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Abstract

Unanticipated exchange rate movements are a fundamental feature of the international economic environment, particularly in the case of floating rates. The exchange rate fluctuations are considered to have a significant impact on the value of both domestic and internationally orientated companies. More, significant empirical evidence of affected firm's values due to movements in exchange rates comes as a confirmation of the sensitivity of the firm's value to exchange rate volatility. Assessing the companies' sensitivity to exchange rate changes has been one of the most challenging issues in international financial management over the last two decades. However, apparently there is neither a real consensus concerning the most relevant parameters that influence currency risk exposure nor real hope to discover a unique model that would integrate the complexity of the effects of exchange rate shocks on firm value. Therefore, the objective of this thesis is to perform an analysis of exchange rate exposure of companies and industries of the Euro Area. In the first part of our analysis we want to estimate company-specific exchange rate exposures. The second part aims to investigate the extent to which different company-, industry- and country-level variables influence the exchange rate exposure. Our findings from the first-stage regression reveal a low level of significant exposure. The outcome of the second-stage regression is consistent with the theoretical background as the coefficient signs match our initial assumptions, although only two variables are statistically significant (the significant variables are proxies for industry competitiveness and domestic market economic background).

Exchange rate exposure of the Euro Area

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Key words	Exchange Rate, Exposure, Time Series Regression, Cross Sectional Regression
Purpose	The aim of this paper is to perform an analysis of exchange rate exposure of companies and industries of the Euro Area. In the first part of our analysis we want to estimate company-specific exchange rate exposures. The second part aims to investigate the extent to which different company-, industry- and country-level variables influence the exchange rate exposure.
Methodology	We have conducted an analysis by running a time-series regression with two independent variables and a cross-sectional regression with various determinants of exchange rate exposure.
Theoretical Perspectives	The theoretical perspective in this thesis is based on theoretical foundations of exchange rate exposure.
Empirical Findings	The empirical findings and the conclusions that have emerged in this research area result from a time-series regression and a cross-sectional regression
Conclusions	Our first-stage regression shows a low level of statistically significant exchange rate exposures. The second-stage analysis indicates that only the regression which uses the exposure to the trade-weighted exchange rate index is statistically significant. As all the regression coefficients have the expected signs our chosen variables were consistent with the theoretical background, although only two variables are statistically significant (one stands for industry competitiveness, the other quantifies national economic status).

Table of Contents

1. Introduction

This introductory chapter presents the choice and the motives behind the research topic of this paper. Further on the purpose of the thesis is addressed. This section ends with delimitations of the previous issues mentioned and the presentation of the thesis outline

1.1 Background

Economic activities and financial processes, especially those referring to the foreign trade, are constantly subject to risks, hazard and chance. This matter of fact comes as a confirmation of Niccolò Machiavelli's famous statement in his masterpiece work, The Prince (1513): *"Fortune (or hazard in this particular case) is the arbiter of one-half of our actions, but that she still leaves us to direct the other half, or perhaps a little less"*[1]. Indeed, the risks are strongly anchored in the modern economic life, with numerous, unknown, underlying features that have a powerful impact on the business environment as a whole and on individual industries in particular. Therefore, as industries undergo structural changes, any activity implies certain risks.

From theoretical perspective, there is a common belief that exchange rate fluctuations are an important source of macroeconomic uncertainty. According to Oxelheim (1984), the value of the firm is affected by changes in interest rates, inflation rates and exchange rates from a macro perspective, but also by changes in prices and volumes at the company level. All these five variables are considered sources of unfavorable changes in the company's future economic value, sources that can affect actions taken by (risk-averse) decision-makers within such firms.

[1] http://machiavelli.thefreelibrary.com/Prince/26-1

Unanticipated exchange rate movements are a fundamental feature of the international economic environment, particularly in the case of floating rates. Such a notion of exposure to exchange rate movements (also called "exchange rate risk") has been the underlying reason of numerous papers that have focused on topics such as: the effect on trade flows of increased exchange rate volatility, the invoicing and hedging practices of firms, the welfare effects of fixed versus flexible exchange rates, the pricing of internationally traded securities, etc. (Hodder (1982)). Moreover, the exchange rate fluctuations are considered to have a significant impact on the value of both domestic and internationally orientated companies (Shapiro (1984), Hodder (1982), Marston (2001)).

It is widely believed that exchange rates have been increasingly affecting the value of the firms during the latest years. While some authors consider that all foreign asset or liability positions are completely exposed, others, like Grauer, Litzenherger and Stehle (1976), state that in the absence of market imperfections, there is no real exposure and that exchange risk is nothing more than *"money illusion"*. Assessing the sensitivity of firm value to exchange rate changes has been one of the most challenging issues in international financial management over the last two decades, even if apparently there is neither a real consensus concerning the most relevant parameters that influence currency risk exposure nor real hope to discover a unique model that would integrate the complexity of the effects of exchange rate shocks on firm value (Muller (2006)).

Jorion (1990), after assessing the annualized volatility of the US dollar/German mark exchange rate over the period 1971-1987, concluded that exchange rates are a major source of uncertainty for multinationals, being typically four times as volatile as interest rates and ten times as volatile as inflation.

