2015•2016
FACULTEIT BEDRIJFSECONOMISCHE WETENSCHAPPEN
master in de toegepaste economische wetenschappen: handelsingenieur

Masterproef

The relationship between changes in foreign exchange rates and the financial situation of Belgian firms: an empirical analysis

Promotor :
Prof. dr. Mark VANCAUTEREN

Dennis Vanoppen

Scriptie ingediend tot het behalen van de graad van master in de toegepaste economische wetenschappen: handelsingenieur

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Preface

This dissertation will provide a basis of analysis regarding the skills I have obtained during my years as a student 'Commercial Engineering' and has been commissioned by the Uhasselt university located in Diepenbeek, Belgium.

Subject of this master thesis are Belgian firms and in particular the effects that changes in foreign exchange rates can have on their financial situation or in other words, their firm value. My interest in working with financial data and quantitative modeling made this subject an excellent choice, since it entails an empirical research study. There has been no direct contact between me and the firms that make up this study. Hence, only publicly available data has been used.

Furthermore, I would like to thank my supervisor, Prof. dr. Marc Vancauteren, for his excellent guidance and for being a genuinely nice person in general.

I hope you will enjoy your reading.

Dennis Vanoppen

Summary

Ever since the breakdown of the Bretton Woods system in the early seventies, foreign exchange rates are no longer fixed, but rather are determined by the forces of supply and demand in the money market. Hence, sudden shifts in exchange rates are able to cause discrepancies in, among other things, envisaged cash flows. As a result transactions can turn out to be less (or more) profitable than expected, influencing the financial performance of businesses. This means that the location of a company can have a serious impact on its competitive (dis)advantage over other global firms in times of great foreign exchange volatility. The last couple of decades, a lot of effort has been put into investigating the effects of these foreign exchange rate fluctuations on firm value, especially in the USA. This master thesis provides a fresh insight concerning this issue with regards to the Belgian market.

The conducted research study is twofold. First, Foreign exchange rate exposure coefficients are empirically determined for a subsample of Belgian listed companies spread over ten different industries. On the basis of which an in-depth investigation is held in order to spot key differences among these firms that are able to explain the variation in the exposure coefficients. Finally, another empirical study is conducted to be able to accept or reject hypotheses made concerning firm-specific variables that might be influencing the direction and magnitude of the foreign exchange rate exposure of Belgian firms.

The findings reveal a main tendency of Belgian firms towards negative foreign exchange rate exposure. However, quite substantial differences are observed with regards to different subsamples such as large positive foreign exchange rate exposures of the more traditional large capitalised firms as opposed to much more modest negative exposure coefficients observed at highly specialised companies with a lot of R&D expenditures. As a result, the following hypotheses concerning firm-specific variables are accepted: an increase in firm size has a positive influence on exposure, while higher relative R&D expenditures, a higher liquidity and higher solvability all negatively affect the foreign exchange rate exposure coefficients of Belgian firms. Furthermore a negative relationship between the market-to-book ratio, a proxy for growth, is also observed. Finally, we do not find a statistically significant relationship between foreign exchange rate exposure and higher dividends with respect to earnings.

Table of Contents

1 Introduction

Ever since the breakdown of the Bretton Woods system in 1973, which resulted in the end of fixed exchange rates between the most important global economies, researchers have been investigating the effects of so-called foreign exchange rate exposure on firms. Because currencies where now able to fluctuate quite severely from their previous levels, deviations from PPP would now be able to take place and have an effect on the firm value of multinational corporations and global competitors[1]. Since sudden shifts in exchange rates are able to cause discrepancies in, among other things, envisaged cash flows. Transactions can turn out to be less (or more) profitable than expected, influencing the financial performance of businesses. This means that the location of a company can have a serious impact on its competitive (dis)advantage over other global firms in times of great foreign exchange volatility.

There are plenty of examples to be found regarding the impact of exchange rate shocks in recent years, or even months. One of those is the decision of Apple Inc. (among others) in December 2014 to halt online sales of its products in Russia due to "extreme" Ruble fluctuations (Higgins, 2014). Following a big slump in oil prices and international sanctions against Russia, the value of the Ruble dropped vigorously against other currencies, making it unprofitable for global companies to make sales at prices established prior to the crash. Another shock occurred only a months later in Switzerland. As of September 2011 there has been a cap on the value of the Swiss Franc against the Euro. However the 15th of January 2015 the Swiss National Bank decided to revoke this cap, resulting in a massive appreciation of the Swiss Franc. Quite a lot of corporations, like hedge funds had to file for bankruptcy. Luxury companies like the watchmaker Swiss and local ski resorts will likely be less profitable because of the new exchange rates (Koltrowitz & Smout, 2015). Although, exchange rate shocks can also be beneficial for global companies. Multinational Unilever for example said its financial performance had received a big boost due to great sales in the United States associated with a very strong USD (Evans, 2015).

The massive surge in globalization over the last couple of decades has brought us great economic prosperity, but with it came a lot of challenges for companies worldwide. Trade in stocks and derivatives is now easier than ever, meaning market corrections and other external factors are having an effect on stock prices a lot faster than they used to. Also a more widely spread impact of shocks is noticeable, like a strong USD that is having an impact on commodity prices worldwide (Nazlioglu & Soytas, 2012).

There are several factors that contribute to the usefulness of conducting this study on Belgian firms. For starters, Belgium has been one of the first countries to contribute to the globalization landscape we see today. It is one of the founding countries of the European Economic Community, the predecessor of the European Union of which the most important decision making organs are situated in Brussels (Wikipedia, 2015). Also, According to the statistics of the world trade organization Belgium is ranked among the top exporters and imports with a 12th and 13th place respectively (Stat.wto.org, 2015). Although more than 70% of Belgium's global trades are

[1] Both Hunter et al. (2008) and Williamson (2001) refer to previous research verifying the effects of deviations from PPP on firm value because of currency risk. In this paper I assume these findings are still valid.

conducted within the Euro area and thus do not contribute to the research concerning trades of Belgian firms in foreign currency, the remaining 30% is still considerably large and EU shares have been dropping in recent years in favor of mostly the emerging economies such as Brazil, India and China.(Agentschap voor buitenlandse handel, 2013). Furthermore in their research, Muûls & pisu (2009) find evidence of a rise in the number of Belgian firms conducting foreign trade activities between 1996 and 2004. More recently, research is also being conducted in countries like Japan and Kuwait (He & Ng, 2009; Alhayky & Houdou, 2009)[2]. Nevertheless most available documentation still originates from the U.S. market (Jorion, 1990; Choi & Prasad, 1995; Wei & Starks, 2013; Hunter et al., 2008)[3]. Williamson et al. (2006) do mention Belgium, in their investigation of corporations based in 18 countries, as being the country with the most negative foreign exchange coefficient. What this means will become clear in later chapters, but the result itself and the lack of other Belgian research surely warrants further investigation.

The goal of this master thesis not only consists of giving a clear view on the severity of exchange rate exposure of Belgian firms, but is also an attempt to find a link between the exchange rate exposure elasticity and the firm- and industry specific variables of the Belgian companies. For example recent research has been studying the cross-sectional variation in the exchange rate exposure of firms that can be attributed to the financial situation of those firms (Wei & Starks, 2013; Akhigbe et al., 2014). They both find a significant positive relation between the chance of financial distress and exchange rate exposure, however the economic reasoning does slightly differ among them. This and other variables will be addressed in later chapters.

When considering all of the above, I feel that this research will not only be beneficial to managers of Belgian firms in order for them to better access the risks involved when conducting foreign trades, or to investors, but that it will also benefit the academic world. Like I mentioned earlier, research has mostly been conducted in de United States. Implicating that a study of a highly developed European country could disrupt, or enhance the conclusions found in earlier research.

The remainder of this master thesis is organized as follows: An overview of the existing literature regarding foreign exchange exposure and its firm-specific determinants well be provided in chapter 2. Next, The data used to conduct this empirical research will be dealt with in chapter 3. Subsequently, the results regarding the foreign exchange exposure of Belgian firms are to be found in chapter 4. Finally, chapter 5 provides answers regarding the firm-specific determinants of foreign exchange exposure.

[2] Research has also been conducted in other countries as well, these are just two examples.
[3] These are examples of U.S. market research and is in no way an exhausting list.

2 Literature Review

Alhayky & Houdou (2009) state two basic approaches to describe the relationship between firm value and exchange rates in agreement with macro-economic literature, namely a flow-oriented and a stock-oriented approach. According to the flow-oriented approach, a depreciation of the home currency will increase the competitiveness of local firms which in turn gives rise to economic expansion and an increase in financial performance. The stock-oriented approach on the other hand says that this increase in performance will cause the home currency to appreciate and have a negative impact on competiveness and firm value, completing the vicious circle. We assume this is indeed the case for a net exporter. Off course for a net importing firm, the effects of an appreciation or a depreciation of the home currency on firm value will be the opposite. For these companies input materials from abroad will be cheaper in time of a strong home currency, increasing profit margins and in effect financial performance. Thus in order to be able to study the effects that changes in value between currencies can have on the financial performance of a company, firm value first needs to be defined.

There have been numerous scientific research studies over the past 40 years regarding the effects of foreign exchange rate exposure on firms. Meaning measuring methods, hypothesis and economic reasoning have evolved dramatically. The first important change in line of reasoning was the fact that even a company doing business domestically, can be exposed to currency risk through their clientele or suppliers. The demand of the former and the price of the latter can be affected by fluctuations in exchange rates due to globally active competitors who operate in the same markets as them or their suppliers (Marston, 2001). Moreover, the demand in business-to-business markets could even depend on the currency exposure of the clients themselves[4]. Therefor accounting techniques of measuring exposure, like the cash-flow based method[5], where substituted with well-known linear regression techniques (Adler & Dumas, 1984). So instead of having to calculate firm value in a very time-consuming manner, stock values could serve as a proxy. Using these regression techniques they were able to obtain the exchange rate exposure using only market data, making it possible to conduct large scale empirical studies. The result is the following regression, with δ_j expressing the total exposure of firm j:

$$R_j = \alpha_j + \delta_j XR + \varepsilon_j \qquad (1)$$

Adler & Dumas (1984) where the first to implement this model into practice, be it a very simple version at the time. Others would soon follow, but the results of studies in the early nineties can be called conflicting or rather mixed at best. According to Hung (1992) the U.S. manufacturing industry lost approximately 10% of total profits due to USD movements during the eighties. Yet, Jorion (1990) could only prove significant exchange rate exposure for 15 of 287 U.S. multinational firms during the period 1971-1987. While Bodnar & Gentry (1993) discovered significant exposure

[4] According to Adler & Dumas (1984)

[5] As cited in Bodnar and Wong (2003) It must be noted that calculating the foreign exchange rate exposure of a single firm is still conducted using theoretical models involving cash-flows. However, due to the difficulty of applying these methods in multiform studies, they won't add any value to this research and thus will not be included.

in merely 3 of the 19 U.S. manufacturing industries in roughly the same period running from 1979 until 1988. Some studies didn't even find any exposure at all (Amihud, 1994; Bartov & Bodnar, 1994).

These results spurred comprehensive research in an attempt to explain and improve the lack of statistical significance. The problem with equation (1) is that it fails to control for macro-economic effects, like for example real interest rates and a market risk premium, which influence the realised returns (Blanchard et al., 1984; Bodnar & Wong, 2003). These effects are correlated with exchange rates and are, because of that, giving a distorted view of the exposure. In order to increase the effectiveness of the equation Choi & Prasad (1995), among others, use a two-factor model including the return of a chosen market portfolio. This results in the following equation[6]:

$$R_j = \alpha_j + \gamma_j XR + \beta_j R_m + \varepsilon_j \qquad (2)$$

Do notice that δ_j has vanished in favour of γ_j. Equation (2) is used to test the null hypothesis that the exchange rate fluctuations have no effect on stock returns : $H_0 : \gamma_j = 0$. This translates itself in γ_j not being the total exposure elasticity, but the residual exposure elasticity. So when a firm has zero residual exposure it actually has the same exposure as the chosen market portfolio. By controlling for a market portfolio, Choi & Prasad (1995) where able to obtain significant exposures at 61 of 409 investigated multinational corporations at the 10% level. Out of these 61 firms, 60% gained from a depreciation of the U.S. dollar, while 40% experienced negative effects. Withal the choice of a particular market portfolio itself can also result in different exposure measurements. Bodnar & Wong (2002) utilised a weighted average, value weighted and global index in a comparative study to demonstrate this is in fact the case. Likewise Bolognesi et al. (2013) point out the benefits of using a weighted average over a value weighted portfolio. However Wei & Starks (2013) do not find significant differences in utilising different portfolios. Nevertheless they opt for the weighted average one when debating their results.

Furthermore Allayannis (1996) thought it peculiar that others before him assumed foreign exchange exposure was constant over time. He was able to prove that instead exposure is time-varying and depends on the monthly proportion of exports and imports in a certain industry. Or as quoted by Allayannis himself: "An examination of trade data for U.S. manufacturing industries between 1978 and 1990 reveals how pervasive these changes have been: approximately 43% of the U.S. manufacturing industries have switched during this period from being net exporters to being net importers or vice-versa". During the whole period 1978-1986 he found significant proof that a 1% appreciation of the USD, would have a negative effect of roughly 0.46% on U.S. export and a positive effect of 0.37 on import, resulting in a net loss of 0.09% in firm value. In this empirical research a comparing study will take place of both firm level regression and yearly averaged regression.

[6] Detailed info about the two-factor model can be found in the research of Choi and Prasad (1995). However in order to easily compare equation (1) with equation (2), the notation of both equations are taken from the research of Bodnar and Wong (2003).

