<td>0.11 0.72</td>
<td>-0.87 0.39</td>
</tr>
<tr>
<td>Leverage</td>
<td>0.45 0.18</td>
<td>0.54 0.25</td>
<td>-2.81 0.01</td>
</tr>
<tr>
<td>Size</td>
<td>12.94 1.98</td>
<td>10.97 1.33</td>
<td>8.23 0.00</td>
</tr>
<tr>
<td>ROA</td>
<td>6.02 7.99</td>
<td>2.33 10.14</td>
<td>3.01 0.00</td>
</tr>
<tr>
<td>RnD</td>
<td>0.04 0.14</td>
<td>0.06 0.23</td>
<td>-0.81 0.42</td>
</tr>
<tr>
<td>Beta</td>
<td>0.90 0.43</td>
<td>0.74 0.32</td>
<td>3.06 0.00</td>
</tr>
<tr>
<td>Volatility</td>
<td>8.29 2.65</td>
<td>6.01 2.40</td>
<td>6.53 0.00</td>
</tr>
<tr>
<td>TobinsQ</td>
<td>0.67 0.19</td>
<td>0.60 0.34</td>
<td>1.96 0.05</td>
</tr>
<tr>
<td>PE</td>
<td>3.46 15.73</td>
<td>1.86 6.76</td>
<td>0.91 0.36</td>
</tr>
<tr>
<td>MtB</td>
<td>0.39 0.79</td>
<td>0.30 0.65</td>
<td>0.91 0.36</td>
</tr>
<tr>
<td>Exposure</td>
<td>-0.04 0.14</td>
<td>0.00 0.02</td>
<td>-2.48 0.01</td>
</tr>
<tr>
<td>Exposure abs</td>
<td>0.05 0.14</td>
<td>0.01 0.02</td>
<td>2.88 0.00</td>
</tr>
<tr>
<td>Liquidity</td>
<td>0.05 0.14</td>
<td>0.01 0.02</td>
<td>2.88 0.00</td>
</tr>
</tbody>
</table>

Table 6.5: Univariate test by firm characteristics of derivatives usage

The proxies for financial distress indicate that the derivatives users are in greater risk of distress when looking at the quick ratio, this is however not significant. Whereas it significantly shows that non-derivatives users have a higher leverage, this can be interpreted as an incentive to hedge. However, the difference in leverage between the two is not that great and a leverage of 54% is not considered a danger of financial distress, and it might also be at this level, as many firms in the light of the recent financial crisis chose to reduce their leverage. The firms that use derivatives are significantly larger than the non-users; this can be seen in relation with the significant difference in multi-nationality level, as those who are more multinational are often those of greater size. There is also a significant difference in profitability, and again the matter of difference in size plays a role in the explanation. At a 5% significance level the test supports previous findings in financial derivatives increasing firm value. When focusing on risk and currency exposure the test shows that derivative users are significantly at a higher risk level both in total and systematic risk and the same goes for currency exposure. To
some extend it contradicts the notion of derivatives as a mean to decrease exposure, though the higher risk and exposure level can also be a result of the higher level of multinationality. It is therefore not possible to interpret what causes what, and multivariate regression analyses are therefore in need.

6.3 Correlation Coefficients
In order to get a proper multiple regression analysis, it is important that there exist some degree of correlation between the dependent variable and the independent variables. Furthermore, it is important that the different independent variables do not correlate in order to avoid problems with multicollinearity. Correlation is important as it refer to the assumptions about linearity and multicollinearity.

The correlation between variables reflects the degree to which the variables are related. A correlation of +1 means that there is a perfect positive relationship between variables, while 0 means that there is no relationship what so ever, and a correlation of -1 is equal to a perfect negative relationship.

The correlation coefficients are presented in appendix 9. Regarding the different dependent variables it shows as expected, that Beta and Volatility are correlated. More interesting though, it also shows that FX exposure and Volatility are highly correlated, indicating that firms with high FX exposure has significantly higher volatility than firms with low FX exposure. When looking at Beta in the correlation matrix the most important and significant correlation with the independent variables, are the correlation with Tot.For, the three MNCs, Size and Liquidity. All of these variables are positively correlated, thus any increase in these variables, would cause Beta to increase. Leverage has a negative correlation with Beta at a significant level of 5%. Significant variables that correlate with Volatility are the three MNCs, Size, ROA, RnD, and Liquidity - only RnD is negatively correlated. Tot.For has a positive correlation at 5% significance. In the FX exposure regression the three MNCs, Size, ROA and Liquidity are positively correlated to FX exposure. Though MNC3 is only significant at a 5% level.
The most significant correlations to the Fin.Hedge variable are Indu3, Size and Liquiditiy, all of which positive. Furthermore, the three MNCs also positively correlate with Fin.Hedge but at a significance level of 5%.

The dependent variable TobinsQ correlates with QR, Leverage, Size, ROA, MtB and Liquidity all significantly at a level of 1%. Furthermore, MNC is significantly correlated at a 5% level. MtB is the variable with the highest correlation factor of 0.561, which is caused by the nature of the two variables, as market and book value also are included in calculating TobinsQ. This correlation also indicates that TobinsQ could be used as growth option instead of MtB.

All of the independent variables have a degree of correlation with each other. Those who have a significant correlation will be tried excluded from the regressions, and attention will be given to the VIF factors in order to avoid multicollinearity. According to Mojisola et al. (2011) a VIF factor above 10 indicates problems with multicollinearity, while a factor close to 1 indicates no multicollinearity.

Summing up the Volatility and FX exposure variables correlate, why the regressions might show similar results. The multinationality variables together with several control variables correlate with most of the dependent variables, indicating that the regressions might show some significant results.

6.4 Regression Analysis
In this section the empirical results of the regression analyses are presented. As mentioned in section 5.3.1, a regression analysis for estimating a proxy for notional amount of financial derivatives is performed. Afterwards, the results of the regressions outlined in section 5.4 will be presented and discussed.

6.4.1 Notional Amount vs. Fair Value Regression
When going through the annual reports of the sample firms, 31 of them only state fair value of their financial derivatives in the report. Fair value is the market value of the notional amount of derivatives; thus as fair value is derived from the notional value, it is reasonable to assume that the correlation between the two variables should be sig-
significant. Based on this assumption, fair value could be calculated into a proxy for notional amount, in order to avoid excluding the 31 firms.

Due to skewness in the distribution of both variables, the natural log of the variables is used. In order to check the hypothesis that a significant relationship between fair value and notional amount exist, a correlation matrix is performed (appendix 10). With a correlation of 0.763 the results of the correlation matrix supports the assumption that fair value can be used as a proxy for notional amount. Thus, it makes good sense to continue with a regression analysis. The regression is done without a constant and includes only firms that report both fair value and notional amount. The results of the regression (appendix 10) fulfil the expectations by indicating a strong relationship with an explanatory power of 78.4%. Hence, 78.4% of the notional amount can be explained by the fair value. The beta value equals 1.66 and is significant at a level of 1%. The results of this regression makes it possible to multiply the log of fair value by 1.66 to get a proxy for the log of notional amount, thus keeping the 31 firms in the sample. As robustness check regressions will be performed excluding the 31 firms.

6.4.2 Risk Regressions

In section 4.1 it was hypothesized that the non-linear relationship between multinationality and the risk profile of the firm is perhaps somewhat bell-shaped. As domestic firms become more multinational they encounter more risk, though at some point they will become operationally hedged and the risk could possibly diminish again. Within the risk profile of the firm two is at interest: systematic (Beta) and total risk (Volatility). Systematic risk being important for the well-diversified investor and total risk for the investor who is not well-diversified. Thus, two seemingly related regressions, with different dependent variables:

\[ \text{Beta} = \alpha + \beta_1 \text{Fin.Hedge}_i + \beta_2 \cdot FD_i + \beta_3 \cdot MNC_i + \beta_4 \cdot MNC_i^2 + \beta_5 \cdot \text{Tot.forei} + \beta_6 \cdot \text{Tot.forei}^2 + \beta_7 \text{Size}_i + \beta_8 \cdot QR_i + \beta_9 \cdot ROA_i + \beta_{10} \cdot \text{MtB}_i + \beta_{11} \cdot \text{Indu1}_i + \beta_{12} \cdot \text{Indu2}_i + \beta_{13} \cdot \text{Indu3}_i + \beta_{14} \cdot \text{Liquidity}_i + \epsilon_i \] (R1)
6.4.2.1 Systematic Risk

The univariate tests indicated that as a firm becomes more multinational the systematic risk also significantly increases, the same showed for firms using derivatives. The Pearson Correlation Matrix further showed that there is a significant positive correlation between Beta and MNC1, 2, 3 and Tot.For, which further supports the findings in the univariate tests. These results will offhand give the impression that there is not a somewhat bell-shaped relationship, though it is further tested within this regression.