1.2 Problem Discussion

Foreign exchange rate changes represent an important source of risk for non-financial corporations. Since the breakdown of the Bretton Woods fixed-parity system in the 1970s, the international economic environment has been characterized by substantial exchange rate

volatility. This led to spectacular losses or even bankruptcies over the last decade, determined by unprofessional management of this kind of risk (Bartram et al. (2005)). The lack of knowledge to control the vulnerability of multinational firms to foreign exchange risk has spawned a considerable amount of research as regards currency risk exposure and estimation models. Starting with the work of Adler and Dumas (1984), that defined the exposure as the sensitivity or correlation of the value of an asset or liability to a change in real exchange rates, and Jorion's (1990) proof of cross-sectional and time variation in exchange rate exposure for 287 U.S. multinationals, subsequent papers studied the impact of different variable definitions, estimation models and various interrelations between exchange rate exposures and economic competitive environments. In contrast to theoretical models, empirical research on exchange risk exposure proved to be mixed and conflicting, with authors debating over the existence of significant exposure of firms to exchange rate risks. As a matter of fact, although numerous studies have investigated the impact of exchange rate risk on the stock returns of non-financial firms, the general conclusion is that there is little evidence of significant exchange rate exposure. Thus, on grounds of previous insignificant empirical evidence, conducting a study with the purpose of obtaining relevant and valid results becomes an even more challenging task.

There are two different approaches to capture exchange rate exposure: the capital market and the cash flow framework. These methods address different questions and are useful for different applications. The **capital market approach** is directed toward understanding the overall impact of exchange rate risk on the value of the firm, making this method relevant for people with a primary interest in maximization of the firm value. The advantage of the capital market model lies in its flexibility and usefulness for creating expectations and future scenarios.

The other approach is the **cash flow framework.** This approach can have implications for assessing the value of the firm due to its advantage of being a more appropriate tool to measure transaction and economic exposures. Yet, as Bodnar and Wong (2003) remark, the unavailability of suitable cash flow data makes the analysis of cash flow exposures generally impossible, and, as a consequence, the majority of foreign exchange rate

exposures studies typically use stock returns to proxy for changes in cash flows. Hence, due to the availability of data consisting of public information of listed companies and its relevancy for targeted audience and further research, we decided to use the capital market approach for our research purpose.

Different industries face different risks and opportunities. We use in this study Ganguin's (2005) classification of industries according to their exposure to economic changes as follows: industries highly affected by economic changes, industries moderately affected by economic changes and industries slightly affected by economic changes. Although each category consists of various components, we only focus on a limited number of industries in order to have a reliable and valid sample of companies for the regressions performed. The industries we use in our study are:

- Basic Materials, Oil & Gas and Retail for **highly** affected industries
- Industrial Engineering, Technologies, Telecommunications, Broadcasting & Entertainment for **moderately** affected industries
- Utilities, Healthcare & Pharmaceuticals, Personal Goods & Households Products for **slightly** affected industries

The effect of exchange rate risk has been shown to depend on a variety of firm characteristics like a firm's or an industry's dependence on net foreign revenues, the competitive nature of an industry, the location and flexibility of production, risk management practices, the degree of exchange rate pass-through or changing competitive structures. A common conclusion regarding the degree of importance of various determinants hasn't been reached yet. Accordingly, we use in our thesis only those ones that along previous undertaken studies have shown the most significant degree of impact on firm value. Another criterion of choice will be the availability of input data.

The macroeconomic setting is known to have a relevant influence on exchange rate exposure. Moreover, the creation of the Euro is also assumed to be the most modern and largest-scale case study of the engineering of an optimum currency area.

The above mentioned facts determined us to try to empirically assess whether our sample of firms traded in Euro as single currency meets the theoretical assumptions and aims of European Monetary Union. In addition to this, to our knowledge, no study that has been conducted so far with the purpose of assessing the exchange rate sensitivity of Euro Area companies.

Therefore, we believe that such as study would contribute to this field of research and would provide further inspiration for any involved audience.

1.3 Purpose

The aim of this paper is to perform an analysis of exchange rate exposure of companies and industries of the Euro Area. In the first part of our analysis we want to estimate company-specific exchange rate exposures. The second part aims to investigate the extent to which different company-, industry- and country-level variables influence the exchange rate exposure.

1.4 Delimitations

In this paper we want to see, according to previous empirical studies in this research area, the impact of exchange rate movements on our sample of companies and assess the correlation of various determinants with exchange rate exposure. There are many factors that affect a firm's sensitivity like a firm's or an industry's dependence on net foreign revenues, the competitiveness of an industry, the location and flexibility of production, risk management practices, the degree of exchange rate pass-through or changing competitive structures. As the interdependence and complexity of these determinants are normally difficult to assess, we were compelled to limit our research to just some of the factors previously used in other related empirical studies.

1.5 Thesis outline

Chapter 1 offers the reader an insight into nowadays exposure of economic activities and financial processes to exchange rate movements. Since the basic underlying assumption of this study is that unanticipated exchange rate movements are an important source of economic uncertainty, the first chapter presents the choice and the motives behind the research topic of this paper, the purpose of our work and also its limitation. Chapter 2 gives an overview of the theoretical foundations of exchange rate exposure, the empirical findings and the conclusions that have emerged in this research area. In the third chapter data collection and methodological methods are discussed. A presentation of the empirical findings and a comprehensive analysis of the performed regressions can be found in Chapter 4. Chapter 5 offers the conclusions of our work and also gives some suggestions for further research. The last chapter provides the reference used in this paper.