Low significance could also be caused by weakness in the methodology (Hunter et al., 2008), a research scope that is too short in time (Bodnar & Wong, 2002), 'mispricing' of investors (Bartov & Bodnar, 1994) and a more broadly defined foreign exchange index, which could cause an averaging out effect of exposure (Akhigbe et al., 2014).

Finally, where Choi & Prasad (1995) use the two-factor model to control for market risk, a three-factor model containing not only a stock market index but also a real interest rate measure could be used (Wei & Starks, 2013)[7]:

$$R_{j,t} = \alpha_j + \beta_j R_t^{fx} + \gamma_j EWRET_t + \delta_j INTEREST_t + \varepsilon_{j,t} \quad (3)$$

By taking this into account results during the late nineties up to now obtain a lot more significant results. For example a study of 817 E.U. firms during the period running from January 1988 to December 2002 by Muller & Verschoor (2006) who found that about 13% of these firms experienced economically significant exposure effects to the JPY, 14% to the USD and 22% to the GBP. Williamson et al. (2006) did also find significant exposure results in their study of globally active firms originating from 18 different countries.

Since we are now able to measure the foreign exchange exposure of firms, we can start to question ourselves what the variables are that do explain the cross-sectional variation in the exchange rate exposure of firms. Jorion (1990), was the first one to make an attempt at analysing the sources of differences in exposure. Regarding a study involving US multinationals, he found evidence of foreign sales being the main determinant of exchange rate exposure. Evidence of this relationship concerning exports and exposure has been found by various researchers (He and Ng, 1998; Bodnar & Gentry, 1993). However, other studies like those of Bartov and Bodnar (1994), do not find this kind of relationship among US multinationals[8]. In addition, Wei and Starks (2013) make a distinction between firms with above average foreign sales and below average foreign sales. They reckon that the former are more likely to be net exporters and thus will exhibit a significant increase in exposure, while the latter, probably being net importers, will be experiencing a significant decrease in exposure. Unfortunately, Belgian data concerning foreign sales or imports is hard to come by. Muûls & Pisu (2009) were able to obtain Belgian Extrastat and Intrastat data available only to the NBB (National Bank of Belgium). However due to the strict confidentiality regarding this information, this data will not be made available for this empirical study. Yet, the obtained foreign exposure elasticity coefficients will be compared with the individual firms in the dataset in order to validate or reject the hypothesis that the sign of the coefficients can tell if we are dealing with a net exporter or net importer.

Soon after, researchers were finding other explanatory variables for differences in exposure among companies. It is very important to keep in mind that most of these variables belong to two overarching categories, namely a firm's hedging strategy and the industry in which the firm operates. One of the explanatory firm specific variables is liquidity (He & Ng, 1998). Since firms

[7] With EWRET being a stock market index like in equation (2) and INTEREST as a real interest rate measure.
[8] He & Ng (1998) argue that the effect of foreign sales on exposure can be undone due to hedging efforts, since hedging is negatively related to exchange rate exposure. Meaning, that these studies would probably have found a significant positive relationship if they controlled correctly for hedging.

with low liquidity aren't able to quickly monetize assets, they can't afford to have a large exposure to any kind of risk and these firms thus tend to have smaller exposure overall. Similar to firms with low liquidity are highly leveraged firms. These firms only have a small portion of equity to back up their assets so they run a greater risk of financial distress. Hence, a higher rate of leverage usually means smaller exchange exposure. Larger firms also tend to have greater exposure than smaller ones, because the impact of a change in exchange rates depends on the magnitude of the conducted trades (Muller & Verschoor, 2006).

According to Bartram et al. (2010) firms can use product pricing to pass-through up to 15% of exposure to customers. One could try to adjust product pricing when confronted with a change in exchange rates, however this depends heavily on the competition abroad. Take for instance following hypothetical example: a European carmaker not only sells cars in Europe, but all around the globe. Should the USD undergo a heavy depreciation against the EUR, the carmaker could try and negate part of its losses on sales in the United States by raising the prices of the cars. However, due to severe competition in the car market it is more likely that no price adjustments will take place and thus the firm will undergo the full exposure (considering they didn't hedge the risk). Ipso facto differences in competition , or in other words the elasticity of demand, also help explain variations in foreign exchange exposure (Shapiro, 1975; Williamson, 2001; Bodnar et al., 2002). Related to differences in competition are the industry in which the firm operates and the substitutability of the product. For example more significant exposure was mainly located by He & Ng (1998) in three specific industries in Japan: electric machinery, precision equipment and transport equipment.

One of the most debated explanation of unexpected results regarding foreign exchange exposure is the possibility to mitigate the effects thereof by the implementation of hedging mechanisms. Once again Bartram et al. (2010) estimate that mitigation of up to 15% is possible through the use of operational hedging techniques, mounting up to a staggering 40% with financial hedging or the use of derivative products. Researchers like Williamson et al. (2006) assume the use of hedging techniques is closely related to firm size, meaning the larger the firm, the more probable that it will use some form of hedging[9]. Yet this doesn't comply with findings in more detailed research which finds a more closer tie to the probability of financial distress and hedging needs. He & Ng (1998) where among the first to notice this relation by investigating the differences in exposure among keiretsu and non keiretsu firms[10]. They concluded that because keiretsu firms could easily obtain funds through their close ties with a financial institution, the probability of distress for these companies was lower and in effect also their exposure. More recent studies are aimed at understanding this relationship at a more profound level.

As cited by Wei and Starks, (2013) about why financially distressed firms are less able to utilise hedging techniques:" We hypothesize this would occur due to the limited ability, or even inability, of these firms to access external capital markets, hedge foreign exchange risks through operational or financial hedging, or to pass through increased costs to their customers." Arguments supporting

[9] In the case of operational hedging this does indeed seem very plausible.
[10] Keiretsu is a set of (Japanese) companies that engage in a close relationship among themselves, but more importantly with a fixed banking institution.

this theory are the higher costs of capital of these firms, combined with a decrease in credit rating, making it harder and more expensive to obtain financial debt and equity. Due to the lack of financial resources, they miss out on attractive investment opportunities. Also, the use of financial or operational hedging becomes too expensive. Because of this a higher probability of financial distress will have a greater effect on firm value when currency shocks occur. Firms with a higher default probability are also more likely to miss out on growth opportunities, which can serve as a proxy for the former. Another theory concerning the lack of hedging in firms with a high probability of default can be found in the agency theory (Akhigbe et al., 2014). Firms in financial distress are likely to face a conflict of interest between the bondholder, who are first in line to recuperate their money should the firm file for bankruptcy (risk-adverse), and the shareholder. These shareholder are most likely tempted in taking a lot of risk in an attempt to save the company (gamble). So shareholder won't opt for any form of hedging in this case. They also discovered that not only firms with the highest levels of financial distress exhibit higher foreign exchange exposure, but also those with the lowest levels of financial distress (mostly healthy multinationals). The economic reasoning behind this is that for these companies, the costs of financial hedging exceeds the benefits.

3 Data

This research is aimed at investigating the effects that changes in exchange rates can have on the financial performance of Belgian companies. Hence, our starting point are all 180 noted companies on the Brussels Euronext stock exchange. However, due to missing stock data for some of these companies during our research period which runs from January 2006 until December 2014 and/or missing firm specific data, we end up with a dataset of 75 Belgian listed companies active in 10 different industries. Reasons for the lack of data regarding the other companies, not present in our dataset, can be numerous. It could be for example that the firm only started to trade its shares on the Euronext stock exchange after the starting period of January 2006 or historical firm-specific data got lost before getting stored in a, by us accessible, database.

Stock data and information regarding the market portfolios are gathered from the Yahoo![11] finance website. The three market portfolios used in this research are, in descending order of market capitalization, the BeL20, the BelMid and the BelSmall. These indices are made up out of 20, 35 and 30 firms respectively. During our sample period, the Bel20 had an average value of 2.962, with the lowest value being 1.697 in February 2009 and a maximum value of 4.698 in May 2007. With regards to the BelMid and the BelSmall indices the observed average values are 3.252 and 7.019 respectively, while we obtain minimum values of 1.808 and 4.082 also both during the month of February of 2009. Like the Bel20, the BelMid reached its maximum value of 4.296 in May 2007, while the BelSmall mounted up to a value of 10.792 in May 2014. These observations suggest that all three indices reached their lowest value during the financial crisis of 2008-2009, but only the BelSmall has been able to surpass its pre-financial crisis level during our sample period. However, this comes at the price of higher volatility with a standard deviation of around 1.500 base points, while the standard deviation of the other two indices aren't even half that amount. Unlike previous research, a combination of these indices will be used to control for market movements that are unrelated to foreign exchange exposure.

Furthermore, like Wei & Starks (2013) we not only utilize a market portfolio as a measure of control, but also a real interest rate measure readily available on the website of the European Central Bank (ECB). Because of the financial crisis, interest rates have been kept beneath 1% levels since May 2009, while they reached a maximum value of 4,25% mid 2008 (figure 1). It remains to be seen if this has any effect on the significance of incorporating real interest rates in our model.

Akhigbe et al. (2014) advice against using a broadly defined currency index, since this can cause an averaging out effect of foreign exchange exposure. Nonetheless, we still opt for the euro currency index[12] which evaluates the euro against a basket of 4 of the most widely used currencies, namely the GBP, the USD, the JPY and the Swiss Franc[13]. For one, because a basket of 4 currencies still seems reasonable and also because a study of the effects of the before mentioned

[11] Historical stock data can be downloaded from the Yahoo! finance website at http://finance.yahoo.com/
[12] Like Wei & Starks (2013), among others.
[13] The euro currency index attributes a weight of 25% to all four currencies in the basket.

currencies on itself might be rather pointless without detailed export data[14]. An appreciation of the Euro against this basket of currencies, will result in an increase in the value of the euro currency index. We consulted data regarding individual currency pairs on the website of the National Bank of Belgium (NBB), while data with reference to the euro index has been extracted from stooq.com. Quite surprisingly the euro index exhibited a more stable progression than we initially would have anticipated with a mean value of 186 and a standard deviation of 9 base points. Nevertheless sufficiently large shocks to be valuable to this research can be seen in figure 2 below.

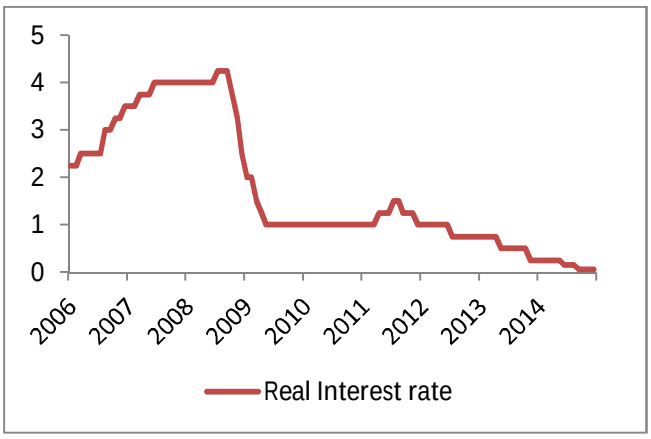

Figure 1: Real interest rate during the sample period

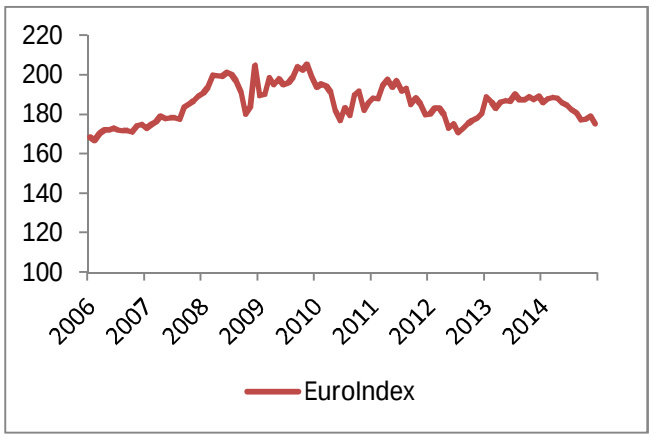

Figure 2: Euro Index during the sample period

In order to be able to draw a clear picture of the foreign exchange exposure residing in various Belgian firms, all exposure estimations are based on monthly data. In other words, data regarding: stock prices, the values of market indices, the euro currency index, foreign exchange rates and real interest rates are all gathered on a monthly basis. This gives us monthly data of 75 Belgian firms over a nine year period, resulting in a dataset of 8100 observations[15]. We feel this number is sufficiently large to be making assumptions about the exposure to foreign exchange movements of Belgian corporations.

Concerning firm-specific data we rely on information from the Bel-First database of Bureau van Dijk, which specializes in financial information regarding Belgian firms. This data will be used in order to empirically determine the firm-specific determinants of foreign exchange exposure. It is important to note that in contrast to our research regarding foreign exchange exposure itself, yearly data will be used here instead of monthly data because of two reasons. For one, monthly data with respect to firm specific variables is often not readily available and secondly, we will be using exposure coefficients on firm level not annual. Out of the 75 firms that make up our study, 24 of them are large cap firm, another 24 are mid cap firms and the remaining 27 are small cap firms. This results in very large standard deviations when comparing firm-specific data, like profit or fixed assets. When studying the exposure of these firms, a detailed analysis of these variables

[14] Due to the high level of confidentiality, we weren't able to obtain detailed export data from the National Bank of Belgium (NBB).
[15] Calculation: 75 firms * 9 years * 12 months = 8.100 observations

will take place in order to try and find key differences. We will do this, instead of providing a simple summary, in order to enhance the comprehensiveness of these figures.