Before heading into the different regressions, the importance of liquidity in stocks has to be tested, as this might affect the risk measures. As defined earlier five different regressions will be performed with samples of firms, whose stocks are not traded 40, 30, 25, 20, and 15 weeks a year respectively; testing whether there is a noticeable difference in the results (Appendix 11). When comparing across the five regressions it shows, that as the number of weeks not traded increases, both the explanatory variable and the significance levels improves, most likely caused by the increase in sample size. Due to these results, it is possible to proceed with the largest sample of firms, despite some within the sample not being traded 40 weeks a year. To capture any effects of liquidity in stocks, a regression is run including a liquidity ratio (appendix 11).

The different significance levels do not deviate much, though the explanatory variable improves, and the ratio is thus included.

A basic regression analysis $R1$ was performed with MNC3, and the former mentioned design criteria for regression analyses were checked. The histogram and P-P plot, which compares the residual distribution to the normal distribution, shows that there is no problem with the normality criteria. Next the design criterion of homoscedasticity is checked by plotting the residuals and the squared residuals against the predicted values. This plot is checked for variation along the horizontal axis, as this could indicate heteroskedasticity (appendix 12). Based on the plot it is not possible to rule out heteroskedasticity, thus as a further check the robust standard errors are computed and compared to the standard errors. There are virtually no differences and the OLS is
therefore used. Attention is also given to multicollinearity, and to check for this both the correlation matrix is considered and the VIF factors are studied\textsuperscript{21}. The correlation matrix shows that the variables; Indu1, 2, 3, Size, ROA and Liquidity are those who have a tendency to significantly correlate with other independent variables. It is therefore tested whether the explanatory variable or the different significance levels improve, by extracting each of these variables separately (see appendix 13). It shows that when removing the three industry dummies neither the explanatory variable nor the significance levels improve, they are therefore included in the regression. Extracting Size improves the significance level a little for some, though worsens for MNC3, which it correlates the most with, it is therefore also included. As mentioned in section 5.3.2 the argument for including ROA and MtB are seemingly similar, however removing ROA from the regression does not improve the results and is thus included. As both the importance in liquidity of stocks and the design criteria for regression analysis have been checked, it is possible to turn back to the basic regression. However the results show that the model does not provide much explanation (see table 6.6), with an explanatory variable of only 24.7%. Furthermore, only Liquidity is significant at 1%, whereas QR and the two Tot.For variables are significant at 5 and 10% respectively. To further test the model, the different MNC variables will be run together with other robustness tests.

\begin{table}[h]
\centering
\begin{tabular}{lcccc}
\hline
\textbf{Model Summary(b)} &  \\
\hline
\textbf{R} & \textbf{R Square} & \textbf{Adjusted R Square} & \textbf{Std. Error of the Estimate} & \textbf{N} \\
\hline
,497a & 0,247 & 0,203 & 0,35795 & 237 \\
\hline
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\begin{tabular}{lcccc}
\hline
\textbf{Unstandardized Coefficients} & \textbf{Standardized Coefficients} &  \\
\hline
\textbf{B} & \textbf{Std. Error} & \textbf{Beta} & \textbf{t} & \textbf{Sig.} \\
\hline
(Constant) & 0,286 & 0,210 & 1,361 & 0,175 \\
Liquidity & 0,408 & 0,143 & 0,281 & 2,856 & 0,005 \\
QR & -0,026 & 0,013 & -0,122 & -2,013 & 0,045 \\
MtB & -0,0001 & 0,000 & -0,101 & -1,630 & 0,105 \\
MNC3 & 0,161 & 0,125 & 0,300 & 1,291 & 0,198 \\
\hline
\end{tabular}
\end{table}

\textsuperscript{21} A rule of thumb says that the VIF factors should not surpass the value of five. The VIF factors are all below five, except for the MNCs and Tot.Fors, though these are expected to correlate as there is both the variable in single and the squared variable.
\[
\begin{array}{cccccc}
\text{MNC3\_2} & -0.040 & 0.059 & -0.163 & -0.690 & 0.491 \\
\text{Indu1} & -0.072 & 0.060 & -0.080 & -1.203 & 0.230 \\
\text{Indu3} & -0.063 & 0.089 & -0.043 & -0.699 & 0.485 \\
\text{Size} & 0.025 & 0.022 & 0.124 & 1.137 & 0.257 \\
\text{Tot.\_For} & -0.613 & 0.314 & -0.566 & -1.951 & 0.052 \\
\text{Totfor\_2} & 0.612 & 0.289 & 0.593 & 2.121 & 0.035 \\
\text{ROA} & -0.002 & 0.003 & -0.048 & -0.780 & 0.436 \\
\text{Fin.Hedge} & -0.014 & 0.105 & -0.008 & -0.132 & 0.895 \\
\text{FD} & 0.002 & 0.027 & 0.004 & 0.070 & 0.945 \\
\end{array}
\]

a. Dependent Variable: Beta

*Table 6.6 Basic regression with Beta*

**Multinationality**

In relation to multicollinearity, it is examined whether the significance of the results will improve by running a regression excluding Tot.\_For and a regression excluding MNC3, as there is a significant correlation between the two. However, the result of these two regressions (appendix 14) shows that there are no improvements, and both variables are therefore kept in the regression.

In the basic regression the variables of MNC3 and Tot.\_For are included, though it is interesting to see which results the variables of MNC2 and MNC1 combined with Tot.\_For will generate. The results of the different regressions are included in appendix 15, and it clearly shows that the variable of MNC1 generates the most significant results. Though, only the regression with MNC1 provides significance in the variables of MNC and Tot.\_For, it is still interesting to graphically view the variables of MNC+MNC\(^2\) and Tot.\_For+Tot.\_For\(^2\) for the three different regressions:

**MNC1 and Tot.\_For (1)**

*Graph 6.1 and 6.2: Distribution of MNC1 and Tot.\_For from R1*
The graphs for (1) and (3) are very similar and indicate the same, it is however only the results of (1) which are significant at 5%. The graph of (2) is somewhat a combination of the two graphs in (3), and generates a different picture with an increasing Beta as the firm becomes more multinational, this is however not significant.

Focusing on (1) as this generates significance, it shows for MNC1 that as a firm increases its level of multinationality so does its systematic risk (Beta), however only to a certain point (level 10), where the systematic risk decreases again. Thus, as firms enter the classification as global firms (appendix 4) their systematic risk declines. This both supports and contradicts previous literature, as they find contradicting results. Hypothesis 1, concerning systematic risk is thus verified. The reason as to why the beta of the firm increases with the level of multinationality is possibly the cause of firms entering into new markets, which might increase the market volatility or perhaps correlate with the UK market. First, as a firm becomes more and more multinational, the volatili-
ty in relation to markets is arguably going to increase, yet as a firm becomes more multi-
national, it also becomes more diversified and operationally hedged, which in turn will diminish the volatility of the markets, thus the bell-shaped relationship. Second, according to the Uppsala Model\textsuperscript{22} firms will at start move into countries similar to their own, and therefore also markets which might correlate with their own, thus increase the beta. However, as they become acquainted with these markets they will move into more distant and perhaps also more uncorrelated markets, and the beta will therefore diminish – again a possible explanation for the bell-shaped relationship.