1.6 Target Audience

Our work aims to be of interest for researchers and academics in the field of corporate finance, the management of companies, practitioners in the financial community, governments and all others that wish to develop further knowledge in macroeconomic exposure research area.

2. Literature review

This section surveys the extensive literature on exchange risk exposure, comprising of the theoretical foundations of exchange rate exposure, the empirical findings and the conclusions that have emerged in this research area, in a comprehensive review that synthesizes the recent work within common frameworks.

2.1 Conceptual Issue of Exchange Rate Exposure

Defined by Adler and Dumas (1984) as the change in the market value of the firm resulting from a unit change in the exchange rate, the concept of foreign exchange rate exposure describes the impact of foreign exchange rate changes on corporations. Bodnar et al. (2005) argue that foreign exchange rate risk exists because international parity conditions such as Purchasing Power Parity (PPP)[2] and the International Fisher Effect (IFE)[3] hold at best in the long run and have no immediate adjustments among exchange rates, interest rates and prices for goods and services. The volatility that appears in the international economic environment as a consequence of deviations from PPP impacts both nominal and real exchange rates. The deviations from PPP triggered by real exchange rate changes are deemed to have a direct effect on firm value for multinational firms and global competitors (Williamson (2001)). These deviations in exchange rates from PPP were found to have an average of four or five years (Froot and Rogoff (1995)), and consequently led to large movements in price markups and profit margins (Froot and Klemperer, (1989)). These factors should imply that exchange rate movements have a measurable effect on firm value. Yet, the lack of significant proof of exchange rate impact on firm value and the failure of previous tests to capture the effects that the deviations from PPP have on firm value leads

[2] An economic theory that estimates the amount of adjustment needed on the exchange rate between countries in order for the exchange to be equivalent to each currency's purchasing power. (http://www.investopedia.com/terms/p/ppp.asp)

[3] An economic theory that states that an expected change in the current exchange rate between any two currencies is approximately equivalent to the difference between the two countries' nominal interest rates for that time. (http://www.investopedia.com/terms/i/ife.asp)

the same author to question whether deviations from PPP are unimportant for global competitors.

Several papers have emphasized the need to consider the exchange rate's correlation with other variables when defining the exchange rate risk and also the theoretical and practical drawbacks surrounding a partial foreign exchange risk analysis. Oxelheim (1986) asserts that a certain disturbance at a macroeconomic level might express itself in the following variables: the exchange rate, interest rate, relative prices and/or exchange and credit controls. Moreover, a threatening devaluation is very likely to be compensated by central banks with an increase in interest rates, which leads the author to the conclusion that uncertainty about exchange rate changes may not be independent of uncertainty about interest rates. Exchange rate variation is also connected to exposure, inflation and relative price changes.

2.2 Traditional Approaches to Measuring Foreign Exchange Exposure

There are many analytical ways of describing the impact of currency fluctuations on firm value. To begin with, the sensitivity of firm value to currency movements is mainly defined with regard to an explicit time period. Stulz and Williamson (2000) decomposed the overall impact of exchange rate movements on firm value, distinguishing between transaction (contractual) exposure, translation exposure and competitive exposure. Oxelheim (1984) defines **translation exposure** as a measurement of the implications of exchange rate movements for the book value rather than the economic value of the company. As for **transaction exposure**, he presents it as a method to assess the impact of exchange rate movements and their effect on the cash flow during a limited period. Unlike transaction exposure, **economic exposure** (also called *operating exposure*) measures any change in the present value of a firm resulting from changes in future operating cash flows caused by any unexpected change in exchange rates (Eiteman (2006)). Economic exposure analysis assesses the impact of changing exchange rates on the firm's future operations and its competitive position in the market with the purpose of enhancing the firm's value in times of exposure to exchange rate movements. While exchange rate movements affect

contractually fixed transactions directly, there are additional effects on future cash flows related to the competitive position of the firm, which can manifest themselves in price as well as quantity effects (Bartram et al. (2005)). The main problem with assessing exchange rate exposure over longer time horizons, as argued by Muller and Verschoor (2005), lies in the fact that while direct exposures (transaction, contractual and translation) can be effectively managed by well structured hedging strategies, economic or competitive exposures are more difficult to be correctly estimated and hence more difficult to efficiently hedge.

2.3 Empirical Evidence on Firm Exchange Rate Exposure

The early research on foreign exchange rate exposure goes back to Jorion's (1990) finding that out of a sample of 287 US multinationals, only 15 had a statistically significant foreign exchange exposure. Bodnar and Gentry (1993) used U.S., Japanese, and Canadian industry sectors to assess the impact of exchange rate exposure and found that this type of exposure is significant for some industries. Apart from individual exchange rate exposure, they also discovered significant dispersion in exchange rate exposure across industries. Bartov and Bodnar (1994) assessed a sample of exporting firms in periods of large foreign currency adjustments in order to address the problem of weakly significant evidence of a contemporaneous exchange rate effect. Using the lagged return response to quarterly exchange rate changes, they showed proof of a stronger exchange rate effect than the one shown in previous studies. The same authors, Bartov et al. (1996), examined the relation between exchange rate variability and stock return volatility for U.S. multinational firms during two five-year periods around 1973 and found a significant corresponding increase in the volatility of monthly stock returns during the specific period of amplified exchange rate variability. Choi and Prasad (1995) revealed that 15% of 409 US multinational firms present significant exchange risk sensitivity and also that exchange rate fluctuations affect firm value. He and Ng (1998) evaluated the exchange rate exposure of a sample of 171 Japanese companies from 1979 to 1993, showing significant positive exposure in 25% of the assessed firms. Their work is consistent to Dominguez and Tesar (2001) paper. These authors revealed that exchange rate movements do matter for a significant fraction of firms