In addition, in order to examine the various industries in which the firms subjected to this research are located, the NACE-code will be used. This code is used all over the European Union to subdivide firms according to their respective economic activities. Should a company be active in multiple industries, only the NACE-code for the main value driver will be supplied. Out of the 21 main industries, 10 are represented by the 75 sample firms. They are mainly active in areas like manufacturing, financial services and wholesale. Examples of categories not represented are companies active in agriculture, mining, arts, etc. A detailed analysis at firm level will also be conducted. The NACE code for the 21 industries can be consulted in appendix D.

Finally, when estimating foreign exposure, as well as when trying to find determinants for these exposure coefficients, robust standard errors will be used. In addition, statistical significance at the 10% level is required in order for a coefficient to be regarded as statistically significant.

4 Foreign Exchange Exposure in Belgium

4.1 Introduction to Foreign Exchange Exposure

We start off our own study by investigating if it would at all be beneficial to debate the effects of foreign exchange exposure on Belgian firms. In order to be useful, there should be currency fluctuation in the sample period that are both unanticipated and permanent (Williamson, 2001). The former is important, because all exposure could easily be hedged if a revaluation of a currency pair is to be expected. The denotations of the euro against the other currencies that make up the euro currency index, from January 2006 to December 2014, are given in figure 3 below.

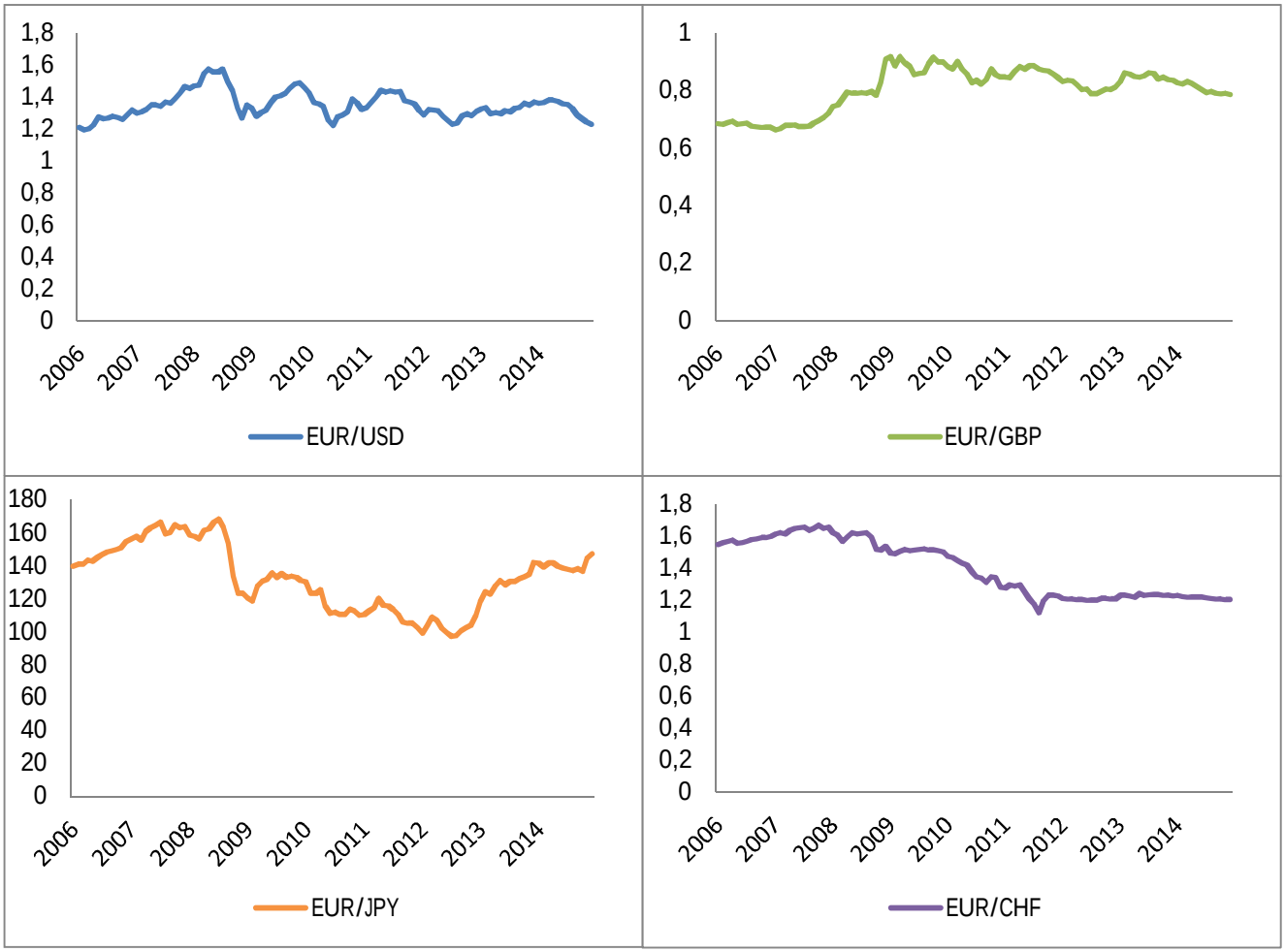

Figure 3: Value of the EUR against the other currencies that make up the euro currency index, namely the USD, GBP, JPY and CHF for the period running from January 2006 until December 2014.

A remarkable distinction between the left-hand side and the right-hand side is noticeable. To the left, the relationship between the euro and the USD as well as the JPY is portrayed. From 2004 until early 2008 there was a steady appreciation of the euro with respect to both currencies, followed by a sharp decline mid 2008 until early 2009. This occurrence can be explained by the subprime crisis: A housing bubble in the U.S. as well as the repackaging of bad mortgages which infected banks all over the world and ultimately caused a global financial crisis. The succeeding period from 2009 to 2013 valuations of the euro against both currencies fluctuated quite severely with positive as well as negative valuation shocks. From 2013 onward a negative trend with respect

to the USD is noticeable, while the reverse is true for the relationship with the JPY. In contrast, smaller discrepancies are observed in the relationship between the other two main currencies of the European continent, namely the GBP and the CHF. With regards to the Swiss franc, a quite linear decline is visible up to 2012. It is at this time that the CHF got pegged to the EUR, explaining the lack of currency fluctuations from 2012 onward. Finally, after an initial stable period, a hefty appreciation of the euro against the GBP took place during the financial crisis of 2008. This appreciation was then followed by a period of mild currency movements. The above observed foreign exchange shocks provide a strong enough foundation for further examination.

4.2 Methodology & General Model Exposure Results:

In order to determine foreign exchange exposure, we adopt the same method as first implemented by Adler & Dumas (1984). Meaning we will regress stock return data against a foreign exchange index using the ordinary least squares (OLS) method and by making use of robust standard errors. Making use of an OLS estimate should result in greater economic information than for example the generalized least squared (GLS) estimate (Choi & Prasad, 1995). Since previous research has shown that controlling for macro-economic effects results in much greater statistical significance, we also adopt a market portfolio (Bodnar & Wong, 2002; Jorion, 1990)[16] and a real interest rate measure (Wei & Starks, 2013) in our model. The resulting model is the following:

$$Price_{i,t} = \alpha_i + \beta_i\, EuroIndex_t + \gamma_i Market_t + \delta_i\, INT_t + \varepsilon_{i,t} \quad (4)$$

Where Price is the stock price of firm i at time t and both Market (market portfolio) and INT (real interest rate) are the controlling variables for macro-economic effects. In order to determine the explanatory power of our model, as well as the benefits of adding a market variable and a real interest rate, we estimate the foreign exchange exposure over all 8100 observations in table 1 below.

	Model 1 b/t	Model 2 b/t	Model 3 b/t
EuroIndex	-0.196	-0.451**	-0.466**
	(-0.96)	(-2.17)	(-2.23)
Market		-0.008***	-0.008***
		(-12.62)	(-12.67)
Int			-205.013
			(-1.35)
constant	91.624**	174.320***	180.382***
	(2.40)	(4.39)	(4.46)
R-sqr	0.000	0.008	0.009
N	8100	8100	8100

* p<0.10, ** p<0.05, *** p<0.01

Table 1: Regression estimates of Belgian foreign exchange exposure

The respective coefficients as well as t-values for the three models are given. In model 1 the stock returns, which are a proxy for firm value, are regressed solely against the euro index. Immediately it becomes clear why early studies like those of Amihud (1994) or Bartov & Bodnar (1994) didn't seem to find significant exposure by implementing this method. The euro index, thus in effect foreign exchange fluctuations, doesn't appear to have any significant impact on firm value and the

[16] Among others

model also doesn't seem to explain any variation in firm value either according to the R^2 value of zero.

In contrast model 2, the two-factor model as proposed by Choi & Prasad (1995), implies that adding a controlling market portfolio to the OLS regression does indeed have a positive impact on statistical significance and explanatory power. However still small, R^2 managed to rise from 0 to 0,008. Meanwhile the euro index is statistical significant at the 5% level and our market variable even at the 1% level. Taken into account that foreign exchanges rates actually only explain a small portion of the variation into stock returns (Griffin & Stulz, 2001; Williamson et al., 2006), we can safely say that model 2 is a significant improvement over model 1. Furthermore the coefficient of the euro index has a value of -0,451, meaning that if the euro index rises with 1 base point (and thus the euro appreciates against the basket of currencies that make up the index), the average loss in firm value regarding all Belgian firms will be 0,451 euro's. In other words: they have a negative foreign exchange exposure of 0,451 euro's. This is in agreement with Williamson et al. (2006) who discovered an overall negative foreign exchange exposure at Belgian firms and the theory of the exporting firm, which says that when domestic rates rise foreign demand will drop and thus in effect firm value.

Finally, we also add a measure of real interest rates to obtain the regression as given by formula (4).The euro index and the market portfolio remain statistically significant at the 5% and 1% significance levels respectively and while the real interest rate (Int) doesn't seem to be significant on its own, model 3 does manage to raise the R^2 value by another 0,001. The value of the exposure coefficient does rise a little to -0,466 but overall the results are quite similar to those of model 2. Due to these positive results we will utilise model 3 in the following chapters in order to estimate foreign exchange exposure on firm level and also annual exposure.

With respect to formula (4) ,it is important to note that there is one distinct difference regarding the market portfolio used as opposed to those in other research studies. The benefits of using of an equally weighted portfolio over a value weighted one has already been pointed out (Bolognesi et al., 2013). Reason for this is that value weighted portfolios are dominated by large firms and hence may bias results towards no exposure (Bodnar & Wong, 2002). Sadly, no equally weighted portfolio of the Belgian stock market is readily available and while creating one would be possible, this would require too much time for such a complex and tedious task and will thus be out of the scope of this study. However, we opted for a third option that should be able to incorporate the benefits of an equally weighted portfolio into that of a value weighted one. The number of firms listed on the Brussels EURONEXT stock exchange is rather limited. Nevertheless, there are three different stock indices available: the BEL20, containing the 20 largest companies, the BelMid, containing companies with a medium market capitalisation, and the BelSmall, containing companies with a much smaller market capitalization. Hence, it is possible to appoint one of these three market indices to a specific company, while estimating exposure through an OLS regression, based on the market capitalisation of that firm. In practice this is done by creating three dummy variables and the following market formula:

$$Market_{i,t} = LargeCapDummy_{i,t}\, BEL20_t + MidCapDummy_{i,t} BelMid_t + SmallCapDummy_{i,t} BellSmall_t \quad (5)$$

If company i belongs to the group of firms with a large market capitalization[17], the LargeCapDummy will return a value of 1 while the other two dummies return a value of zero. Because of this the variable Market, which is included in our OLS regression, will return the value of the BEL20 index at the given year t and hence larger firms aren't subjected to movements in the markets of smaller firms and vice versa.

In the end, β is the coefficient of interest. As quoted by Williamson et al. (2006): "Beta is the estimate of exchange rate exposure. It is the change in firm i's returns that can be explained by changes in the exchange rate[18] after controlling for movements in the market." The same research also points out that β gives us the net exposure, meaning the exposure after hedging activities have taken place. As for the interpretation of the Beta coefficient: A positive β means that an appreciation of the euro against the basket of other currencies will have a positive impact on firm i's stock returns (and hence firm value), while the opposite is true for negative Beta coefficients.

In the following sections, the above procedures will be implemented in order to estimate foreign exchange exposure on annual and firm levels.

[17] Which group of market capitalization a firm belongs to can be seen at the detailed company information sheet at the EURONEXT website.
[18] Or in this case: the exchange rate index.

4.3 Foreign Exchange Exposure: Annual Model

Reflecting back to the exchange rates shown in figure 3, quite some currency shocks have taken place during the sample period. With for example an overall depreciation of the EUR, against the USD and the JPY, in 2008 and an overall appreciation in 2009. Hence it might be useful to compare the foreign exchange exposure of Belgian firms during the various years that make up our sample period. We do this by utilising model 3 of table 1 in the previous section, but instead of estimating a single exposure coefficient, a coefficient for every year of every firm is estimated. Because all estimations are based on monthly data, this approach is viable and results in a total of 675 beta coefficients[19]. Subsequently an average is derived of all coefficients of a particular year in order to get a notion of the annual differences regarding the general Belgian foreign exchange exposure. The results are shown in figure 4 below.