However, when looking at the graph of Tot. For the picture becomes more blurred. It could seem reasonable that as a firm increases its foreign sales the beta decreases, as the firm becomes more diversified, though the reason as to why the beta at a certain point of foreign sales (0.5) will start to increase again is missing in this explanation. In order to find a possible explanation for this different methods are used. As examined under the design criteria, the distribution of the variables looks fine, and the explanation cannot be found there (appendix 16). First, it is tested whether the following simple regressions will generate the same results as R1:

\begin{align*}
\text{Beta} &= \alpha + \beta_1 \cdot \text{MNC}_i + \beta_2 \cdot \text{MNC}_i^2 + \varepsilon_i \quad \text{(R1a)} \\
\text{Beta} &= \alpha + \beta_1 \cdot \text{Tot. For}_i + \beta_2 \cdot \text{Tot. For}_i^2 + \varepsilon_i \quad \text{(R1b)} \\
\text{Beta} &= \alpha + \beta_1 \cdot \text{MNC}_i + \beta_2 \cdot \text{MNC}_i^2 + \beta_3 \cdot \text{Tot. For}_i + \beta_4 \cdot \text{Tot. For}_i^2 + \varepsilon_i \quad \text{(R1c)}
\end{align*}

For all three regressions the explanatory variable is below 12% and the significance level also decreases; only R1a provides significant results. However when looking at these results of R1a, it shows that it generate the same result more or less as in the ‘original’ regression, R1 (appendix 17). Due to consistency in the results any complicated interaction between the different variables can be ruled out as an explanation to the findings above.

Secondly, it is also examined whether the results are depended on the time period investigated. This dependency of time is also examined under the total risk regression (appendix 28), and it is found not to cause any differences in the results. Thirdly, it is

\textsuperscript{22} The Uppsala Model is a theory explaining the internationalization of the firms: first firms gain experience from their domestic market before moving into foreign markets, second; firms start operating in countries which are culturally and/or geographically close to their own and from there they move into more distant countries (Hollensen 2007).
possible to take a step back by performing more univariate tests and examine whether the results of these can indicate the cause of the distribution in graph 6.2. The sample of 237 firms are sorted by Tot.For and afterwards divided into 5 smaller samples of approximately 47. Four univariate tests are then performed for the 5 ‘groups’: 1vs.2, 2vs.3, 3vs.4 and 4vs.5 (appendix 18). In order to get an overview, the results are put into a table showing the change in the individual variable when sorted according to Tot.For (appendix 19). The Beta variable indicates, as in the graph, a bell-shape pointing downwards, though the decrease from group 4 to 5 is not possible to see in the graph, as group 4 and 5 are gathered within the last two columns. From the univariate tests it can be found, significance set aside, that the variables Size, FX exposure and Liquidity resemble the pattern of Beta. Recalling the correlation matrix is showed a significant positive correlation between Tot.For and Size and Liquidity. The correlation between Size and Liquidity is also significant and as mentioned earlier, the significance in Liquidity is to be seen in relation to the significance in Size, as Size is a probable cause of Liquidity. Thus, as it is not possible to rationally explain the distribution of Beta in graph 6.5, Size can possibly provide the explanation. The correlation matrix also showed a significant correlation between Beta and Size. Hence, as firms go from being domestic to selling abroad, the firm size has a tendency to drop, thus a drop in Beta. However, the characteristic of firms selling more than 50% abroad, show that the firm size increase again, thus an increase in beta. In the end firms selling 100% abroad have a tendency to be smaller than those selling between 50-100%, again a drop in Beta. Though significance is set aside, it is the most plausible explanation for the distribution of Beta.

Financial Hedging

Turning back to the basic regression it indicates that the use of financial derivatives has a negative effect on the systematic risk, whereas having foreign debt increases the systematic risk. However, the coefficients are very small and very insignificant, so it could perhaps just as likely have been the other way around. As robustness check a regression was performed containing only those firms reporting notional amount of financial derivatives, though the results are the same (appendix 45). In order to exam-

23 MNC2 are not included, as Tot.For is a part of that variable.
ine the effect of derivatives and FC debt on the systematic risk, the approach by Bartram et al. (2010) is used. Running three different regressions: (1) only derivative users, (2) only FC debt users and (3) users of both derivatives and foreign debt (appendix 20). Though Bartram et al. (2010) examines it for FX exposure, the findings of these three regressions do not resemble their results, which indicated that the use of both derivatives and FC debt will cause the greatest reduction. Furthermore, the findings of this study are highly insignificant, and it is therefore not possible to say anything about their effect on systematic risk.

Though the correlation matrix does not indicate any significant correlation between Fin.Hedge (derivatives) and FD, some of the previous literature finds that both are used for hedging. It is interesting to examine what the results would be if the two were added together under one heading of financial hedging. The results are however worsened by doing so (appendix 21) and they are therefore not added together\textsuperscript{24}.

\textit{Control Variables}

For the different control variables only Liquidity and QR are significant at 1 and 5\% respectively. The coefficients indicate that the more liquid the stocks are the higher the systematic risk, and if the firm has a high quick ratio, thus seemingly not in financial distress, the lower the systematic risk. As defined earlier, different proxies are used for both financial distress and underinvestment costs\textsuperscript{25}. Robustness test show that each of the different variables can be used as proxies (appendix 23).

Summing up the basic regression does not explain much, due to the poor explanatory variable. Furthermore, not much significance can be found within the different variables. Though, it shows that when including the variable MNC1 the significance of MNC improves and Tot.For becomes significant. The negative relationship between Fin.Hedge and Beta verifies hypothesis I, however not significantly. The distribution of

\textsuperscript{24} It is also tested what happens if Fin.Hedge or FD are excluded from the basic regression, this does however not improve the results (appendix 21).

\textsuperscript{25} RnD is also a proxy for underinvestment cost, as 93 of the 237 firms record RnD as n.a., a robustness check is performed to test whether these can be assumed 0 (appendix 22), which is verified.
MNC1 in graph 6.1 verifies hypothesis II though the distribution of Tot.For is much more complex. Next it will be examined whether the same goes for total risk.

6.4.2.2 Total Risk
Concerning the univariate tests and the correlation matrix the same shows for total risk as for systematic risk. So once again there is offhand not an indication of a somewhat bell-shaped relationship.

All the design criteria for regression analysis are fulfilled, thus no problems with e.g. hetroskedasticity or multicollinearity (appendix 24).

The basic regression generates the following results and again the explanatory power is not that high:

<table>
<thead>
<tr>
<th>Model Summary(b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
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<tr>
<td>1</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>B</td>
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<tr>
<td>-------</td>
<td>---</td>
</tr>
<tr>
<td>1 (Constant)</td>
<td>0.826</td>
</tr>
<tr>
<td>FD</td>
<td>-0.159</td>
</tr>
<tr>
<td>Fin.Hedge</td>
<td>-0.179</td>
</tr>
<tr>
<td>QR</td>
<td>-0.283</td>
</tr>
<tr>
<td>Indu1</td>
<td>0.285</td>
</tr>
<tr>
<td>Indu3</td>
<td>0.06</td>
</tr>
<tr>
<td>Size</td>
<td>0.384</td>
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<tr>
<td>ROA</td>
<td>0.064</td>
</tr>
<tr>
<td>MtB</td>
<td>-7.80E-05</td>
</tr>
<tr>
<td>Liquidity</td>
<td>1.676</td>
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<tr>
<td>Tot.For</td>
<td>4.95</td>
</tr>
<tr>
<td>Totfor_2</td>
<td>-5.024</td>
</tr>
<tr>
<td>MNC3</td>
<td>-2.328</td>
</tr>
<tr>
<td>MNC3_2</td>
<td>1.214</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Volatility

*Table 6.7: Basic regression with volatility*
**Multinationality**

Again in relation to multicollinearity it is examined whether excluding MNC3 or Tot.For will improve the results. It shows no sign of improvement and both are included in the regression (appendix 25). Running the regression with the three different MNC variables show that they all indicate the same relationship, though it is MNC3 that generates the highest significance, thus the basic regression:

From these two graphs the rational in explaining these distributions are the other way around than at systematic risk. Concerning Tot.For is it reasonable that as firms increase their sales abroad they encounter more risk, and the volatility increases. Then at some point (0.47) they will become so diversified in sales that the volatility will start to diminish again. However this reasoning somewhat contradicts the notion of Size having a matter, as under systematic risk.