from eight non-U.S. countries, including Japan. Allayannis and Ihrig (2001) assessed different industry sectors in the United States and found in 22.2% of them significant foreign exchange rate exposure, while Bartram and Karolyi (2003) found 9.9% of 701 multinational firms from 20 countries in their study to be affected by exchange rate risk. The work of Doidge, Griffin and Williamson (2002) brought strong empirical arguments that exchange rate movements can have an economically significant impact on firm value and that exchange rates play an economically and sizable role in explaining stock returns. Lastly, De Jong (2006) has found a surprisingly high significance level (50%) for the assessed Dutch companies' exposure and further presented in a detailed manner the reasons behind the firm's generally low significant exposure.

Yet, not all the authors agree that firm value is influenced by exchange rate fluctuations. Amihud (1994) found no significant exchange rate exposure for his sample of 32 large U.S. exporters, from 1979 to 1988. Khoo (1994), using stock market data for mining firms in Australia, discovered that the proportion of stock returns explained by exchange rate movements is small. Later on, Griffin and Stulz (2001), utilizing a dataset of industry indices from the United States, Canada, United Kingdom, France, Germany, and Japan from 1975 to 1997, revealed that the average impact of U.S. industries' shocks to their foreign counterparts is of little economic importance. Similarly, Di Iorio and Faff (2000) discovered minimal evidence of significant exposure in a study of the Australian equity market.

Overall, the average exposure shown by firms to exchange rate movements appears to be in percentage of 10–25% for all firms, regardless of the study characteristics. The reason for such a small value is considered to be the use of financial and operative hedging at the firm level, operation that reduces exposure and hinders an appropriate evaluation of the impact of exchange rate volatility at the firm or industry level.

2.4 Determinants of Exchange Rate Exposure

Along time, many authors have argued the existence of different determinants when examining the firm's exposure to exchange rate movements. As such, Shapiro (1975) argued that the firm's exposure should be related to the proportion of export sales, the level of foreign competition, and the degree of substitutability between local and imported factors of production. Jorion (1990) found evidence of significant exchange rate exposure, showing that the level of foreign sales is the main determinant of exchange rate exposure for his sample of 287 U.S. multinational firms. Marston (2001) also reached the conclusion that net foreign revenues are the main component of a firm's exchange rate exposure. This result is supported by Levi (1994), which showed that the main impact on the value of a multinational firm is the profitability of sales in a foreign country. Chow et al. (1997) discovered that the cross-sectional differences in the magnitude of exposure of industrial firms are significantly related to firm size but not to the relative portion of foreign sales to total sales. Williamson (2001) argued that the exchange rate exposure of a firm is a function of its net foreign revenues, the elasticity of demand of the products made by the firm and the firm's market share. There are other authors that suggest different determinants of exchange rate exposure, such as: firm size (Dukas et al. (1996)), leverage (He and Ng (1998)), the use of derivatives (Allayannis and Ofek (2001)), firm liquidity (Bartram (2004)) or firm characteristics (the percentage of foreign sales), regional factors (geography, strength of currency) and industry characteristics (competition, traded goods) (Bartram and Karolyi, (2006)). Similarly, Allayannis and Ihrig (2001) focused on changing competitive structures. They showed that exchange rate changes affect a firm's returns through three channels: the competitive structure of the market where the firm sells its products, the export share and the industry structure, and thirdly the import share as well as the competitive structure of the imported input market. Lastly, Ihrig and Prior (2005) found some firms that have significant exposure only during crisis periods.

A distinct category of exchange risk exposure is mentioned in Koutmos and Martin (2006) paper; it comprises of asymmetric pricing behavior, hysteresis, and asymmetric hedging, as responses to currency appreciations and depreciations. Taking these variables into

consideration, Bartram (2004) and Koutmos and Martin (2003) assessed asymmetric responses to appreciations and depreciations of exchange rate. Other evidence of asymmetric responses to currency appreciations and depreciations is provided by Choi and Prasad (1995) and Di Iorio and Faff (2000).