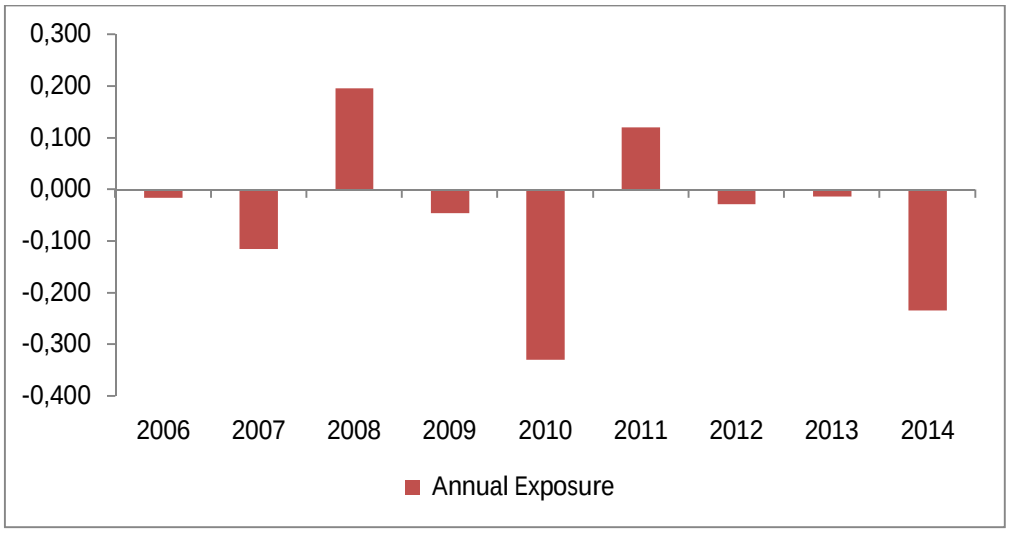

Figure 4: Annual foreign exchange exposure of the Belgian economy

By taking a first glance at the annual exposure of Belgian firms, we notice mostly negative annual exposures except for the years 2008 and 2011. This complies with the general coefficient of -0.466 we found in the previous section. The findings are more noticeable during the years 2008, 2010 and 2014, while values closer to zero, or no exposure, are observed during the other six years. The amount of years with negative coefficients as opposed to the two years with positive exposure is also the most plausible according to macro-economic theory which states that an appreciation of a given currency should have a negative effect on foreign demand and as a result on BBP (sum of the added value by domestic firms)[20]. There is however an obvious explanation for the aberrant exposure of 2008, where a depreciation of the euro led to a depreciation in overall firm value (figure 2). In the initial stage of an economic crisis global demand slows anyhow. Even if it becomes cheaper to import goods from other countries, people will not increase their spending in that currency because of economic uncertainty. Hence the severe depreciation of the EUR against

[19] Of every 75 firms in our dataset, monthly data was available for 9 years (2006-2014), resulting into 9*75 = 675 regression estimates.

[20] Do note that this hasn't have to be the case for a single firm, since a net importer does benefit from a stronger home currency.

the USD and the JPY during 2008 resulted in a loss in overall firm value of Belgian listed companies. Yet an explanation for the largest observed value, the year 2010, isn't as clear-cut. A possible explanation might be found in the recovery of firm value lost. Same goes for the year 2011, where the implementation of the Greek adjustment programme , also called bailout programme, caused economic uncertainty in the whole EU area and might be responsible for the positive observed exposure.

4.4 Foreign Exchange Exposure: Firm Model

4.4.1 Comparison of Methodology

Up to now estimates with regards to the overall foreign exchange exposure of Belgian firms, as well as the annual exposures of the sample period have been dealt with. Yet we haven't touched the key area of this study yet, namely foreign exchange exposure at firm level. Just because a particular country has a general tendency towards a certain direction of exposure, doesn't imply that every company located there exhibits the same relationship between currency swings and firm value. An in depth analysis at various levels regarding firm level exposure will be conducted in the chapters following this one, however we first need to make a decision about the method we will apply to obtain our exposure coefficients. We differentiate between two paths of action. The first, and most currently used, is conducting an OLS regression for each firm spanning the entire sample period. The second one is taking all annual observations that belong to a single firm, by conducting annual OLS regressions, and use them to calculate the average exposure coefficient for the aforementioned firm. In the previous chapter we have already estimated all 675 annual coefficients, so we would only have to take the average value of the coefficients from the year 2006 to 2014 for each firm to end up with 75 averaged firm level foreign exposure coefficients.

The resulting foreign exposure coefficients on firm level can be consulted in appendix (A) for the first method and appendix (B) with regards to the second one. The main reason we decided to compare these two approaches is because of the time-varying nature of exposure (Allayannis, 1996). According to this theory it might not be wise to determine one fixed exposure coefficient over a long period of time for a single firm, because it might be possible that the sign of the exposure coefficient has switched signs multiple times during that particular timeframe. Hence, we very much like to confirm these time variations in foreign exchange coefficients, as well as investigate if the resulting firm level coefficients differ substantially from each other.

In order to put the hypothesis of foreign exchange exposure being time-varying to the test, We take a close look at our annual regression results. Out of the 75 firms, 72 of them had at least 1 statistical significant annual observation at the 0.10 significance level. Of those 72 firms 57% swapped from having a positive exposure coefficient to a negative one at least once, or vice versa. Furthermore out of the 60 companies that had at least 2 significant annual exposure coefficients, 63 of them (84%) swapped exposure signs in-between certain years. Because of this we indeed find sufficient proof to back the claim Allayannis made about exposure being time-varying. One of the few examples of a firm that did not swap signs throughout the sample period is the financial institution KBC, which had four statistically significant and consecutive years of positive foreign exchange exposure from 2006 until 2009. We will try to find an explanation for this behaviour when comparing subsamples.

Does this mean however that the coefficients found in appendix (A) and appendix (B) differ substantially? To find the answer, a paired sample T-test is conducted (appendix C). The results indicate that the null hypothesis, H0: the mean of both sets of firm level foreign exposure coefficients is equal, is rejected at the 5% significance level. In other words: we can be for 95% sure that the exposure coefficients will differ depending on the method used to calculate them.

So which set of coefficients is better, those from the first or the second estimation method? To answer this question we discriminate on the basis of statistical significance. When carrying out annual OLS regressions, only 28% of the obtained coefficients appear to be significant at the 10% level. This even drops to only 8% at the more strict 1% significance level. Much better results are obtained when the exposure is calculated directly on firm level. We are able to prove significant exchange rate exposure for no less than 56% of the companies in our dataset at the 10% significance level. Also the drop in significant results isn't as severe here as it was with our other approach, since still 43% of the β coefficients are significant at the 1% level. This much higher relative amount of statistical significant isn't that peculiar. The OLS regressions per firm gives us the exposure of a certain company during the whole sample period, while the annual regressions result in exposure coefficients of a certain company over a 12-month period. Hence the time span of the former is much greater than that of the latter. This is in agreement with findings of Bodnar & Wong (2002), among others, who concluded that conducting OLS regressions over a longer time period has a positive impact on statistical significance. A conclusion for which this study provides additional prove. We further hypothesize that the high level of significance expressed in both approaches can be attributed to the variables MARKET and INT that control for macro-economic effects. Because of the above findings, we will be using the firm level foreign exchange exposure coefficients found in appendix (A) to conduct a more in-depth analysis of the foreign exchange exposure present in Belgium.

4.4.2 Statistically Significant vs. Non-Significant Exposure Coefficients

As has been mentioned before, when conducting an OLS regression on firm level, we obtain statistical significant Beta coefficients (formula 4) for 42 of the 75 sample firms, or 56%, at the 10% significance level. With respect to earlier research, this is a very sound number of firms[21]. Yet, the question remains why we find a significant exposure coefficient for some firms and none for others. We have already established that a longer time frame does indeed affect statistical significance, but why is this the case? In order to find an answer to the underlying causes of this topic, an in-depth analysis of the firms that make up these two categories of significant and non-significant exposure rates is conducted. It is however important to note, that this does not entail an empirical study of the determinants of exposure yet. Such an empirical study will be dealt with in chapter 5, but here and in the following sections we are simple trying to determine key differences between two groups of firms. Obviously this does provide a solid basis for the aforementioned empirical study of foreign exchange exposure determinants.

We start our investigation by comparing if the mean values, the median and standard deviations of standard accounting figures like profit, fixed assets, liquidity etcetera differ substantially among the two groups. At first sight both group of firms seem quite alike, apart from higher values of mean profit and dividends for the group of firms that do not poses significant exposure. So maybe firm size might have an influence on statistical significance, since firms with larger profits and dividends are mostly larger companies. We do indeed notice a tendency towards more large cap companies in the group that lacks significance. To be exact, 45% of the companies that show significant exposure coefficients are small cap firms, while 45% of the companies that don't show this significance are large cap firms. Concerning the mid cap firms, we notice an almost even dispersion among the two groups. Although, since both groups do have firms of all market capitalisations, may it be in different relative amounts, size can't be the only determining factor. We also don't find any significant differences concerning the industries in which the different firms are active. Hence, a look at the underlying stock values, which are a proxy for firm value, might proof out to be beneficial.

Obviously the mean value of stock prices will be higher at the group exhibiting no significant exposure, due to the presence of larger firms. We do notice however an average standard deviation that is twice as high as those of the significant exposed firms. Some of this can also be explained by the larger values of stocks, however it still warrants further investigation. Since, once again, stocks with low as well as high standard deviations during the sample period are present in both groups, we decide to compare the progression of stock prices between firms of both groups. The resulting graphs are to be consulted in figure 5. From top to bottom firm values are shown of stocks with large to small standard deviations. Stock progression of firms with significant foreign exposure coefficients are placed on the left, while those who do not poses significant exposure are shown on the right-hand side. Spotting differences will be easier by placing firms from both groups with similar standard deviations in stock prices during the sample period aside each other. Finally, also a trend line has been added.

[21] Jorion (1990) for example, was only able to prove statistically significant exchange rate exposure for 15 out of 282 U.S. multinationals, which equals 5%

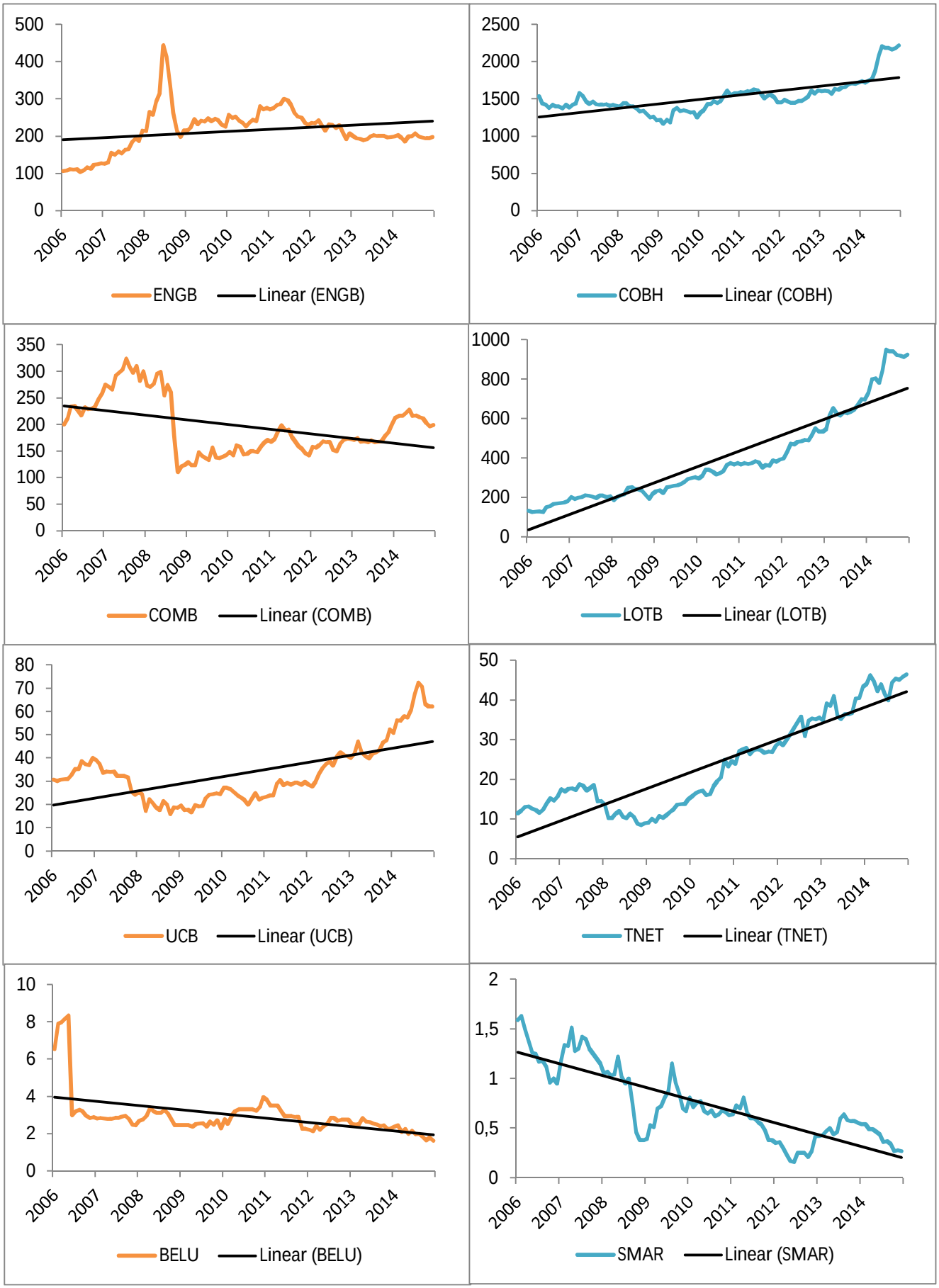

Figure 5: Firm value progression throughout the sample period is given for 4 firms with statistically significant exposure coefficients on the left-hand side and 4 firms with non-statistical exposure coefficients on the right-hand side

On the left-hand side stock values of the following companies are shown: Rossier (ENGB), specialised in the manufacturing and sale of mineral fertilizer; Cie Bois Sauvage (COMB), an investment firm; Union Chimique Belge (UCB), active in the pharmaceutical sector; Beluga (BELU), a venture capital firm. While to the right stock values are shown of: Société Commerciale de Brasserie (COBH), the third largest beer manufacturer in Belgium, following AB Inbev and Alken-Maes; Lotus Bakeries (LOTB); manufacturer of bakery products; Telenet (TNET), a popular telecommunications company active on the Belgian market; SmartPhoto (SMAR), a company offering all kinds of photo-related products and services.