This distribution of MNC3 is however much more tricky to explain. The fact that firms experience an increase in total risk as they progress their internationalization seems reasonable, as they expand their breadth and depth. Furthermore, as the operationally hedging increases, so does the volatility in cash flow (see section 2.5.1) which will increase the total risk. However, as firms go from domestic to being slightly multinational they seem to be experiencing a fall in total risk, which is unexplainable. The variable of MNC3\(^26\) has the drawback, that no firms are categorized between 0 and 1. This is caused by the proxy of depth, as firms often get the value of 1 here, as many of the

\(^{26}\) Calculated on the basis of four proxies: breadth, depth, dispersion index I and II (section 5.3.1.2)
firms have all their subsidiaries within two countries. In order to check whether the
distribution of MNC3 is caused by this drawback, a regression is performed with an
MNC3 variable excluding the depth ratio. The significance level worsens and the distri-
bution of MNC3 is same, though not as extreme (appendix 26). Thus, in order to ex-
plain the distribution the same methods as under systematic risk will be used.

First, simple regressions are set up, to test whether they generate the same results:

\[ \text{Volatility} = \alpha + \beta_1 * \text{MNC}_i + \beta_2 * \text{MNC}_i^2 + \epsilon_i \]  
\[ \text{(R2a)} \]

\[ \text{Volatility} = \alpha + \beta_1 * \text{Tot. For}_i + \beta_2 * \text{Tot. For}_i^2 + \epsilon_i \]  
\[ \text{(R2b)} \]

\[ \text{Volatility} = \alpha + \beta_1 * \text{MNC}_i + \beta_2 * \text{MNC}_i^2 + \beta_3 * \text{Tot. For}_i + \beta_4 * \text{Tot. For}_i^2 + \epsilon_i \]  
\[ \text{(R2c)} \]

For all three regressions the significance level does not change much, only Tot.For be-
comes insignificant in one. Though, the distribution of the both MNC3 and Tot.For are
the same, and complicated interactions between the variables can therefore be ex-
cluded (appendix 27).

Second, it is examined whether there is a time dependency. In the basic regression the
variable Volatility is calculated on the basis of daily stock returns for the last year
(March 2011 – March 2012). As a robustness check three other volatility variables are
calculated: (1) based on the daily stock returns for the last two years, (2) daily stock
returns for March 2010 – March 2011 and (3) daily stock returns for March 2009 –
March 2010 (Appendix 28). It shows that the findings are robust over the years, and
time dependency is therefore ruled out as a possible explanation.

Thirdly, univariate tests are performed. Sorting the sample by MNC3 and afterwards
dividing the sample into five smaller samples - same procedure as under systematic
risk (appendix 29). Looking at the changes within the univariate tests (appendix 19),
none of the variables resemble the same pattern as Volatility, except for FX exposure.
These two variables also have a significant correlation, though it is difficult to explain
the behaviour of Volatility by the degree of FX exposure, as it for both of them is
somewhat unexplainable why they at the beginning of increase in multinationality
drop. Volatility also significantly correlates with Size; though the changes (appendix 19)
show that Size significantly increases from group 1 to 2, thus not able to explain the

\[ \text{Depth} \text{ is calculated as the sum of the subsidiaries in the two countries with the largest number of}
\text{subsidiaries divided by the MNCs total number of foreign subsidiaries} \]
drop in Volatility. None, of the above methods are therefore able to explain the distribution of Volatility. Rational arguments are also missing as to explain why firms going from being domestic to a low level of multinationality experience a decrease in total risk, after which it starts to increase as they become more multinational.

**Financial hedging**

Both the use of financial derivatives and FC debt seems to have a negative effect on the total risk of the firm, thus indicating that FC debt is also used as a hedge. However, both findings are insignificant, and it is therefore not possible to conclude anything with certainty. Again it is tested whether adding the two variables together will improve the results. The combined variable still indicates an effect of decreasing the total risk, though the finding is still insignificant (appendix 30).

**Control Variables**

The results of the different control variables show that only Size, ROA and Liquidity are significant at 1 and 10% respectively, thus larger firms have a tendency to have greater total risk. Resembling the findings of systematic risk, which was to be expected. Again robustness tests show that the different proxies for financial distress and underinvestment costs can be used.

Summing up the basic regression, R2, explains more than the one under systematic risk, however the explanatory variable is still rather low. Again it is primarily foreign sales and multinationality which are able to explain the risk, in this case total risk. Though, the evolvement in Volatility as MNC3 increases is still unexplainable, in relation to the discussed drop. It is therefore only Tot.For, a part of multinationality, which is able to verify hypothesis II.

In both risk regressions a negative relationship is found between risk and financial hedging, which verifies hypothesis I, they are however insignificant. In relation to multinationality the findings within the two risk terms are somewhat contradicting, as they do not find the same relationship, which was expected. A joined conclusion is therefore impossible, as only some of the distributions verify hypothesis II. Focusing on the distributions within systematic risk, which is relevant for the well-diversified investor,
MNC1 indicates a bell-shaped relationship; this would seemingly indicate that firms ought to use financial hedging accordingly.

6.4.3 Foreign Exchange Exposure Regressions
In this section the second and third hypotheses will be tested. The hypotheses stated in section 4.2, accentuates that financial hedging is negatively correlated with FX exposure while multinationality and FX exposure is somewhat bell-shaped, hence a firm with a low degree of multinationality will experience increasing FX exposure when becoming more multinational whereas a highly multinational firm will be operationally hedged, thus being able to lower its FX exposure.

Recall that there are two approaches for exposure regressions; the first is a basic multiple regression analysis, the second is a regression where the sample is divided into ‘net importers’ and ‘net exporters’ based on the sign of the individual exposure. The models are as follows:

**Basic Regression**

Absolute value of FX exposure = α + β₁ Fin.Hedgeᵢ + β₂ FDᵢ + β₃ MNCᵢ + β₄ *
MNCᵢ<sup>2</sup> + β₅ Tot.forᵢ + β₆ Tot.forᵢ<sup>2</sup> + β₇ Sizeᵢ + β₈ QRᵢ + β₉ ROAᵢ + β₁₀ *
MtBᵢ + β₁₁ Indu₁ᵢ + β₁₂ Indu₂ᵢ + β₁₃ Indu₃ᵢ + β₁₄ Liquidityᵢ + εᵢ

(R3)

**Import/Export Regression**

Absolute value of FX exposure = β₀ Dᵢ + β₁ D * Fin.Hedgeᵢ + β₂ D * FDᵢ + β₃ D *
MNCᵢ + β₄ D * MNCᵢ<sup>2</sup> + β₅ D * Tot.Forᵢ + β₆ D * Tot.forᵢ<sup>2</sup> + β₇ Sizeᵢ + β₈ D * QRᵢ +
β₉ D * ROAᵢ + β₁₀ D * MtBᵢ + β₁₁ D * Indu₁ᵢ + β₁₂ D * Indu₂ᵢ + β₁₃ D * Indu₃ᵢ + β₁₄ D *
Liquidityᵢ + β₀d (1 − D)ᵢ + β₁d (1 − D) * Fin.Hedgeᵢ + β₂d (1 − D) * FDᵢ + β₃d (1 − D) *
MNCᵢ + β₄d (1 − D) * MNCᵢ<sup>2</sup> + β₅d (1 − D) * Tot.Forᵢ + β₆d (1 − D) * Tot.forᵢ<sup>2</sup> +
β₇d (1 − D) * Sizeᵢ + β₈d (1 − D) * QRᵢ + β₉d (1 − D) * ROAᵢ + β₁₀d (1 − D) * MtBᵢ +
β₁₁d (1 − D) * Indu₁ᵢ + β₁₂d (1 − D) * Indu₂ᵢ + β₁₃d (1 − D) * Indu₃ᵢ + β₁₄d (1 − D) *
Liquidityᵢ + εᵢ

(R4)

The results of the univariate test indicated that firms with a high level of multinationality have a significant higher FX exposure than domestic firms, and firms with a low level of multinationality. Furthermore, the correlation matrix showed that the three
MNCs, Size, ROA and Liquidity are all positively correlated to FX exposure. Thus, the result of the univariate test and correlation matrix does not indicate the hypothesised bell-shaped relationship between multinationality and FX exposure.