2.5 Modern Approaches to Capturing Exchange Rate Exposure

The complex nature of foreign exchange exposure and the insufficient financial statement disclosures on management have managed to impede the capital market to assess the exposure. Another route to assess the sensitivity to exchange rate movements is through the examination of cash flows' sensitivity to exchange rate movements. The two approaches used to assess exchange rate exposure are presented as follows:

2.5.1 The capital market approach

This approach is constructed around the assumption that exchange rate risk is a priced factor and therefore stands as a good measure for analysts, investors and portfolio managers to understand the sensitivity of stock returns to exchange rate movements. The convenience of this model lies in the fact that knowing the degree of foreign exchange exposure of a firm's equity allows an investor to increase or decrease the equity holdings so that they reflect their risk tolerance. In case the manager is not willing to decrease his holdings, the investor may choose instead to decrease his exposure to foreign exchange risk by hedging (Martin and Mauer (2005)). Also, if exchange rate risk is a priced factor and the cost of equity is impacted by the degree of foreign exchange exposure, the managers will be inclined to consider their exposures when proposing an appropriate discount rate to evaluate investment opportunities. Griffin and Stulz (2001) believe that the capital market approach is a suitable method to assess exchange rate exposure due to the existing complexity of exchange rate effects on firm value. Because of the availability of stock return data (and on the other hand the unavailability of suitable corporate cash flow data), almost all academic studies employ this model to estimate exposure. On the other hand, since stock returns stand for ongoing changes in firm value, Bartram (2008) considers the

value of the firm equivalent to the present value of all current and future (net) cash flows. The stock return is also acknowledged to be a comprehensive measure of corporate performances that incorporate all effects of currency matching and diversification, operational and financial hedging, pass-through, etc. The capital market approach and the assumption that stock returns stand for proxy of the firm value represent the foundation of the first econometrical model (Adler and Dumas (1984)) that defined exchange rate exposure using a simple regression with stock returns as dependent variable and the relevant exchange rate movement as explanatory variable. The beta of this regression was later defined as total exposure and afterward considered to have both an idiosyncratic component and a macroeconomic, systematic one (De Jong (2006)). To control this latter component and thus reduce the residual variance of exposure, researchers have added to Adler and Dumas (1984) model an additional variable that stands for the return on market portfolio. The new developed model defines beta as the residual exposure and considers this variable a suitable estimation for the correction of the total exposure of macroeconomic influences (De Jong (2006)).

2.5.2 Cash flow framework

While most of the empirical literature on foreign exchange rate exposure has employed the stock market approach, the theoretical risk management literature uses the exchange rate risk exposure on corporate cash flows, rather than stock prices. The employ of cash flow framework in corporate risk management is motivated by the presence of capital market imperfections such as bankruptcy costs, a convex tax schedule or underinvestment problems (Bartram (2007)). Yet, in spite of the difficulty of finding appropriate cash flow data, most of the theoretical work on foreign exchange rate exposure is based on corporate cash flows (Bartram (2008)).

The main difference between these two approaches lies in the fact that while the capital market model may identify significant foreign exchange exposures, the cash flow method does not. The reason beyond this difference is presented by Martin and Mauer (2005), who suggest that differences between ways of capturing exposure arise whenever capital market

expectations incorporate a range of influences on future earnings beyond those captured in past exposure patterns by the cash flow method. In a parallel manner, there are also reasonable arguments such as the inherent complexity of foreign currency exposures or the lack of publicly-available information that explain why the capital market model may not detect significant exposures, while the cash flow model instead reveals significant ones.

2.6 Hedging Foreign Exchange Rate

While the operations of the multinational firms have significant exposure to foreign exchange rate risk due to foreign currency-based activities and international competition, corporate hedging mitigates this gross exposure. In an imperfect competitive market, firms have an incentive to hedge their currency risk through financial instruments and/or business diversification, which may result in a lack of evidence for firms trying to estimate their sensitivity to exchange rate movements. The empirical examination of firms' hedging policies has been affected by the general unavailability of data on hedging activities. Until the beginning of the 1990s, a firm's position in derivatives was not disclosed because it was considered to be an important component of strategic competitiveness. Only afterward the corporations were required to report in the footnotes of their annual reports the notional amount of derivatives they were using (Allayannis (2001)).

Several issues affect the ways in which stock returns react to the exchange rate changes, as argued by Hsin et al. (2007). Firstly, the extent to which a firm is exposed to exchange rate risk is largely dependent on its foreign activities and these are namely a firm's pre-hedging exposure factors. Secondly, the way a firm exercises its operational and financial hedging strategies to manage the economic and transaction risks from currency movements affects its exposure to exchange rate volatility. Recent studies have investigated whether the currency risk management practices of non-financial companies are effective in reducing the effects of exchange rate changes on firm value. Pantzalis et al. (2001) have provided evidence of effective operational hedging, while Allayannis and Ofek (2001) have documented the effective use of FXDs in reducing currency risk. However, no empirical study to date has examined whether the past ineffective use of these derivatives helps

explaining future changes in currency risk management practices (Anderson et al. (2004)). Bartram et al. (2009) present in their paper three different mechanisms that serve the purpose of mitigating exchange rate risk. Firstly, to varying degrees, firms can pass through to customers the changes in costs due to exchange rate movements. Secondly, firms can often affect their exchange rate exposure by choosing the location and currency of costs (e.g., where factories are located). Thirdly, firms can utilize financial products, such as foreign currency denominated debt and foreign exchange derivatives, as exchange rate risk management tools. In principle, the operating cash flow will reflect the gross exposure of a firm's operations in general and its foreign sales in particular, net of operational hedging (foreign currency costs), pass-through and currency diversification. Eiteman (2006) defines exchange rate pass-through as the degree to which the prices of imported and exported goods change as a result of exchange rate changes. Also, he considers that incomplete exchange rate pass-through is one of the reasons why a country's real effective exchange rate index can deviate for lengthy periods from it PPP equilibrium level of 100.