Taking into the account the above information as well as the observed stock valuations in figure 5, two possible discrepancies among the two groups under investigation are detected. For starters, there does seem to be a more pronounced trend in the stock values of firms with no significant exposure coefficients during the sample period. For example, LOTB exhibits an almost linear rising trend, while the trend of COMB is much more horizontal. However, this difference in trajectory is less pronounced between ENGB and COBH, apart from fluctuation in both directions instead of one for ENGB. Even more peculiar is the progression of SMAR's stock returns, that exhibits valuation fluctuations in two directions and a clear trend. So, the explanation regarding the statistical significance of foreign exchange exposure at Belgian firms might be found in the second observation, namely the international character of the firms.

When we take a closer look at the activities of the 8 firms above, we might suspect a higher level of international trade among members of the group that does exhibit significant exposure. Although we do not poses the actual export data, we can make a series of assumptions. For example, we do know that Rossier's turnover consists out of 34% international sales outside of the EU area[22]. It is also known that Cie Bois Sauvage has, among other things, investments in real estate projects in the USA . Furthermore Union Chimique Belge has offices in 35 countries on 5 continents and hence, it probably has a lot of foreign customers. Not much is known about Beluga, but they might have vested interest in projects outside of the EU area. In contrast, it is known that Telenet only provides services in Belgium and maybe some other adjoining European countries. The same goes for SmartPhoto with clients exclusively located in the EU. Less clear is the export behaviour of Société Commerciale de Brasserie and Lotus Bakeries, however it does seem quite plausible that both companies are mainly active in the EU.

Hence, we hypothesise that the level of foreign sales might be the main driver which discriminates between the group of firms exhibiting significant exposure coefficients and those with the lack thereof. Proof of this relationship has also been found in earlier research like that of Jorion (1990), among others. In addition, There might also be a relationship between significance and the trend of the underlying stock values during the sample period. However, this hypothesis seems to be less consistent. That being said, statistical significance isn't the only thing we can discriminate among our exposure results. Next, a similar analysis will take place concerning the difference in direction of the foreign exposure coefficients.

[22] Information regarding foreign sales, here and in later firm investigations, is mainly found on the detailed company information page on the EURONEXT website

4.4.3 Positive vs. Negative Exposure Coefficients

The sign of the foreign exposure coefficients, or Beta coefficients, is quite important since it determines the way firm value reacts to certain currency movements. The direction of the exposure is dependent on the fact if firm value carries a direct or inverse relationship with movements of the euro index. A positive foreign exchange coefficients means firm value is directly related, while a negative foreign exchange coefficients points to an inverse relationship. When an overall appreciation of the euro takes place the euro index rises. Firms with positive exposure coefficients notice a positive effect on firm value in this case, while firms with negative exposure coefficients notice a loss in their firm value. Because of this the former are often hypothesised to be net importers, while the latter are supposed to be net exporters (Wei & Starks, 2013). Net importers benefit from a stronger currency. An appreciation of the euro enhances their purchasing power when buying in other currencies. Hence a higher level of imports, like for example input materials, with respect to exports, foreign sales, should explain the positive effect exchange rates have on firm value. In addition, net exporting follow a scenario that is much more in line with macro-economic theory. The reasoning here is twofold. First a rise in the domestic currency, lowers the purchasing power of foreign clients which in turn will lower the amount they purchase. Secondly, sales made in a foreign currency have to be converted back to the domestic currency. Since it isn't always possible to continuously adapt prices, significant losses can arise in the process. As we have seen in chapter 4.2, the general exposure of the Belgian firms in our sample, taken together, is negative. Summary statistics concerning the foreign exposure coefficients under investigation, at firm level, are shown below (Table 2).

	Mean	Median	St. Deviation	|Max|	|Min|	Count
$\beta < 0$	-0,12	-0,07	0,12	-0,477	-0,002	42
$\beta > 0$	0,37	0,14	0,77	4,283	0,003	33

Table 2: Summary statistics of β coefficients among groups of firms with positive and negative exposure

As can be expected from a country like Belgium, which ranks high on both global exports and imports, there seems to be a fairly decent distribution of firms among the two groups. Though, slightly in favour of firms with a negative exposure coefficient (56%). Yet, with respect to the other variables, much smaller values are observed here. The observed mean is much closer to zero for the group with negative coefficients, meaning currency swings don't impact them as much as the average positively exposure firm. The standard deviation also appears to be 6 times as low, thus the coefficients of the 42 firms are much more alike (row 1, table 2), something which can also be seen by looking at the minimum and maximum values. The highest observed absolute value observed is -0.447 for the firm RealDolmen at the negative side and an astounding 4.283 for the firm Rossier at the positive side. As we have mentioned before, Rossier is a manufacturer of mineral fertilizer active in international market. RealDolmen on the other hand is a firm specialised in the development and integration of software solutions. In fact it is quite logical for a company active in the IT industry to have negative foreign exchange exposure, since the main resource they use in manufacturing their product is human capital, paid in the home currency. Nevertheless it is very easy for them to sell software solutions on a global scale in foreign currency.

Since we now have a general idea of the differences among both groups, it is time to investigate possible discrepancies between the firms present in these groups. We start by conducting our research the same way as in the previous chapter concerning statistical significance by looking at general accounting figures. After calculating some mean values and standard deviations we notice some very large deviations concerning negative exposed firms. Also a negative average profit in conjuncture with quite sizeable dividends are observed. We attain these peculiar results because of a quite sizeable outlier, namely Dexia Bank. For those unfamiliar with this company, Dexia was one of the largest financial institutions of Belgium, alongside other players like KBC bank and BNP Paribas Fortis (just called Fortis back in 2009). Dexia, just like Fortis, accumulated hefty losses due to the subprime crisis of 2008. Fortis, which isn't part of our dataset, has been mainly bought out by the French BNP Paribas in order to form BNP Paribas Fortis. Dexia on its part, got bailed out by the Belgian government and was transformed in the financial institution Belfius. The reason the firm Dexia as a separate entity is present in our sample is because it lived on as what is called a 'bad bank' where all bad securities are held. Obviously this 'bad bank' causes our data to be skewed and hence we will no longer consider this firm when conducting in-depth analysis our in our empirical research regarding foreign exchange exposure determinants in chapter 5. A visual representation of Dexia's profits is shown below (Figure 6).

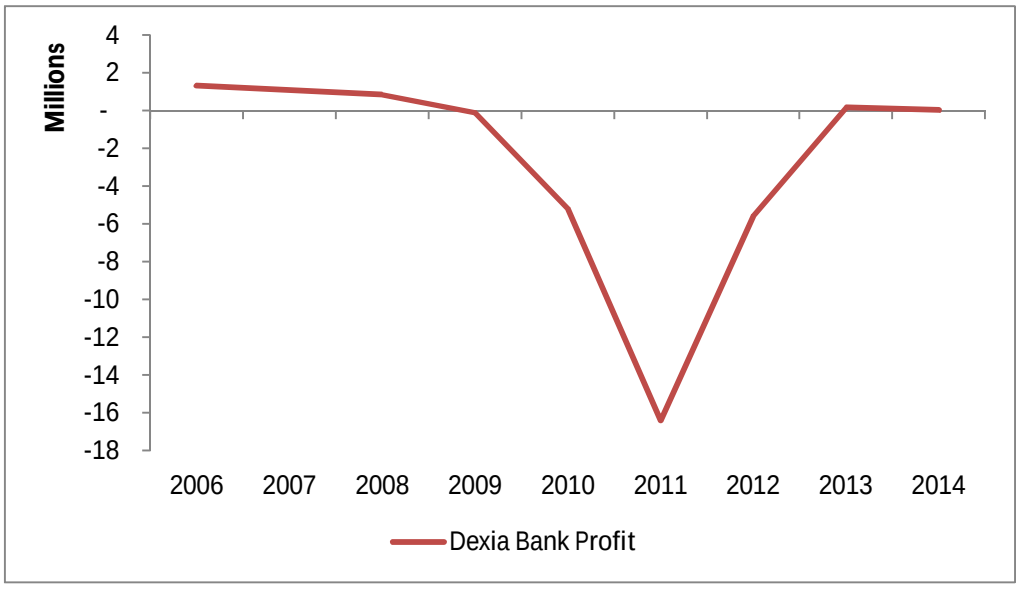

Figure 6: Yearly profits of outlier Dexia Bank during the sample period

With the outlier out of the way, dissimilarities between positive-, and negative exposure firms start to surface. Again, no real differences between the main industries are observed. We do notice a notable difference in two smaller sectors, namely category J: Information & communication and category M: professional, scientific & technical activities. Both of whom are represented mainly by firms with negative exposure coefficients. Also, like we did in previous chapter, we notice a significant difference in firm size. Seventy per cent of all small cap firms in our sample have negative exposure coefficients, while the firms with positive exposure are represented by sixty per cent of all large cap firms. Once again, mid cap firms are more evenly distributed. Furthermore, firms with negative coefficients seem to invest more in research and development, especially when taking into account firm size. Finally these firms also tend to have higher average liquidity and

solvability, in conjuncture with larger standard error. A closer look at these two variables tells us that it is mostly those small cap firms that account for these large values while the large cap firms in general have lower liquidity and solvability.

In conclusion we discovered that the collection of positive exposure coefficients generally consists of larger traditional companies, with more well-known names like for example the manufacturer of bakery products, Lotus Bakeries; the all Belgian Colruyt, a wholesale firm and the financial institution KBC. The average exposure to foreign exchange fluctuations is generally higher for these firms, probably because they see little value in taking on the extra cost of hedging (Akhigbe et al., 2014). A similar explanation can be given concerning the lower liquidity and solvability ratios. Because of their size, a single setback will be rather limited and won't have a devastating effect. Hence, a lot has to go wrong before their creditworthiness is affected and thus the ability to take on extra debt for example.

In contrast, firms with a negative foreign exposure coefficient are generally smaller specialised firms, explaining the higher focus on R&D. Often these firms don't rake in a lot of profit yet. This makes them a more risky investment, which explains the high liquidity and solvability. Same goes for the absolute size of the exposure to foreign exchange fluctuations, which are generally very close to zero. We can think of two reasons for this phenomenon. For one, these small cap firms might not be very active yet on the international market and so foreign sales are low. Secondly, they might be more prone to engage in risk reduction activities, like financial and operational hedging. In order to relate to these findings, two examples are given. The first example is the firm with the largest negative exposure, RealDolmen (REA). RealDolmen is active in the information & communication industry. It is a small cap firm with considerable investments in R&D which averages 67.000 euro annually. This can be explained by the nature of their activities, since custom made software solutions are ever-evolving. During the sample period, RealDolmen had to take on an average loss of 1.3 million annually. The second firm we're discussing is Option (OPTI). Option is active in the professional, scientific & technical activities industry. Specifically, Option is a pioneer regarding the design, development and manufacturing of technological wireless products. They have two research facilities, one in Belgium and one in Germany. With respect to foreign sales we were able to find on the EURONEXT website that 34% of their turnover originates from sales in the US, 11% from Asia-Pacific and 8% other non-European countries.

By comparing groups of firms with negative-, as well as positive foreign exchange coefficients, we were able to discover a lot of new information that can proof to be useful in the empirical study which will be conducted in chapter 5 concerning the determinants of foreign exchange exposure. Also, for the second time now, important differences regarding firm size where found. Hence an investigation which discriminates accordingly might be overdue. In what follows, we will find out if we can find any new information regarding our sample firms, which hasn't been touched yet by the previous two investigations, by discriminating according to market capitalisation.

4.4.4 Discrimination Analysis According to Firm Size

So far, a couple of indications regarding the importance of firm size have been found. Quite a number of large cap firms seem to be lacking statistical significant exposure coefficients. Furthermore, a rise in firm size appears to correlate with lower liquidity and solvability. We also found a tendency to positive foreign exchange exposure for large firms, while smaller firms tended towards negative exposure coefficients. Finally, we think larger firms are more likely to be present in more established industries, while smaller the smaller firms seem to be more involved in highly specialised, R&D based industries. This is the general picture we have painted regarding firms size as of now. Yet, in order to be more certain about these assumptions a more in depth-study is in order. Summary statistics of foreign exchange exposure according to firm size can be consulted in table 3 below.

	Mean	Median	St. Deviation	Max	Min	Count
Large Cap	0,14	0,02	0,40	1,701	-0,212	24
Mid Cap	0,02	-0,02	0,23	0,667	-0,350	24
Small Cap (1)[23]	0,13	-0,03	0,86	4,283	-0,477	26
Small Cap (2)[24]	-0,04	-0,03	0,22	0,472	-0,477	25

Table 3: Summary statistics of β coefficients among groups of different firm size

We have performed two separate calculations regarding small cap firms. In the first calculation we haven't included Dexia bank (DEXB), because we've established that this firm is indeed an outlier. In the second calculation we have also excluded the firm Rossier (ENGB). Not because it is an outlier regarding our overall sample, but since it appears to be an outlier regarding small cap firms. Reason for this is the large value of its beta coefficient. We feel that excluding Rossier from the analysis gives us a better overall picture of the companies with a smaller firm size.