6.4.3.1 Basic Regression
Recall from section 5.3.1 that the FX exposure variable could not be obtained for all firms at a five years basis, why it is tested whether one, three or five years generate the most significant results (see appendix 31). In the regression with exposure based on five years, both MNC3 and MNC3$^2$ are significant. The results for three and one year show that none of the variables are significant, and that the explanatory variable decreases despite the increase of firms in the sample. Thus, the five-year based FX exposure will be used for the rest of the exposure analysis with a sample of 219 firms. When comparing the results of the three regressions it shows the same distribution of MNC and Tot.For, thus no indication of effects from the financial crisis on the five-year FX exposure exists.

The results of the basic regression are shown below. All of the design criteria are fulfilled (appendix 32), no outliers were removed as it made the results less significant. As in the former tests the explanatory variable is rather low at 10.4% and only the two MNC variables are significant.

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<th>Model Summary(b)</th>
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<th>Standardized Coefficients</th>
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<td></td>
<td>FD</td>
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<td></td>
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<td></td>
<td>QR</td>
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<td>Indu1</td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>Indu3</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>Size</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>ROA</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>MtB</td>
<td>-3.12E-06</td>
</tr>
<tr>
<td></td>
<td>Liquidity</td>
<td>0.051</td>
</tr>
</tbody>
</table>
Table 6.8 Basic regression with FX exposure

<table>
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<tr>
<th></th>
<th>0.005</th>
<th>0.099</th>
<th>0.016</th>
<th>0.047</th>
<th>0.963</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tot.For</td>
<td>-0.002</td>
<td>0.091</td>
<td>-0.008</td>
<td>-0.026</td>
<td>0.979</td>
</tr>
<tr>
<td>Tot.for_2</td>
<td>-0.097</td>
<td>0.04</td>
<td>-0.648</td>
<td>-2.438</td>
<td>0.016</td>
</tr>
<tr>
<td>MNC3</td>
<td>0.051</td>
<td>0.019</td>
<td>0.753</td>
<td>2.753</td>
<td>0.006</td>
</tr>
<tr>
<td>MNC3_2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Multinationality

Before interpreting the results of MNC3, the regression analyses with MNC1 and MNC2 are performed (appendix 33). MNC2 is also significant and shows almost the same distribution when put into a graph, while MNC1 differs from the two, though highly insignificant.

The distributions of MNC3 and Tot.For are shown in the graphs below. MNC3 does as mentioned earlier not cover any value between zero and one, thus MNC2 is included as it provides a better overview of the relationship for firms with low multinationality.

Graph 6.8 and 6.9: Distribution of MNC3 and Tot.For from R3

Graph 6.10: Distribution of MNC2 from R3
Graph 6.9 shows a decreasing positive relationship to FX exposure, thus as firms increases foreign sales to total sales FX exposure increases, however insignificant. Hence, the results equal the findings of previous studies. However it is a decreasing positive relation almost showing the hypothesized pattern. The rationale for the findings is that firms with high foreign sales experience a higher degree of diversification, which reduces FX exposure, though not enough to create a bell shape. Due to the insufficiency, the results are unreliable.

MNC3 shows that when multinationality increases from zero to one, the FX exposure decrease and afterwards it starts to increase again, as in the Volatility regression. MNC2 shows that there exists an upturned bell-shape, with a top point at 1,4. The rationale for the findings is as mentioned under the volatility regression rather difficult to explain. Therefore, as in the volatility regression, a simple regression is used in order to check for interactions between the variables.

The results of the simple regression are included in appendix 34. Tot. For changes, but is still very insignificant, thus this will not be further elaborated. The results for MNC are consistent with the result of the basic regression, thus any complicated interaction between the different variables can be ruled out as an explanation.

The univariate tests from appendix 19 show that only Volatility has the same pattern as Exposure between the different levels of multinationality. Thus as in the volatility regression none of the methods used are able to explain the relationship, and also rational arguments are missing as to explain why firms going from being domestic to a low level of multinationality experience a decrease in total risk. While the rationale for the increase, could be explained by operationally hedged firms having a higher degree of cash flow variability than financially hedged firms as described in section 3.4.

Financial Hedging

In the basic regression FD is positively related to FX exposure, indicating that increases in FD increases the firms FX exposure, thus not used as a hedge, while Fin.Hedge as expected correlates negatively. Since none of the two variables are significant it could very well be the other way around, especially FD with a beta value of 0,002.
Putting the insignificance aside, the findings do correspond to the previous literature, were most studies like Bartram (2010) and Allayannis and George (2001) find that financial hedging effectively reduces FX exposure. When adding FD and Fin.Hedge into one variable (appendix 35) beta worsens and it is highly insignificant, thus no further interpretation.

Control Variables
Most of the control variables are highly insignificant and with beta values close to zero. As in the other regressions, robustness tests are performed on the control variables, and the findings are similar. Both Size and MtB were expected to have positive betas, however since both values are close to zero and highly insignificant, no interpretations are made.

6.4.3.2 Import/Export Regression
Recall that in this FX exposure regression the sample is divided into net importers and net exporters based on the sign of the exposure variable. The Result of the R4 regression shown in the table below has an explanatory power of 22.3%, thus significantly higher than the basic regression though still low. Only the two MNC3 and Net.Ex.ROA are significant at a 10% level. All of the design criteria’s are fulfilled (appendix 36), as in the basic regression, removing outliers made the model less significant.

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>0.223</td>
<td>0.109</td>
<td>0.1073</td>
<td>219</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Netlm.Fin.hedge</td>
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<td>0.123</td>
</tr>
<tr>
<td>Netlm.QR</td>
<td>0</td>
<td>0.004</td>
</tr>
<tr>
<td>Netlm.Indu1</td>
<td>0.019</td>
<td>0.028</td>
</tr>
<tr>
<td>Netlm.Indu3</td>
<td>0.006</td>
<td>0.039</td>
</tr>
<tr>
<td>Netlm.Size</td>
<td>-0.004</td>
<td>0.012</td>
</tr>
<tr>
<td>Netlm.ROA</td>
<td>-9.11E-05</td>
<td>0.001</td>
</tr>
<tr>
<td>Netlm.MtB</td>
<td>-1.65E-06</td>
<td>0</td>
</tr>
<tr>
<td>Variable</td>
<td>Coefficient 1</td>
<td>Coefficient 2</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>NetEx.Fin.hedge</td>
<td>-0.055</td>
<td>0.061</td>
</tr>
<tr>
<td>NetEx.QR</td>
<td>-0.015</td>
<td>0.016</td>
</tr>
<tr>
<td>NetEx.Indu1</td>
<td>-0.001</td>
<td>0.026</td>
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<tr>
<td>NetEx.Indu3</td>
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<td>0.042</td>
</tr>
<tr>
<td>NetEx.Size</td>
<td>0.002</td>
<td>0.009</td>
</tr>
<tr>
<td>NetEx.ROA</td>
<td>0.003</td>
<td>0.002</td>
</tr>
<tr>
<td>NetEx.MtB</td>
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</tr>
<tr>
<td>Net.IM.FD</td>
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<td>0.009</td>
</tr>
<tr>
<td>Net.EX.FD</td>
<td>0.034</td>
<td>0.025</td>
</tr>
<tr>
<td>Net.IM.Liquidity</td>
<td>0.04</td>
<td>0.067</td>
</tr>
<tr>
<td>Net.EX.Liquidity</td>
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<td>0.064</td>
</tr>
<tr>
<td>Net.IM.MNC3.2</td>
<td>0.008</td>
<td>0.01</td>
</tr>
<tr>
<td>Net.EX.MNC3.2</td>
<td>0.087</td>
<td>0.027</td>
</tr>
<tr>
<td>Net.IM.Tot.For.2</td>
<td>0.013</td>
<td>0.145</td>
</tr>
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<td>Net.EX.Tot.For.2</td>
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<td>0.126</td>
</tr>
<tr>
<td>Net.IM.Tot.For</td>
<td>-0.04</td>
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</tr>
<tr>
<td>Net.EX.Tot.For</td>
<td>-0.005</td>
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</tr>
<tr>
<td>Net.IM.MNC3</td>
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<td>Net.EX.MNC3</td>
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<td>Net.IM.Constant</td>
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</tr>
<tr>
<td>Net.EX.Constant</td>
<td>-3.15E-06</td>
<td>0.101</td>
</tr>
</tbody>
</table>