Lastly, when assessing exchange rate exposure, the connection between the volatility of exchange rates and risk premiums should be discussed. Oxelheim (1996) states that, taking into consideration the character of the exchange rate premium, the findings are ambiguous and the tests conducted so far in order to asses constant risk premiums have produced mixed results. Consistent with Oxelheim's results, Frenkel (1978) found a statistically insignificant constant premium and significance in the case of certain currencies. Yet, Oxelheim (1996) acknowledges that the premium for exchange rates is small related to the size of the unexpected change in exchange rates.

3. Methodology and Data collection

This chapter gives a description of the methodology used in this study. Afterwards, the data used to perform the following analysis are presented and discussed taking into account the collection method, the validity and reliability of our sample.

3.1 Research Approach

The purpose of this thesis is to empirically test part of the theoretical foundations of exchange rate exposure within companies and industries; hence a deductive approach is used (Bryman and Bell, (2003)). More specifically, the first part of our study aims to analyze the exchange rate exposure across listed companies having a common currency (EUR), but belonging to different countries and industries. In the second part, we investigate the extent to which several internal and external factors influence corporate exchange rate exposure.

In order to accomplish our research purpose, we perform a quantitative study of 467 Euro Area firms across ten industries and then we select a reduced sample of 205 companies in order to analyze the explanatory power of our chosen exposure determinants.

3.2 Research Method

We use a quantitative approach to reach the aim of our study, following the studies of Dominguez and Tesar (2001) and Bodnar and Wong (2003). Due to the geographical distribution and the significant number of companies included in our study, we were unable to conduct any qualitative research. This is not considered to minimize the value of our work, as we believe that objective, quantitative data are more suitable to accomplish our research purpose.

3.3 Data Collection

The input data consist only of secondary information since we didn't conduct any survey-based research. The main source used is the database Datastream which is one of the financial products of Thomson Reuters Corporation, a leading global provider of detailed economic data. The data were cross-checked with the companies' financial reports for possible inconsistencies. Additionally, we used existing information from the websites of different providers of financial data or regional/global statistics providers.

3.3.1 The sample

Our sample was selected using the following filters: EUR as single currency, availability of stock data for five years time period (2004-2008) and affiliation to one of the following 10 industries: Basic Materials, Oil & Gas, Retail, Industrial Engineering, Technologies, Telecommunications, Broadcasting & Entertainment, Utilities, Healthcare & Pharmaceuticals, Personal Goods & Households Products. The selection of industries was based on the classification made by Ganguin (2005), according to the industries' sensitivity to macroeconomic changes (low, medium and highly exposed) and to the number of eligible companies from each category. More specifically, we have chosen a roughly equal number of companies from each of the three categories. After applying all the filters, the resulting sample consisted of 467 companies, distributed evenly across the three types of industries (approximately 150 companies for each type). Both samples are distributed almost uniformly across the chosen industry categories (Appendix 1). For the industry analysis in the first-stage regression we used 466 companies (after removing one outlier). As for the second-stage regression, we were able to use only 205 companies (due to limited availability of financial information), corresponding to the same number of observations (Table 1).

Table 1. Number of companies used to run the regressions

The table shows the number of companies from the samples used to run the regressions as a percentage of the Euro Area industry peers, the Euro Area companies and the EU companies, retrieved from Datastream after applying filter "Europe".

Sample	Euro Area industry peers (%)	All Euro Area companies (%)	All EU Companies (%)
467	44,73	34,29	18,54
205	19,64	15,03	8,14

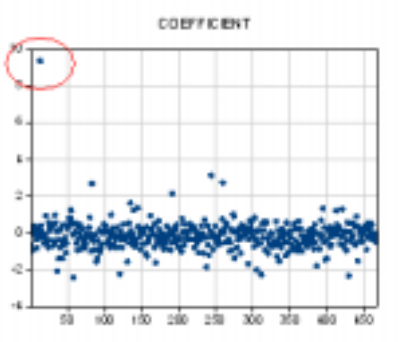
- *Euro Area industry peers:* companies belonging to the chosen 10 industries within the Euro Area.
- *All Euro Area companies:* all the listed companies in the Euro Area
- *ALL EU companies:* all the companies of the European

3.3.2 Excluded observations

As our data were collected according to the availability of recent stock information, we consider highly unlikely the probability of encountering outliers with a high probability of default. Due to a very large amount of observations and due to the methodological approach used in the first analysis that implied separate time series regressions for each company, we didn't consider necessary to conduct any preliminary outlier tests before running the first regression. Further on, after running the summary statistics for the resulting coefficients, we found one extremely high exposure (Chart 1).

Chart 1. First-stage regression, coefficients analysis

Plot graphic for the resulting regression coefficients, displaying the existence of an outlier



The inconsistent value (9.356), highlighted with the red circle, forced us to check the initial input for that specific company, AES Chemunex. Indeed, we found out that the regression had been biased due to an unusually high value of monthly stock return. Therefore we excluded the company from our sample, which was thus reduced to a number of 466 companies for the cross-industry analysis. The input required for our cross-sectional analysis led to a further reduction of our initial sample, as the needed data were available for only 205 companies.