We start by focussing our attention on the mean and median values of exposure. For both of them positive values are observed concerning large cap firms. Small cap firms have a negative mean-, and median value, while for mid cap firms they appear to have different signs. These result do indeed support our previous claims of the greater likelihood for large firms to have positive exposure to foreign exchange rates, while the reverse is true for small firms. It also explains why we keep finding a rather equal dispersion of mid cap firms in our control groups. Furthermore, standard deviations also seem to rise with increasing firm size. Finally, an almost equal dispersion of the sample firms among the three groups is observed.

Things do get interesting when comparing industries in which firms of different sizes are active. We had already established that category M of the NACE code, being professional, scientific and technical activities was more represented by smaller firms with a focus on research and development. In fact, no less than six firms active in this industry are small cap firms, while for the

[23] All small cap firms, with the exception of the outlier Dexia (DEXB)
[24] All small cap firms, with the exception of the outlier Dexia (DEXB) and the firm Rossier (ENGB)

other two groups only one company operates in this industry. This in part also explains the fair amount of average R&D spending of 6.8 million euros. Much higher average liquidity (4,0) and solvability (61,1) are as well characteristic of smaller firms. So while smaller firms like RealDolmen or Option[25] seem to fill the void on this front, we notice that the dispersion of firms among the various industries is almost completely similar for large- and medium sized firms. So where do these firms differ? In order to answer that question, we investigate a firm of both groups active in the most represented industry, the manufacturing industry.

The two manufacturing firms under investigation are the large cap firm Bekaert (BEKB) and the medium sized firm IBA (IBAB). Bekaert is a multinational, known for its advanced metallic transformations and steel wire products. Its turnover is made up of less than 25% in European sales, meaning they have to deal a lot with foreign currencies. This is noticeable in a quite large positive exposure coefficient of 0,96. Mean R&D expenditures of 53.2 million are quite large, as are the fixed assets with a mean of 1.8 billion during the sample period. Average profit was 40.1 million a year. Finally Bekaert has rather low liquidity (0,5) and solvability (29). Then we have IBA, a company which specialises in the design, production and sale of cancer diagnostic and treatment products. As we have seen with Bekaert, IBA also does most of its business outside of the EU area. Yet, the exposure coefficient, with a value of 0.04, is much smaller. Such an advanced area of expertise needs a lot of research, hence average R&D expenditures mounted to 123 million euros a year. This figure is even more impressive when compared with average fixed assets of merely 150 million. Average profit turned out to be negative with an average loss of 4.6 million a year. Its liquidity is higher than that of Bekaert (1,5) while they are less solvable (20,7).

So what can we take away from the comparison of these two manufacturing companies of different sizes? Let's start with the similarities. Both companies very much engage in international trade. In order to stay competitive they both rely on quite sizeable R&D investments, yet they don't appear to have the need to be able to convert assets to cash quickly like most small sized firms in our sample. Now, there are also quite sizeable differences. For one the R&D to assets ratio is huge for IBA. This is probably due to the constant adapting environment of cancer related research. Secondly IBA also appears to be less solvable, which might point to a heavy focus on debt to finance its research. This can also explain the very small exposure in comparison with Bekaert. Bekaert is probably happy to take on some form of exposure to foreign exchange fluctuations, while IBA might be under pressure from debt holders to minimize its risk. It is very plausible that IBA does indeed hedge away as much of its foreign exchange risk as possible. Finally Bekaert appears to be more profitable. So does this imply that the higher average R&D spending of medium sized firms (19,4 million) as opposed to an average of 12,1 million for large firms is due to the higher specialised nature of these mid cap firms? This idea of medium sized firms focussing on more specialised 'niche' areas within the large industries would indeed explain the much lower average observed profit and dividends, which are 17.5 million and 14.7 million for medium sized firms as opposed to 225.6 million and 133.3 million for large firms. More importantly, higher R&D expenditure might be negatively correlated with foreign exchange exposure due to risk minimization strategies. Hence, R&D might be a valuable exposure determinant.

[25] Both of whom we have already discussed in the previous chapter

4.4.5 Industry Analysis

As we have seen, an analysis of industries, both among them or within a single one, can turn out to be quite interesting. Yet, a clear tendency of a particular industry towards one kind of exposure proved out to be hard to find, since most industries are represented by firms with positive as well as negative exposure coefficients. Off course there are exceptions like industry M, "professional, scientific and technical activities", which mainly consists of smaller companies with negative exposure coefficients. Also, earlier research did point out the importance of industries and the fact that they might even be more valuable in explaining exposure than the country of residence (He & Ng, 1998; Williamson, 2001). An explanation therefor can be found in the level of competition which has an effect on, among other things, pass-through rates. After further investigation we discovered much clearer tendencies towards a certain kind of exposure when only taking into account those firms which have statistical significant exposure coefficients, as can be seen in table 4 below. In what follows we will try to find differences among industries with a clear disposition towards a certain kind of exposure, as well as analyse those industries where such a relation isn't as clear cut. Industries that meet this description are: C, manufacturing; H, transportation & storage; K, financial services. Additionally, firms with mostly positive exposure coefficients are: F, construction; G, wholesale & retail trade; L, real estate. Finally industries with a tendency towards negative exposure rates: J, IT & communication; M, professional, scientific and technical activities; N, administrative and support service activities (Appendix D).

Industry	All Sample Firms		Significantly Exposed Sample Firms		Disposition
NACE-code	$\beta < 0$	$\beta > 0$	$\beta < 0$	$\beta > 0$	
C	11	12	7	5	none
D	1	0	0	0	none
F	1	1	0	1	+ exposure
G	4	6	2	5	+ exposure
H	2	1	2	1	none
J	6	2	3	0	- exposure
K	10	7	5	5	none
L	0	1	0	1	+ exposure
M	6	2	4	0	- exposure
N	1	1	1	0	- exposure
Subtotal	42	33	24	18	
Total	75		42		

Table 4: Industry distributions

We begin by analysing the three industries that show a tendency towards positive foreign exchange exposure: wholesale & retail trade, construction and real estate. The latter two are both represented by only one firm: CFE, a construction firm with dredging as its main activity and Think-Media, a real-estate investor. Aside from the lack of R&D, there isn't really anything remarkable to report about these two industries. Off course the fact that they both appear to be quite traditional could also be classified as a characteristic. Luckily we have more to work with when examining the wholesale & retail trade industry. A wide range of firms is represented here from wholesalers like Delhaize and Colruyt to a firm like Sapec, which has the production and distribution of agrochemical products as one of its core activities. The sector as a whole is characterized mainly by low R&D expenditures, firms of all sizes and rather low liquidity. Because most of these companies have a lot of property, think about wholesale stores like Delhaize for example, average fixed assets of about 1.5 billion are observed. We also spot something that might be very crucial for firms with positive exposure. We have already explained the concept of companies with positive exposure coefficients being sometimes called net importers. Bearing that in mind, we do indeed notice a lack of sales outside of the European Union. Wholesalers are mainly only active in Belgium, while retail sellers like Sapec get most of their turnover from within the borders of the EU (more than 95%). That being said, since two out of the 7 firms do have negative foreign exchange rate coefficients, we like to now at what front they differ from the others. The first firm is Fountain, a company that produces and sells soluble products like instant coffee. The other one is Zetes, which develops and sells product- and person identification solutions. As can be expected when taking into account their activities, on average, they are much more R&D oriented. The fact that they not only sell the goods, like for example Colruyt, but also produce them might have something to do with that. Furthermore they have much lower profits, dividends, firm size and fixed assets on average, combined with high liquidity and solvability.

In addition, we examine the following industries, which are oriented towards firms with negative foreign exchange exposure coefficients: IT; professional, scientific and technical activities and in conclusion administrative and support service activities. The latter is represented by a single firm, namely Union Chimique Belge. A company that we already discussed earlier and appears to be a little out of place here, because it is the only large cap firm observed in these three industries. Since the other two industries consist out of six small firms and one medium sized one, we have in fact already written down our remarks about these two remaining industries in the previous chapter about firm size. The examples of RealDolmen and Option where given. To summarize, both industries have negative average profit as well as low dividends and fixed assets. The IT sector does seem to be a little less risk adverse with a mean liquidity ratio of 0,9 as opposed to 7,3 for the professional, scientific and technical sector. Some firms in both industries focus heavily on R&D, like option. Others not so much.

At first sight, the transportation and storage industry appears to be divided, however after taking a closer look at the industry we have our doubts about one of the companies with a negative exposure coefficient. Reibel is a company that takes care of specific assignments with regard to transportation problems. In other words, they themselves aren't actually involved in any transportation- or storage activities. That leaves the companies Euronav and fluxys. Financially

both companies are actually quite similar. Both have very large fixed assets of 1,5 billion and 2billion respectively. Euronav is a transporter of petroleum products and has a lot of freighters that could explain these large figures. Fluxys is an utility company responsible for the transport of natural gas in Belgium and probably owns a lot of valuable infrastructure like transportation tubes. Furthermore, they both have large average profits of around 60 million, and average liquidity of 1.2. Exactly because Fluxys it is a utility company and thus doesn't interact with countries outside of Belgium, let alone internationally, we don't value its negative exposure coefficient that much. What we actually try to say is that we see the transportation and storage industry as one with mainly positive exposure: Traditional companies with low R&D expenses and high profits / fixed assets.

That just leaves us the two most populated industries by our sample firms, manufacturing and financial services. Because of the large amount of firms with both kinds of exposure we might suspect them to be rather alike, but as a matter of fact these two industries are generally quite different from one another. For starters, the financial services industry has a very low average exposure of 0,08 with a standard deviation of merely 0,25. In contrast, the manufacturing industry has an average beta coefficient of 0,46 and a much larger standard deviation of 1,2. This could point to the use of hedging practices and a general risk evasive attitude in the financial industry. Further evidence is found in a much larger average liquidity ratio: 4,0 in comparison with 0,9. Several explanations might be feasible. For one, financial institutions are used to working with financial derivatives and have a deep knowledge of risk reduction practices. Secondly, our sample period contains the financial crisis of 2008. Financial institutions received criticism all over the world and were obliged to meet so called stress tests in the years that followed. In addition, the manufacturing industry contains aforementioned firm like Bekaert and Rossier. For these kind of firms, a great deal of their turnover is made up out of sales outside of the European Union. The idea that companies dealing the most with foreign currencies have the largest exposure to them sounds simple and does seem to apply here. Yet out of the 12 significant exposed firms in the manufacturing industry only one, Bekaert, is a large cap firm. While there is an almost even firm size distribution in the financial services industry. Last but not least, none of the 10 significantly exposed firms in the financial services industry has R&D expenditures. This is in large contrast with the manufacturing industry where 67% of the firms engage in research and development with an average expenditure of 32 million a year.

After painting a general picture of the two most important industries in our sample we also want to know what separates the positively exposed, from the negatively exposed firms. In the financial services industry, these two groups are mainly dissimilar through their respective size and liquidity. Negative foreign exchange rate coefficients are mainly observed in smaller firms with very high current ratio of 6,6 as opposed to a current ratio of 1,4 that the positive financial firms have on average. In the manufacturing industry the two differ mainly by R&D expenditures and the size of the exposure coefficient. The prevailing average foreign exchange rate coefficients are -0,12 and 1,29 with a standard deviation of 0,09 and 1,51 respectively. In addition, R&D expenditures average 47,5 million a year for negatively exposed firms in contrast with 10,9 million a year for the

others. We have seen by comparing firms out of this industry earlier that this can be explained by the more specialised, R&D intensive, nature of the activities of these usually smaller firms.

To summarize, we hypothesise that negatively exposed firms are mainly found in specialised, high technological or R&D intensive industries. If not they generally hold a more “niche” position inside the traditional industries. This generally goes hand in hand with a great risk aversion and hence smaller absolute exposure coefficients, probably due to financial hedging or the use of financial derivatives. In contrast we portrait positively exposed firms as being more active in the traditional industries with a lot of fixed assets, higher profits and dividends, while being less R&D intensive. To conclude, the highest absolute exposure to foreign exchange rate volatility is found in the manufacturing industry, probably because these firms are more involved with transactions in an international context. To support these findings we take a quick look at the ten most exposed firms. RealDolmen is the only firm in the top ten with a negative exposure coefficient of -0,477 in agreement with our hypothesis above. Furthermore, 50%, or five firms are active in the manufacturing industry and their average liquidity and solvability ratios show that they aren’t afraid to take on some form of risk. Finally, aside from the firm Bekaert, R&D expenses are rather limited. This does indeed all seem to be in agreement with our earlier findings, however to be sure we will empirically investigate several subsamples in order to try and find statistical significant determinants of exposure and in effect reject our accept the several hypotheses made here. To conclude a visual representation of the ten largest exposure coefficients is shown below (Figure 7).