a. Dependent Variable: FX.Exposure

Table 6.9: R4 regression of FX exposure Im/Ex

**Multinationality**

Like the previous regression, running the regression with MNC1 and MNC2 checks the robustness of the multinationality measures. The output and graphs in appendix 37 show that the results for net exporters are more or less the same for the three MNC measures, though the level of significance is worsened when using MNC1 or MNC2. For net importers the three measures provide different pictures of the relationship, though, as they are all insignificant no further comments will be made on this. The graphs of the relationship between FX exposure and MNC3 and Tot.For are shown below:
Neither Tot.For nor MNC shows the expected bell-shaped relationship to FX exposure. The findings for Tot.For within net exporters are positive, thus an increase in Tot.For increases FX exposure, while Tot.For for net importers are negatively correlated. The rationale for the findings is that, if net importers increase their foreign sales ratio, their import-export balance will approach zero, and thus reduce the FX exposure and opposite for net exporters.

The findings within MNC for net exporters are significant though similar to the findings in the basic regression, thus no further interpretations will be made. The MNC for net importers are insignificant.

**Financial Hedging**

For net importers Fin.Hedge is positive and FD is negative while it is the opposite for net exporters. Though none of the variables are significant, FD for both net importer and net exporter fulfil the hypothesis. The rational for the findings within FD and FX exposure is that a net importing firm can hedge its FX exposure with FD as described
previously in section 3.3, while a net exporting firm is not able to hedge its FX exposure by taking on FD as it will increase the export of cash flow, thus increasing the FX exposure. The negative correlation between Fin.Hedge for net exporters and FX exposure equals the hypothesized, in that financial hedging effectively reduces FX exposure. The fact that Fin.Hedge is positively correlated for net importers is on the other hand the opposite of what was expected based on theory and previous empirical studies. The findings could be interpreted as if net importers use financial hedging for a speculative purpose, though it is highly insignificant and no conclusions are certain.

Control Variables
As in the basic regression, Size and MtB are insignificant and close to zero. The VIF factor shows that Size has a high degree of multicollinearity with the other independent variables, and is therefore excluded from the regression (appendix 38). The result of the regression shows a better level of significance, but as the beta values are almost the same no further comments will be made.

Net.Ex.ROA are the only significant control variable, with a positive beta of 0.003 it contributes to an increasing FX exposure. Since all other control variables are highly insignificant no interpretation is possible. Again the robustness of the control variables are accepted

Summing up the two regressions for FX exposure both have poor explanatory power and only few significant variables, thus it is difficult to draw any certain conclusion based on the findings. A possible reason for this could be the calculation of FX exposure, which is calculated with a broad effective exchange rate index instead of a firm specific exchange rate index. Using a firm specific index would be a more accurate estimate for the FX exposure of the firms, as it includes only the currencies in which the firms have operations.

However the results of the basic regression showed that diversification of foreign sales reduces FX exposure and operational hedging increase FX exposure due to the higher cash flow volatility operationally hedged firm’s experience. In addition to the positive correlation between Tot.For and FX exposure, the second regression showed that it is negative for net exporters, thus they can reduce their FX exposure by increasing foreign sales.
6.4.4 Financial Hedging Regression

Earlier it was hypothesized that the non-linear relationship between multinationality and financial hedging is somewhat bell-shaped (section 4.3). Indicating that as firms increase their multinationality level so does their need for financial hedging, though at some point of multinationality the use of derivatives becomes less important as the firm is more diversified and operationally hedged. Forming the following regression:

\[
\text{Finhedg} = \alpha + \beta_1 * FD_i + \beta_2 * MNC_i + \beta_3 * MNC_i^2 + \beta_4 * \text{Tor.for}_i + \beta_5 * \text{Tor.for}_i^2 + \\
\beta_6 * \text{Size}_i + \beta_7 * QR_i + \beta_8 * \text{ROA}_i + \beta_9 * \text{MtB}_i + \beta_{10} * \text{Indu1}_i + \beta_{11} * \text{Indu2}_i + \\
\beta_{12} * \text{Indu3}_i + \beta_{13} * \text{Liquidity}_i + \epsilon_i
\]

(R5)

The correlation matrix showed that MNC, Size, Liquidity and one of the industries correlates positively with Fin.Hedge. The univariate test showed that when dividing the sample into quartiles based their level of multinationality, Q1 including domestic firms hedge less than Q4, and when comparing non hedgers to hedgers, the firms that hedge, are significantly more multinational than the group of non-hedgers. Thus, the findings so far have not shown the hypothesized bell-shape.

All the design criteria’s are fulfilled for this regression (appendix 39). The basic regression generates the following results, again a poor explanatory variable:

<table>
<thead>
<tr>
<th>Model Summary(b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>1 (Constant)</td>
<td>-0,303</td>
<td>0,13</td>
</tr>
<tr>
<td>FD</td>
<td>0,004</td>
<td>0,018</td>
</tr>
<tr>
<td>QR</td>
<td>0,005</td>
<td>0,024</td>
</tr>
<tr>
<td>Indu1</td>
<td>-0,002</td>
<td>0,038</td>
</tr>
<tr>
<td>Indu3</td>
<td>0,231</td>
<td>0,055</td>
</tr>
<tr>
<td>Size</td>
<td>0,027</td>
<td>0,014</td>
</tr>
<tr>
<td>ROA</td>
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<td>0,002</td>
</tr>
<tr>
<td>MtB</td>
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</tr>
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</table>
Table 6.10 Basic regression with Fin.Hedge

<table>
<thead>
<tr>
<th></th>
<th>Liquidity</th>
<th>Tot.For</th>
<th>Tot.for_2</th>
<th>MNC3</th>
<th>MNC3_2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0,003</td>
<td>0,156</td>
<td>-0,11</td>
<td>0,025</td>
<td>-0,011</td>
</tr>
<tr>
<td></td>
<td>0,09</td>
<td>0,2</td>
<td>0,184</td>
<td>0,079</td>
<td>0,037</td>
</tr>
<tr>
<td></td>
<td>0,003</td>
<td>0,239</td>
<td>-0,177</td>
<td>0,077</td>
<td>-0,075</td>
</tr>
<tr>
<td></td>
<td>0,03</td>
<td>0,779</td>
<td>-0,598</td>
<td>0,314</td>
<td>-0,299</td>
</tr>
<tr>
<td></td>
<td>0,976</td>
<td>0,437</td>
<td>0,55</td>
<td>0,754</td>
<td>0,765</td>
</tr>
</tbody>
</table>

**Multinationality**

In relation to multicollinearity it is as previously, examined whether the results improve be excluding either MNC3 or Tot.For. The results show no sign of improvement and both are therefore kept in the regression (appendix 40).