3.3.3. Industry and country specific data

The indices used in our first-stage regression were collected from Datastream. The main filter used for all our data was EUR currency, as we were only interested in specific indicators for the Euro Area. The exchange rate indices were chosen among those provided by the European Central Bank (ECB), while the market index was taken from the financial firm Dow Jones & Company Inc (DJ), which provides several Euro Area specific market indices with a detailed description of their components.
For our second-stage regression we used the same classification Behrens (2005) used, which is based on certain characteristics of industry specific products. As regards the source of information about Euro Area's trade flows and other industry-level statistics and rankings, we have selected some of the Organization for Economic Co-operation and Development (OECD) publications. The country ratings were taken directly from Standard & Poor's (S&P's) and Moody's websites.

3.4 Regression Analysis

The main tool used in any quantitative study is the regression analysis, which provides a statistical and econometrical interpretation of the chosen data. Choosing the most appropriate regression for an analysis can be a challenging task. Following the steps suggested by Brooks (2002), we found several important aspects that had to be covered: the detailed objective, the regression model, the estimation method and the variables chosen. In order to perform our regression analysis, we used both EViews and Microsoft Excel.

3.4.1 Regression model

As our research purpose is two folded and the corresponding datasets have different structures, we performed two different regression models, referred in our analysis as *first-stage* and *second-stage* regression. Our initial purpose was to capture the companies' exposure and the high dependence of the two regression stages. This dependence is highly important because the beta estimated from our first-stage regression is afterward used as input for the second-stage regression.

For the **first-stage regression** we employed the capital-market approach. The choice of the first-stage regression model was a difficult task, as the matrix dimension of our data permits the use of multiple regression models:

- *Pooled regression:* might seem a feasible model according to our dataset structure, but this approach would eventually lead to the estimation of a single exposure for all the companies. As our purpose is to analyze individual exposures, we couldn't have been able to use the output from our second-stage regression. Therefore this model is not suitable in our analysis.

- *Panel regression:* another common method to analyze bidimensional data is panel regression. In our case, using a panel regression would have led to a dramatic decrease of our degrees of freedom, as the number of time series observations should equal the one of explanatory variables. Hence, when using monthly observations, we would have been forced to reduce our sample of companies to only 60 and thus to utilize the same small number of exposure estimations for the second regression. Consequently, the outcome of our entire analysis would have displayed a low significance.

- *Cross-sectional analysis:* is not suitable simply because, as mentioned before, the independent variables don't vary across companies.

Therefore, the only appropriate and feasible model in our case is the ***time-series regression***, which had to be run for each company according to the chosen five year time period (2004-2008). This approach led to 466 different regression equations and 466 company-specific betas.

The most common method to run the regression is the Ordinary Least Squares (OLS), which is preferred due to its simplicity, accuracy and suitability for a wide range of datasets. Computing OLS is no longer a problem, since statistics software can easily perform all the calculations, while providing a wide range of statistical tools to test/forecast/customize any type of analysis. Nevertheless, the regression model has to fulfill several criteria so that OLS can provide Best Linear Unbiased Estimators (BLUE). We address this issue in the Methodological Issues section.

The **second-stage regression** focuses on the investigation of the influence of different determinants on corporate exchange rate exposure. The choice of the regression model is quite straightforward, as, intuitively, a company's exposure should be expressed as a function of the chosen company-specific determinants. Using statistics terminology, this is equivalent to a cross-sectional analysis. Hence, our second model can only be ***cross-sectional***.

3.4.2 First-stage regression

We estimated the residual risk exposure as the total risk exposure corrected by a market specific beta, according to Dominguez and Tesar (2001). Hence the general equation is:

$$R_{i,t} = c + ß_{1,t}\ \Delta s_t + ß_{2,t} R_{m,t} + \varepsilon_{i,t}$$

Where:

$R_{i,t}$ = the stock return of firm *i* at time *t* (proxy for firm value)

$ß_{1,t}$ = the change in returns that can be explained by movements in the exchange rate after conditioning on the market return for company *i* (residual company exposure)

Δs_t = the change in the relevant exchange rate at time *t*

$ß_{2,t}$ = the change in returns with respect to market portfolio (also called residual exposure) for company *i*

$R_{m,t}$ = the return on market portfolio at time *t*

$\varepsilon_{i,t}$ = error term

In the following subsections we describe in detail each of the components, as well as the frequency of our observations.

3.4.2.1 Return horizon

Although former studies have employed a wide range of return horizons, monthly observations seem so far to be the most used ones (Dominguez and Tesar (2001)). In fact, calculated exposure over longer return horizon has led to biased results (De Jong (2006)). Our total timeframe of five years is not suitable for longer return horizon observations because this would lead to a decreasing value of our degrees of freedom. On the other hand, we cannot use shorter intervals: firstly because both exchange rate and market indices are published on a monthly basis, and secondly because daily observations can be biased due to non-synchronous trading, while weekly observations can be plagued by the end-of-week effect (De Jong (2006)). Therefore, we chose to use monthly stock returns.

3.4.2.2 Dependent variable

According to the existing literature and consistent with our previous description of exposure, we have used as dependent variable the company stock returns which are considered to be a proxy for company value. Using the company stock price as input, we have computed the returns applying the arithmetic rate of return formula.