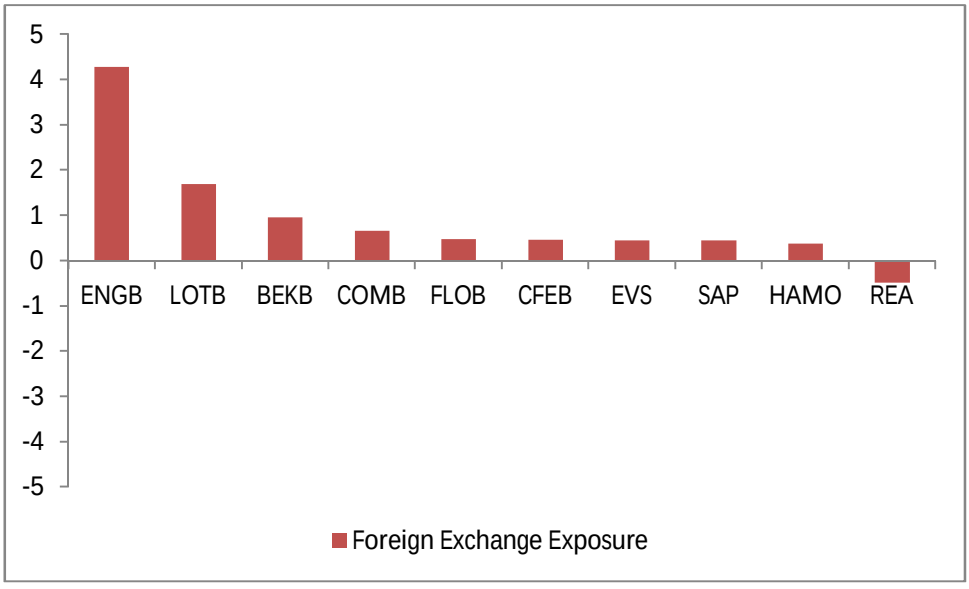

Figure 7: Bar chart of the ten firms with the largest absolute foreign exchange exposure coefficients

5 Determinants of Foreign Exchange Exposure

5.1 Methodology

In the previous chapters we have found a lot of indications of determinants that might have an influence on foreign exchange rate exposure. This was done by creating subsamples and comparing these subsamples with one another in order to spot differences among the firms in our sample. We mainly looked at average financial values, standard deviations and differences in the foreign exchange rate exposure itself. Like we mentioned, quite some determining variables where found, however none of these are statistically substantiated yet. Hence in this chapter, an empirical research will be conducted in order to proof or reject the hypothesis made about these firm-specific determinants of exposure. Not only a general model of these determinants will be provided, but also several models based on subsamples like we did before. This is made possible by the use of so called dummy variables, allowing us to conduct an OLS regression on a selection of observation of our dataset. We start by giving a description of the variables adopted in this study, as well as missing data that might be important. Next, the general model will be looked at, followed by an analysis of the several subsamples. Finally, we will be able to draw conclusions regarding the firm-specific determinants of foreign exchange exposure and hence assumptions made in the previous chapters might be accepted or rejected on the basis of this empirical investigation.

The first variable included in this study is LnSize. This is calculated by taking the natural logarithm of the market capitalisation. This natural logarithm is necessary in order to control for the large difference in values which can range from €440 to €34 million. We have found several indications that firm size might be positively related to exposure. These large firms appear to a tendency towards positive exposure, as well as larger exposure coefficients in general. In contrast a clear tendency of smaller firms towards negative, smaller exposure coefficients was observed, while mid cap firms are located somewhere in between these two. A similar analysis was made for the amount of fixed assets. For example, the transportation industry appeared to be very asset heavy with companies like EuroNav having positive exchange rate exposure. The variable used to measure the impact of fixed assets is LnFixedAssets. Again the natural logarithm of fixed assets has been used, because of values ranging from as low as €2 to a figure of €17,5 billion. The third variable included in the empirical research study is R&D expenditure. Rather than taking the natural logarithm of the R&D expenditures, we normalised them by dividing by fixed assets like Wei & Starks did before us (2013). On several occasions a link between R&D expenditures and foreign exchange rate exposure has been spotted. We hypothesise that firms with these high expenditures differ from others in their tendency to negative and generally smaller exposure coefficients. Of which an explanation can be found in risk reduction strategies regarding these often unpredictable “niche” sectors. Furthermore we also take a look at the market-to-book ratio. Researcher like He & Ng (1998) include this variable as a proxy for growth. This gives us the ability to make a judgement about high growth companies in for example the IT industry and the effect growth has on our beta coefficients. The fifth and sixth variables are the liquidity and solvability ratios, of which the liquidity ratio is the current ratio. These two variables will be able to tell us something about the effect of low- and high risk firms on foreign exchange rate exposure. The hypothesis

here is that risk reducing firms with a high liquidity and solvability have smaller exposure, because of the high probability of the utilisation of hedging instruments like the use of financial derivatives. The last variable included in this research is the Pay-out ratio. This ratio gives the amount of distributed dividends with respect to the yearly profits made. Hence it answers the question if turning out larger relative dividends have an effect on the foreign exchange rate exposure. Unfortunately, the variable which might explain the largest variation in the exposure coefficients, foreign sales, isn't part of this study. Like we have mentioned multiple times already, data regarding these figures does exists, but is highly confidential. This might be a valuable addition in later research if clearance to use these figures should be granted. In general we hypothesised that companies of which the turnover is made up of generally international sales, have much larger absolute coefficients than those firms who are mainly active on the European Market. The above variables result in the following formula, with Exp_i being the firm level exposure coefficient of firm i:

$$Exp_i = \alpha_i + \beta_i LnSize_{i,t} + \gamma_i LnFixedAssets_{i,t} + \delta_i R\&D_{i,t} + \theta_i MB_{i,t} + \mu_i Liquidity_{i,t} + \pi_i Solvability_{i,t} + \rho_i Payout_{i,t} + \varepsilon_{i,t} \quad (6)$$

Our dataset contains 666 observation. These consists of nine-year data for every 74 firms in our sample. The company Dexia Bank, isn't included because of its high inconsistent financial values that where observed previously. The exposure coefficients are the same during the nine year period, since we use firm level derived foreign exchange coefficients which have a higher statistical significance than annual coefficients. Firm-specific data on its turn is collected on an annual level. We conduct a general empirical investigation as well as a comparison of: statistically significant versus non significant exposure coefficients; positive versus negative exposure coefficients; large-, mid- and small cap firms; several industries. Empirical results of the general model, as well as the different subsamples are to be consulted in table 5 & 6 on the next two pages. In addition, as with the estimation of the foreign exchange rate coefficients, robust standard error are used.

	General b/t	Sign Coef b/t	Non Sign C~f b/t	Coef > 0 b/t	Coef < 0 b/t	Large Cap b/t
LnSize	0.052***	0.176***	0.003	0.018	-0.001	0.051
	(2.97)	(4.38)	(0.27)	(0.45)	(-0.12)	(1.34)
LnFixedAssets	-0.058**	-0.183***	-0.008	-0.063	-0.004	-0.155***
	(-2.55)	(-3.58)	(-0.81)	(-1.29)	(-0.70)	(-3.21)
R&D	-0.062***	-0.080***	-0.060***	-0.303***	-0.015***	8.953***
	(-4.14)	(-3.73)	(-3.54)	(-4.52)	(-4.78)	(2.76)
MB	-0.006**	-0.035**	-0.003**	-0.012***	-0.001	-0.025**
	(-2.51)	(-2.33)	(-2.43)	(-3.25)	(-0.87)	(-2.19)
Liquidity	-0.006***	-0.012***	-0.003	-0.011	0.002	-0.010
	(-3.11)	(-2.65)	(-1.09)	(-0.95)	(0.72)	(-0.97)
Solvability	-0.003***	-0.005***	-0.003***	-0.002**	-0.000	-0.004***
	(-4.52)	(-3.22)	(-4.25)	(-2.02)	(-1.45)	(-4.86)
Payout	0.002	-0.007	0.003	-0.008	-0.000	0.010
	(0.27)	(-0.44)	(0.68)	(-0.77)	(-0.09)	(1.18)
constant	0.706***	1.774***	0.285***	1.232***	-0.050	2.200***
	(3.03)	(3.36)	(2.64)	(2.61)	(-1.01)	(4.16)
R-sqr	0.043	0.086	0.070	0.050	0.033	0.289
N	666	369	297	297	369	216

* p<0.10, ** p<0.05, *** p<0.01

Table 5: OLS regression results of firm-specific foreign exchange rate exposure determinants. The leftmost column shows the results for the general model containing all sample observations, followed by results for the following subsamples: statistically significant exposure coefficients; non-significant exposure coefficients; positive exposure coefficients; negative exposure coefficients; large cap firms

	Mid Cap b/t	Small Cap b/t	Positive Ind b/t	Negative Ind b/t	Manufactur~d b/t	Financial ~d b/t
LnSize	-0.022	0.200***	0.065***	0.013	0.384***	-0.020
	(-1.08)	(2.95)	(3.37)	(1.19)	(4.79)	(-0.85)
LnFixedAssets	-0.022*	-0.057**	-0.041**	-0.007	-0.488***	0.009
	(-1.68)	(-2.22)	(-1.99)	(-1.11)	(-4.49)	(0.46)
R&D	-0.066*	-0.077***	-3.065**	-0.020***	-0.264***	0.000
	(-1.73)	(-3.03)	(-2.52)	(-3.33)	(-3.53)	(.)
MB	0.036***	-0.002	-0.006	0.003**	-0.166***	-0.007
	(5.20)	(-0.94)	(-0.71)	(2.37)	(-3.60)	(-1.26)
Liquidity	-0.005	-0.004	-0.008	0.000	-0.171***	0.001
	(-0.62)	(-1.65)	(-1.30)	(0.04)	(-4.46)	(0.32)
Solvability	-0.001	-0.004**	-0.001	-0.001	-0.008**	-0.006***
	(-0.65)	(-2.58)	(-0.74)	(-1.53)	(-2.53)	(-6.23)
Payout	0.002	-0.024	-0.009	0.003	-0.008	0.014
	(0.16)	(-0.78)	(-0.62)	(0.35)	(-0.76)	(1.60)
constant	0.370**	0.324*	0.325*	-0.064	5.039***	0.457***
	(2.01)	(1.72)	(1.66)	(-1.51)	(4.44)	(3.34)
R-sqr	0.130	0.068	0.201	0.112	0.211	0.218
N	216	234	144	162	207	144

* p<0.10, ** p<0.05, *** p<0.01

Table 6: Second part of OLS regression results of firm-specific foreign exchange rate exposure determinants. From left to right, results for the following subsamples are given: mid cap firms; small cap firms; firms active in industries with a preference for positive exposure coefficients; firms active in industries with a preference for negative exposure coefficients; the manufacturing industry; the financial services industry

5.2 General Results

Results of the general model are shown in the leftmost column of table 5. The model has an R^2 of 0,043. In other words, our model is able to explain 4,6% of the variation in the exposure coefficients. This low value may be explained by the lack of for instance export and import data. However, it is crucial not to put too much value on this statistic alone. Reason for this is the high significance of the variables that do make up our model. Four out of the seven variables are statistically significant at the 1% level, two at the 5% level and one, Pay-out, doesn't seem to explain any significant variation in the foreign exchange rate exposure coefficients.

Since we have established that most of our variables do indeed explain a significant portion of the variation in the exposure coefficients, we are now mostly interested in what kind of impact these variables are having. As expected, an increase in firm size does have a positive effect on exposure of 0,052. So a rise in the variable LnSize of 1 unit, results in an increase in the exposure coefficient of 0,052 units. Furthermore this finding is statistically significant at the 1% level. Secondly we take a look at fixed assets. According to our hypothesis, we would expect a positive relationship between an increase in fixed assets and exposure, however this doesn't seem to be the case. Instead a rise in LnFixedAssets of 1 unit results in a decrease of the beta coefficients of 0,058 units. The impact thereof is even larger than we have observed for firm size and is statically significant at the 5% level. Next, we observe an inverse relationship between R&D expenditure and exposure coefficients of 0,062 significant at the 1% level. This is in agreement with our assumption about highly specialised firms being more negatively exposed in general. About the market-to-book ratio we haven't really made any assumptions yet, so it gives us more of an observation. MB does appear to have a significant negative influence on the rate of exposure, although very small. A rise in the market-to-book ratio only seems to have an effect of 0,006 units in exposure. In other words, high growth firms have smaller exposure coefficients in general, but the impact is very small. In addition, both Liquidity and Solvability are statistically significant at the 1% level and negative. This agrees with our line of reasoning that more risk-adverse firms generally have lower exposure. The effects of an increase in liquidity and solvability are -0,006 and -0,003 respectively. Finally, no significant impact of higher dividends with respect to earnings (Pay-out ratio) is observed.

In summary, based on the results of our general model we accept the following hypotheses: an increase in firm size has a positive influence on exposure, while higher relative R&D expenditures, a higher liquidity and higher solvability all negatively impact the foreign exchange rate exposure coefficients. Furthermore a negative relationship between the market-to-book ratio, a proxy for growth, is also observed. We do not find a statistically significant relationship between foreign exchange rate exposure and higher dividend with respect to earnings. In the final chapter of this study, a comparison between several subsamples will take place.

5.3 Comparison of Subsamples

First off, we compare a subsample of 41 firms with statistically significant exposure coefficients with respect to the other 33 firms without this significance at the 10% level. Not surprisingly, the main difference among these two subsamples lies in the statistical significance of the firm-specific variables. Like the general model, the variables in the first subsample (column 2, table 5) are all statistically significant apart from the pay-out ratio. In contrast, we only observe 3 variables with this significance in column 3 of table 5, namely R&D, market-to-book ratio and solvability. However, both models do seem to explain more of the variation in the exposure coefficients. This is shown by the R^2 values of 0,086 and 0,070 as opposed to the 0,043 for the general model. The relationship between the several variables and the direction of their impact on foreign exchange rate exposure do stay the same as observed before. Yet, Higher absolute values are noticeable for the model with statistically significant coefficients.