When running the regression with the three different MNC variables, they all indicate the same relationship, though all equally insignificant (appendix 41), below is the distribution of the basic regression:

Both distributions are somewhat bell-shaped with top points at 1.1 and 0.7 respectively. It is however not as visible for the distribution of MNC3, as with MNC2 and MNC1, as it has the former mentioned disadvantage of no firms being categorized between 0 and 1. Insignificance set-aside for a moment, both distributions seem to verify hypothesis III. It is interesting to find that when examining the relationship between the use of financial hedging and the level of multinationality, firms at lower levels of multinationality use an increasing amount of financial derivatives. Yet, at some point of diversification of sales and operational hedging they begin to lessen the amount of derivatives. The previous empirical findings indicate that operational hedging and financial
hedging are complements, and Kim et al. (2006) find a positive relationship between the two. Operational hedging can be aligned with the MNC3 above, though both MNC3 and Tot.For, thus multinationality, finds a positive relationship in the beginning, but it will at some point start to diminish again. However the insignificance in the findings excludes a certain conclusion on this, and it will in the following be examined whether this can be improved.

Financial Hedging

For this regression the variable Fin.Hedge is the dependent variable, though FD is still kept as an independent variable. As discussed previously, theory states FC debt as a possible hedge of currency risk, and also the empirical findings show sign of it being used as a hedge, though it is suggested that some use it for speculation. As examined within the other regressions the variables of Fin.Hedge and FD will be added together, forming one variable for financial hedging. Running this regression, after two outliers were removed through SPSS, gave the following output:

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>N</th>
</tr>
</thead>
<tbody>
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<td>0.502a</td>
<td>0.252</td>
<td>0.216</td>
<td>0.37376</td>
<td>235</td>
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</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>1 (Constant)</td>
<td>-0.897</td>
<td>0.211</td>
</tr>
<tr>
<td>QR</td>
<td>-0.006</td>
<td>0.04</td>
</tr>
<tr>
<td>Indu1</td>
<td>0.031</td>
<td>0.062</td>
</tr>
<tr>
<td>Indu3</td>
<td>0.227</td>
<td>0.09</td>
</tr>
<tr>
<td>Size</td>
<td>0.076</td>
<td>0.023</td>
</tr>
<tr>
<td>ROA</td>
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<td>0.003</td>
</tr>
<tr>
<td>MtB</td>
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<td>0.337</td>
</tr>
<tr>
<td>Liquidity</td>
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<td>0.148</td>
</tr>
<tr>
<td>Tot.For</td>
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<td>0.33</td>
</tr>
<tr>
<td>Totfor_2</td>
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<td>0.301</td>
</tr>
<tr>
<td>MNC3</td>
<td>0.209</td>
<td>0.13</td>
</tr>
<tr>
<td>MNC3_2</td>
<td>-0.118</td>
<td>0.061</td>
</tr>
</tbody>
</table>

a. Dependent Variable: FD_Fin.Hedge

*Table 6.11 Regression with FD_Fin.Hedge*
The explanatory variable is still rather low; however, the significance of both MNC3 and Tot.For has improved, as all four variables almost are significant at 10%. Thus, by combining Fin.Hedge and FD, the above distributions do not change though they become much more significant. As robustness check a regression was performed containing only those firms reporting notional amount of financial derivatives and it gave the same results (appendix 45). Therefore, hypothesis III is now verified with much more certainty. These findings also seem to indicate that firms use both financial derivatives and FC debt as means to hedge their currency exposure; however it is not possible to verify this in the earlier findings (See section 5.4.1 and 5.4.2).

**Control Variables**

The expectations for the control variables (section 5.4.3) are Size and MtB having a positive beta while QR has a negative beta. Size is the most significant of the control variables, showing the expected positive relationship to financial hedging. The rational for this is that there exists some degree of economy of scale in the use of hedging instruments. MtB are zero, while QR has the expected negative beta, though rather insignificant. Furthermore, it is interesting to see that firms in industry 3 hedge significantly more than the firms in industry 1 and 2. Again robustness checks show that the different proxies for financial distress and underinvestment cost can be used. To check for multicollinearity both Indu1, 2, 3 and Size have been excluded from the regression as they have the highest VIF factors. However, removing the variables makes the model less significant.

To sum up, the results of the regressions show the expected bell-shaped relationship to multinationality, meaning that as firms increase their level of multinationality they become operationally hedged, thus the need for financial hedging diminishes. When adding FD and Fin.Hedge into one dependent variable the model improves both in explanatory power and significance, indicating the firms use FD as a hedge of the FX exposure. Both size and industry of the firm is important factors for the degree of hedging.
6.4.5 Firm Value Regression

The hypothesis for the regression on firm value states that both multinationality and the use of financial hedging improve firm value (section 4.4). The basic regression is included below:

\[
TobinsQ = \alpha + \beta_1 \text{Fin.Hedge}_i + \beta_2 \text{FD}_i + \beta_3 \text{MNC}_i + \beta_4 \text{MNC}_i^2 + \beta_5 \text{Tot.for}_i + \\
\beta_6 \text{Tot.for}_i^2 + \beta_7 \text{Size}_i + \beta_8 \text{QR}_i + \beta_9 \text{ROA}_i + \beta_{10} \text{MtB}_i + \beta_{11} \text{Indu1}_i + \beta_{12} \text{Indu2}_i + \beta_{13} \text{Indu3}_i + \beta_{14} \text{Liquidity}_i + \epsilon_i
\] (R6)

All the design criteria are fulfilled for the present regression on firm value (appendix 42). Five outliers were removed through SPSS as it improves the model by making the variables noticeably more significant. The basic model as shown below generates the best explanatory variable among the different regressions of this thesis, though it is still rather low as it explains only 41.3% of the firm value.

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>,643a</td>
<td>0,413</td>
<td>0,378</td>
<td>0,16555</td>
<td>232</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Constant)</td>
<td>0,309</td>
<td>0,098</td>
</tr>
<tr>
<td>FD</td>
<td>-0,002</td>
<td>0,013</td>
</tr>
<tr>
<td>Fin.Hedge</td>
<td>0,055</td>
<td>0,049</td>
</tr>
<tr>
<td>QR</td>
<td>-0,008</td>
<td>0,006</td>
</tr>
<tr>
<td>Indu1</td>
<td>-0,008</td>
<td>0,028</td>
</tr>
<tr>
<td>Indu3</td>
<td>-0,048</td>
<td>0,041</td>
</tr>
<tr>
<td>Size</td>
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<td>0,01</td>
</tr>
<tr>
<td>ROA</td>
<td>0</td>
<td>0,001</td>
</tr>
<tr>
<td>MtB</td>
<td>0,202</td>
<td>0,021</td>
</tr>
<tr>
<td>Liquidity</td>
<td>0,042</td>
<td>0,067</td>
</tr>
<tr>
<td>Tot.For</td>
<td>-0,068</td>
<td>0,147</td>
</tr>
<tr>
<td>Totfor_2</td>
<td>-0,001</td>
<td>0,135</td>
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<tr>
<td>MNC3</td>
<td>-0,103</td>
<td>0,058</td>
</tr>
<tr>
<td>MNC3_2</td>
<td>0,049</td>
<td>0,027</td>
</tr>
</tbody>
</table>

a. Dependent Variable: TobinsQ

Table 6.12 Basic regression with TobinsQ
**Multinationality**

To test for multicollinearity, both Tot.For and MNC have been tried excluded as shown in appendix 43. Both variables become slightly more significant when the other is excluded, but since beta does not change noticeably the basic model is kept. The regression results and graphs for MNC1 and MNC2 are included in appendix 44. The graphs for the different MNCs and Tot.For are similar, thus robust between the different multinationality measures. MNC3 are the only variable that is significant at 10%, though MNC2 are close with a significance level of 13,6%.

![Graph 6.17 and 6.18: Distribution of MNC3 and Tot.For from R6](image)

The graph for Tot.For shows contradictory to the hypothesized a linear negative relationship, meaning that as a given firm increases its foreign sales ratio, the value of the firm is reduced. However, both Tot.For variables are highly insignificant, thus no further interpretations are made based on the findings.

The expectations for MNC were to find a positive relationship; hence firms are able to increase value by increasing their multinationality. However, the result shows almost the same picture as in the volatility and FX exposure regressions. Domestic firms becoming multinational reduce their value, while multinational firms in all states above 1,1 are able to improve their value by increasing multinationality. The rationale for this finding might be that the costs of going from domestic to multinational are so high, they exceed the benefits, while the costs of multinational firm, expanding its level of multinationality are smaller, for instance due to know-how and expertise among the employees etc. Thus, after having paid the price of going from domestic to slightly multinational it is possible to start benefitting on becoming more multinational. The
findings somewhat tally with the previous studies finding that multinationality and operational hedging increase firm value, though none of them test the non-linear relationship and thus do not find the decrease when domestic firms go abroad.

Financial Hedging

The basic regression shows that Fin.Hedge is positively correlated with TobinsQ while FD is negatively correlated. Both variables are insignificant at 25.6% and 90.5% respectively. However, setting insignificance aside for a moment, the findings concerning Fin.Hedge conform to the expectations of financial hedging having a positive effect on firm value. The use of FD was expected to increase firm value if used in combination with Fin.Hedge, as shown in section 6.1 most of the sample firms having FD also use financial hedging, thus it was expected that FD would be positively correlated to firm value. Like in the previous regressions, Fin.Hedge and FD are tried added into one variable, which does not improve the results.

Control Variables

The robustness check shows that the different proxies for financial distress and under-investment cost can be used. To test for multicollinearity the control variables with the highest VIF factors are tried excluded as can be seen in appendix 43. The model is improved by removing Size, and further improved when the industry dummies are excluded as well. When trying to remove ROA and QR, the levels of significance increase, thus these variables stays in the final model below:

<table>
<thead>
<tr>
<th>Model Summary(b)</th>
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<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>-------</td>
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<tr>
<td>1</td>
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</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Constant)</td>
<td>0.522</td>
<td>0.039</td>
</tr>
<tr>
<td>FD</td>
<td>0.003</td>
<td>0.013</td>
</tr>
<tr>
<td>Fin.Hedge</td>
<td>0.053</td>
<td>0.047</td>
</tr>
<tr>
<td>QR</td>
<td>-0.011</td>
<td>0.006</td>
</tr>
<tr>
<td>ROA</td>
<td>0</td>
<td>0.001</td>
</tr>
</tbody>
</table>
After removing Size and the industry dummies, the level of significance is as mentioned improved, however, the result does not change noticeably compared to the previous mentioned results, except for FD, which is positive though still highly insignificant. MtB is as expected positive while QR contrary is negative and ROA zero.

Summing up the regression on firm value, increases in Tot.For have a negative effect on value, while increases in MNC have a positive effect when the level of MNC is above 1. The hypothesis on multinationality was that increases would improve firm value. This is to some extent satisfied, though the reduction in value for domestic companies becoming multinational is contradicting the hypothesized. Both Fin.Hedge and FD proved to be insignificant, however both variables fulfilled the expectations that increases in Fin.Hedge improves firm value while the opposite is found for FD.
7. Limitations
In relation to this study there are some limitations, which need to be considered. The results presented show that the regressions used to test the hypotheses does not provide much explanatory power. Given that the criteria for OLS regressions are assumed fulfilled or otherwise tested, the results indicate that the data material used in the regressions was not sufficiently enough. A possible way to solve this would be to include more variables, though the variables used cover most of those used in previous literature. In relation to this, it can also be noted that the sample size of this study is not as large as for some of the previous studies. A larger sample size could possibly have improved the lack of significance within some of the regressions. To generate a larger sample, it would have been a possibility to focus on non-financial firms instead of just manufacturing. These were however chosen, as they are assumed more suitable for operational hedging, due to possible production sites abroad.

Multinationality, one of the key variables, is defined in three different ways. As discussed earlier there are some limitations to MNC1, as there is the same ‘distance’ between the classifications and it is furthermore ordinal scaled. However, significance set aside, the regressions with MNC1 showed the same distribution as the others. Concerning the four proxies, who constitute MNC3, they lack the possibility of firms being assigned a value between zero and one, as depth is often a value of one (see section 6.4.2.2). Though Aggarwal et al. (2011) highlights the value of a simplified model (MNC1), it would be interesting for further research to work on a better definition for multinationality. A drawback of this study is also the missing classification of whether the subsidiaries are for sale or production; this would however require access to more informative databases.

Regarding the FX exposure, it is limited by using a broad trade weighted foreign exchange rate index, instead of calculating a specific exchange rate index for each firm. This could possibly improve the results of the regression, though requires a large amount of work, out of scope of this paper.

Within the analyses it is not controlled whether the firms diversify across industries, as this would possibly affect the risk profile of the firm. As the sample is limited to manufacturing firms it is not assumed a big problem, though it is thinkable that some of the firms within the sample produce within different categories.
Within this study the amount used on financial hedging is limited to one year, as only the annual report for the previous year is examined. For further research it would be interesting to investigate how the amount used of financial hedging within the individual firm evolves as the firm becomes more or less multinational.

One of the key notions in this study is operational hedging - real options, which provides firms with the flexibility of changing production site as currencies fluctuate. Theory describes how this is possible and research is done to examine how this type of hedging relates to risk, financial hedging and value. Though, it is possible in theory to change production site, thus gain on currency fluctuations, is it then also a flexibility firms in reality use? For further research it would be interesting to examine whether MNCs make use of these real options. As even though it might be possible, it is seemingly not without cost to stop production in one country and expand within a different. Furthermore, this also requires that the different production sites produce the same or are able to do so, as it is possible that they produce different components for the final product. Thus, examine whether firms do change production site, how large fluctuations might trigger this and how do they determine whether these currency changes are somewhat permanent and therefore worthwhile the change.
8. Conclusion
This study investigates the interrelationship between financial hedging and multinationality, and how the use of financial hedging is affected by the given firms level of multinationality. In relation to this it is examined how these affect the risk profile of the firm and the FX exposure, and the following effects on firm value. A sample of 237 manufacturing UK firms was tested through descriptive statistics, univariate tests, a correlation matrix and finally various regression analyses.

Regarding financial hedging and multinationality the results of the regression analysis supported the hypothesized bell-shape though only significant when foreign debt was included in the dependent variable. Thus, when firms become more multinational their use of financial hedging increases, until they reach a level of multinationality where they become operationally hedged and thus reduce their level of financial hedging. Furthermore the regression indicated that large firms hedge significantly more than small firms and the industry of the firm also plays an important role for the level of financial hedging.

Disregarding insignificant results for systematic risk as well as unsystematic risk, a negative relationship was found between risk and financial hedging. In relation to multinationality the findings within the two risk terms were somewhat contradicting, though part of the multinationality variables showed the expected bell-shape, indicating that highly multinational firms obtain operational hedging and thus reduce risk.

The results of the FX exposure regressions showed that foreign sales increase FX exposure, it is though a lessening increase due to diversification. Operational hedging increase FX exposure due to the higher cash flow volatility operationally hedged firm’s experience. In addition to the positive correlation between foreign sales and FX exposure, the findings also showed that net exporters are able to reduce their FX exposure by increasing foreign sales.

Concerning firm value, the findings showed a positive relationship to financial hedging meaning that the use of financial hedging does improve firm value, the results for fi-
nancial hedging was however insignificant which also was the case for foreign debt and foreign sales, which showed a negative relationship to firm value. Multinationality was significant and showed that as the level of multinationality increases, so does firm value. Though it was unexpected to find that purely domestic firms reduce their value when going abroad and starts being multinationals, the rationale found was that the costs of entering into new markets exceed the benefits. Afterwards it is possible for the firm to benefit on increasing multinationality.

The findings in this thesis indicate that as firms become more multinational their use of financial hedging reduces as they become operationally hedged. Though, both hedging methods adds value to the firm, they have different effects on risk and FX exposure. While financial hedging seems to be reducing both risk and FX exposure (insignificantly), operational hedging seems to be reducing systematic risk while increasing both total risk and FX exposure. The explanation can be found in the correlation between size and multinationality and the increasing volatility of cash flow caused by operational hedging.
9. Bibliography

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