When comparing the subsample of 33 firms with positive exposure coefficients (column 4, table 5) with the subsample containing firms having negative exposure coefficients (column 5, table 5), we observe a lot less statistical significance across the board. Explaining variables for the former are R&D, market-to-book and solvability. For the latter only R&D seems to be having a significant influence on foreign exchange rate exposure. What we take away from these results is mainly the size of the impact caused by R&D expenditures. The negative effect they have on firms with positive exposure coefficients is 20 times as great as the effect observed in the second subsample. The reason for this might be that most firms in the second subsample invest in R&D, while for positive exposed firms a lot less effort is being put into new research. Also, the market-to-book appears to be more important than we would have initially thought, because of its persistent statistical significance over other variables like for example firm size and liquidity.

Things get really interesting when comparing the subsamples of different firm sizes. Results for the subsample of 24 large cap firms are to be found in the rightmost column of table 5, while the first two columns of table 6 show the impact of our variables on 24 mid cap and 26 small cap firms respectively. The comparison by means of firm size is interesting because of the differences among the results of the three subsamples, which can be rather large. For instance, the firm-specific variables appear to explain a great deal of variation in the exposure coefficients when only considering large firms, but this value drops vigorously with declining firms size samples. This is shown by a R^2 value of 0,289 (28,9% of variance explained) for the subsample of large firms, which drops to 0,130 (13%) for medium sized companies and even to as low as 0,068 (6,8%) for the subsample containing only smaller firms. Not only do the firm-specific variables appear to explain more of the variation the foreign exchange rate coefficients when only considering large companies, some of them are also having a larger absolute impact. Take for example LnFixedAssets, a statistically significant variable negatively affecting exposure for all three subsamples to some degree. The effect of one unit increase in this variable decreases exposure by about -0,022 units for medium sized firms and -0,057 for small firms. However, for large firms the effect is approximately three times as great with a value of -0,155. The most interesting results might be those of the normalised R&D expenditures and the market-to-book ratio. Regarding the market-to-book ratio, a proxy for growth, values of -0,025 for large cap firms and 0,036 for mid

cap firms are observed, while the coefficients of small firms doesn't meet our requirement for statistical significance. Hence, companies that experience higher growth are prone to reducing their risk when they are large in size, while medium sized companies notice an increase in their exposure to currency fluctuations instead. We think of this as a rather rational outcome. Medium sized firms are given the chance to grow without putting too much restriction on it by reducing risk, while large companies traded on the main index are more careful to not let the share price balloon too much in favour of risky behaviour. In addition, R&D expenditure seems to be the one variable that is having a consistent significant impact on foreign exchange rate exposure. Values for small and medium sized firms are consistent with previous observations with values of -0,077 and -0,066 respectively. However, a rather peculiar value of 8,953 , statistically significant at the 1% level, is observed for large cap firms. Our reasoning here lays in the fact that we normalize R&D expenditures by dividing them by fixed assets. Small and medium sized companies are generally focussed more on high technological activities requiring a lot of R&D expenditure. Hence, the value of their R&D expenses are very high with respect to fixed assets. In contrast, we see large firms as being much more heavy asset focussed in general. A lot of these firms don't invest in R&D and if they do, the expenses are rather small in comparison with fixed assets. Examples of large firms who do have sizeable R&D expenditures are Bekaert, the known manufacturer of steel wires and CFE, a dredging company. Both of them have rather large positive foreign exchange rate exposure coefficients, thus explaining the positive value for R&D expenditures of 8,953 . Finally, the solvability ratio is statistically significant for large and small firms with a value of -0,004 for both subsamples. So risk adverse companies have lower exposure coefficients across the board, which is to be expected.

In conclusion we cast a glance at differences that might exists between industries. The industries given in column 3 of table 6 are those of the mainly positive exposure focused industries such as: construction; wholesale & retail trade; transportation & storage and real estate. Those in column 4 of table 6 are mainly represented by negatively exposed firms as there are: IT & communication; Professional, scientific & technical activities and Administrative & support service activities. The two rightmost columns of table 6 show the results of the two largest industries that are represented by both kind of firms, namely the manufacturing industry and the financial services industry. A lack of statistically significant results, as well as small coefficient values are noticeable for both the financial services industry as the industries with a preference for negatively exposed firms. The outcome for the latter one falls in line with our findings regarding negatively exposed firms found in column 5 of table 5. As for the financial services industry this lack of statistically significant results enhances our vision about the industry being one of high risk evasion (high liquidity, solvability and probably hedging) and in effect would explain these poor results. With regards to the industries with a tendency towards positive foreign exchange rate coefficients, three variables having a significant impact on exposure are found: LnSize, LnFixedAssets and R&D expenditures. We attribute this small increase in statistical significance to higher average value of the exposure coefficients for positively exposed firms, in conjuncture with the results found in column 4 of table 5. Special attention should be given when examining the results of the manufacturing industry. In our opinion, the results found in the general model are mainly driven by firms in this industry. This is in agreement with the research of He & Ng (1998). Apart from the pay-out ratio, all variables are

statistically significant at least at the 5% level and most at the 1% level. The direction in which these firm-specific variables are having an influence are the same as those for the general model. Furthermore, applied on this subsample, the model is able to explain 21,1% of the variance in the foreign exchange rate exposure coefficients. We strongly believe that these beneficial results are due to the amount of international trade in which these sample firms engage. In contrast with other industries that are mainly focussed on the European market, firms like Agfa-Gevaert, specialised in imaging systems, and Campine, a chemical concern, sell their products all over the world and hence are way more involved with foreign exchange rates and exposure in general. This also enhances our believes of foreign sales (outside of the EU area), being the main determinant of foreign exchange rate exposure.

6 Conclusion

In this master thesis, we examine the effects of changes in foreign exchange rates on the Belgian market and with a special focus on Belgian firms in particular. This has been established by an empirical analysis of foreign exchange exposure on country, annual and firm level. In addition, a second empirical research study has been conducted in order to be able to identify firm-specific variables that might be able to explain the firm level variation in the aforementioned foreign exchange exposure.

During our sample period, which runs from January 2006 to December 2014, a tendency towards negative exposure has been found for the Belgian market in general. Hence, we hypothesise that an appreciation of the euro, with respect to the other main currencies, has an overall negative effect on the Belgian economy. However, it is important to note that this relation doesn't always hold during smaller time intervals. We observed a direct relationship between currency swings and exposure during the years 2008 and 2011. Although, it must be said that these discrepancies are probably due to major economic events in the European Union where a depreciation of the euro wasn't the main driver of loss in economic value.

The main subject of this master thesis however, deals with the foreign exchange exposure of the various Belgian firms in our sample. We expressed a preference for standard firm level exposure coefficients over averaged firm level coefficients, because of their superior statistical significance. With respect to this statistical significance, indications of a lack thereof have generally been found for firms with no sales outside of the EU area. In addition. more firms with negative exchange exposure are observed. However the absolute value of these exposure coefficients are on average a lot smaller than those of the positively exposed firms.

With regards to the firm-specific variables that are able to explain some of the variation in foreign exchange exposure, we were able to find proof for the following relationships. R&D expenditures, as well as the market-to-book ratio, fixed assets, liquidity and solvability all seemed to have a negative impact on foreign exchange exposure, with R&D expenditures being the most persistent throughout the various subsamples. Only one significant variable having a positive impact on the exposure of Belgian firms has been found, namely firm size. Yet, we did find indications that also the variable foreign sales might be positively related with foreign exchange exposure.

The above assumptions in conjuncture with an in-depth analysis of our sample firms give us reason to believe that positive foreign exchange exposure is generally found at the more traditional, highly capitalised firms that are able to take on some form of risk. In contrast, we observe negative and much more modest exposures at smaller, highly specialised companies with a lot of focus on R&D expenditures and risk-limiting behaviour. In addition, most explanatory value with regards to foreign exchange exposure can be found in the manufacturing industry. We hypothesise this is the case because these companies are more likely to conduct business on a global scale and are thus more exposed to foreign currencies.

Finally, we definitely see room for further improvement on this subject. Especially the incorporation of import and export data would create significant value in the analysis of the foreign exchange exposure of Belgian firms. Furthermore, we believe that part of the high statistical significance achieved is due to the implementation of market dummy variables in order to calculate the market variable, which is used to control for macro-economic effects.

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Appendices

A Firm Level Exposure Coefficients

Ticker	PanelID	Beta	P>|t|
ACCB	1	-0,011	0,00
ACKB	2	0,184	0,16
AGFB	3	-0,145	0,00
ATEB	4	0,296	0,00
BAR	5	-0,332	0,00
BEKB	6	0,954	0,01
BELR	7	-0,031	0,53
BELU	8	-0,044	0,00
CAMB	9	-0,082	0,08
CFEB	10	0,466	0,00
COMB	11	0,667	0,00
COBH	12	-0,302	0,84
COLR	13	0,133	0,01
CONN	14	0,020	0,15
DIE	15	-0,041	0,64
DECB	16	-0,111	0,00
DELB	17	0,227	0,00
DEXB	18	-0,189	0,00
EZBG	19	-0,081	0,00
ECONB	20	0,020	0,18
ELI	21	-0,022	0,57
EURN	22	0,234	0,00
EVS	23	0,455	0,00
EXM	24	-0,063	0,01
FLOB	25	0,472	0,03
FLUX	26	-0,087	0,06
FOU	27	-0,076	0,00
GBLB	28	0,064	0,14
GRYFO	29	0,148	0,00
HAMO	30	0,386	0,00
IBAB	31	0,042	0,11
IEP	32	-0,369	0,00
IMMO	33	-0,013	0,77
JEN	34	0,014	0,48
KBC	35	0,097	0,09
KBCA	36	-0,063	0,25
KEYW	37	-0,164	0,00
KIN	38	-0,022	0,73
LOTB	39	1,701	0,29
MELE	40	0,013	0,83
MIKO	41	0,009	0,72
MOBB	42	-0,025	0,75
MOUR	43	-0,377	0,00
NEWT	44	-0,021	0,34
OPTI	45	-0,306	0,00
PCBB	46	-0,075	0,00
PIC	47	-0,060	0,27
PROX	48	0,069	0,17
REA	49	-0,477	0,00
REC	50	0,003	0,53
REI	51	-0,145	0,00
RES	52	0,332	0,02
ENGB	53	4,283	0,00
ROU	54	-0,350	0,00
SAB	55	-0,031	0,49
SAP	56	0,452	0,00
SIOE	57	0,009	0,55
SMAR	58	-0,002	0,57
SOF	59	0,164	0,01
SOFT	60	-0,010	0,25
SOLV	61	-0,183	0,14
SOLB	62	0,027	0,86
SPA	63	-0,065	0,32
SUCR	64	0,055	0,17
TNET	65	-0,104	0,22
TERB	66	-0,058	0,07
TESB	67	0,019	0,53
TEXF	68	0,138	0,02
THI	69	0,042	0,00
TUB	70	-0,212	0,00
UCB	71	-0,203	0,02
UMI	72	-0,005	0,94
VAN	73	-0,034	0,25
ZENT	74	-0,045	0,00
ZTS	75	-0,062	0,01

B Annually Averaged Firm Level Exposure Coefficients

Ticker	PanelID	Beta
ACCB	1	-0,003
ACKB	2	0,109
AGFB	3	-0,015
ATEB	4	0,028
BAR	5	-0,355
BEKB	6	0,011
BELR	7	-0,208
BELU	8	-0,050
CAMB	9	-0,168
CFEB	10	0,030
COMB	11	0,531
COBH	12	-3,618
COLR	13	-0,106
CONN	14	-0,005
DIE	15	-0,041
DECB	16	-0,006
DELB	17	-0,097
DEXB	18	-0,051
EZBG	19	-0,063
ECONB	20	-0,003
ELI	21	-0,043
EURN	22	0,011
EVS	23	0,073
EXM	24	0,044
FLOB	25	0,093

Ticker	PanelID	Beta
FLUX	26	-0,098
FOU	27	-0,035
GBLB	28	0,086
GRYFO	29	-0,047
HAMO	30	0,103
IBAB	31	0,087
IEP	32	-0,007
IMMO	33	-0,078
JEN	34	-0,003
KBC	35	0,192
KBCA	36	0,154
KEYW	37	-0,077
KIN	38	-0,139
LOTB	39	-1,493
MELE	40	-0,030
MIKO	41	0,045
MOBB	42	-0,017
MOUR	43	0,134
NEWT	44	0,036
OPTI	45	-0,034
PCBB	46	-0,008
PIC	47	-0,029
PROX	48	-0,009
REA	49	-0,258
REC	50	0,006

Ticker	PanelID	Beta
REI	51	0,030
RES	52	0,318
ENGB	53	1,781
ROU	54	-0,178
SAB	55	-0,182
SAP	56	0,113
SIOE	57	-0,017
SMAR	58	-0,001
SOF	59	-0,031
SOFT	60	-0,011
SOLV	61	0,170
SOLB	62	0,199
SPA	63	-0,025
SUCR	64	0,033
TNET	65	-0,175
TERB	66	-0,068
TESB	67	0,096
TEXF	68	-0,081
THI	69	-0,014
TUB	70	-0,207
UCB	71	-0,231
UMI	72	-0,014
VAN	73	-0,023
ZENT	74	-0,001
ZTS	75	0,063

C Paired Sample T-test: Firm Level Exposure Coefficients

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Beta Yearly Average	-,051710729362963	75	,512738381921278	,059205928565221
	Beta firm	,094602841	75	,5766483050	,0665856108

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Beta Yearly Average & Beta firm	75	,348	,002

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Beta Yearly Average - Beta firm	-,146313570696296	,624146340900759	,072070211586555	-,289916601989371	-,002710539403222	-2,030	74	,046

D NACE-Code: Industries

NACE-Code	Sections
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage; waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	Activities of extraterritorial organisations and bodies

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