3.4.2.3 Independent variables

After reviewing a considerable number of studies, it seems that the choice of independent variables for this regression is by far the most debated topic. There is a multitude of indices that can be used as a proxy for market return and for exchange rate.

A. Exchange rate indices (tw21, EUR/USD)

According to the simplified exposure definition given by Adler and Dumas (1984), company's beta depends primarily on the exchange rate movements. Thus, choosing the correct foreign currency(ies) becomes a matter of high importance. There have been discussions among authors regarding the usage of exchange rate indices and, consequently, regarding the impact of using them. Some authors suggest to use the currency of the main trading partner(s), while others prefer trade-weighted exchange rate index. Since both alternatives display specific advantages as well as drawbacks, we have decided to use two different regressions, one for each category of exchange rate index. In the end we compare the two outputs.

Since our research concerns Euro Area companies, the choice of trade weighted index has been taking into account. We selected ECB's Effective Narrow Nominal Exchange Rate, collected from Datastream as well, officially called EER-21. The rate is computed as a trade-weighted index over a basket of 21 currencies representing the main Euro Area trading partners: non-Euro Area EU member states, Australia, Canada, China, Hong Kong, Japan, Norway, Singapore, South Korea, Switzerland and US. We refer to this trade-weighted index as ***tw21***. In spite of being the most used exchange rate measure throughout literature, trade-weighted exchange rates lead to an underestimation of exposure for all companies that have a small number of trading currencies (Williamson (2001)). To minimize the likelihood of this bias, we used the trade-weighted exchange rate index based on the main 21 currencies instead of the one based on 41 currencies.

In order to perform our analysis we have also taken into consideration the usage of one single exchange rate index. ECB gives a weight to each country that belongs to the EER-21 (Appendix 2). The United States has the largest weight in the basket of these 21 countries, meaning that the US dollar is considered to be the most important foreign currency in the trade between the non-Euro- and Euro-Area. Therefore, we decided to run a second regression using the European Central Bank EUR/USD average exchange rate. We refer to it as ***EUR/USD***. The major drawback of choosing only one currency is that some companies might have significant exposures to other currencies as well. Hence, the total exposure could be incorrectly estimated.

Dominguez and Tesar (2001) find significant differences in the industry level exposures by using a single exchange rate index for the main trading partner and an alternative exchange rate index, like a trade-weighted index that includes the currencies of the main trading partners. Chart 2 displays an imperfect correlation between the two exchange rate indices. Comparing our findings with Dominguez and Tesar (2001) study is one more additional reason for using both exchange rate indices.

B. Market portfolio index (DJTMI)

While Dominguez and Tesar (2001) emphasize the importance of choosing an appropriate exchange rate index, Bodnar and Wong (2003) stress the fact that the market index could also significantly influence the residual exposure. The main index types are value-weighted, equally-weighted and worldwide, and all of them are widely employed throughout the existent empirical studies. Nevertheless, the equally-weighted one seems to be preferred. In the same study, Bodnar and Wong (2003) state that an equally-weighted market index is more suitable because it is considered to be more consistent with the residual exposure estimation. This estimation usually assumes an equal weighting of all companies, which is the same situation we faced in our study.

Table 2. Correlation matrix between exchange rate and market portfolio indices

The table shows the correlations between exchange rate and market portfolio indices considered as potential indices to perform the second-stage regression analysis.

	EUR/USD	tw21	DJ STOXX 1800	DJ STOXX TMI	DJ STOXX 50
EUR/USD	1				
tw21	0,884284	1			
DJ STOXX 1800	0,071237	0,012196	1		
DJ STOXX TMI	0,304956	0,294112	0,943415	1	
DJ STOXX 50	0,354378	0,358079	0,918872	0,993276	1

- *EUR/USD:* exchange rate EUR/USD

- *tw21:* trade-weighted index consisting of 21 currencies of the most important trading partners of the Euro Area countries

- *DJ STOXX 1800:* it comprises the largest 600 stocks in the developed markets in each of these regions: Europe, the Americas and Asia/Pacific

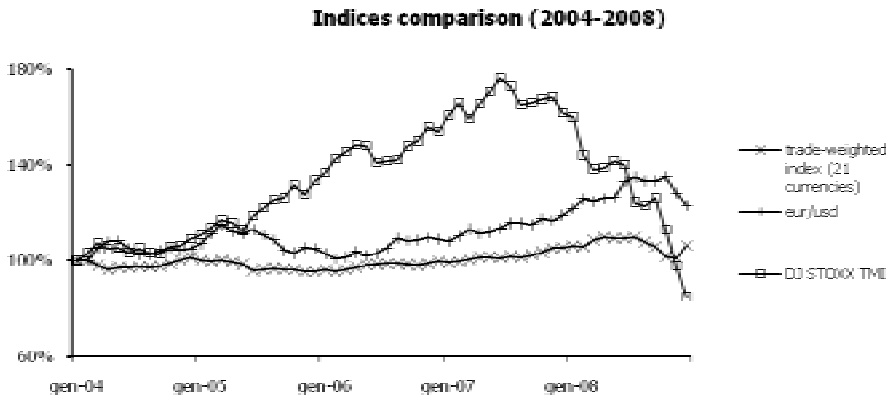
- *DJ STOXX TMI (Total Market Indices):* it covers 95 percent of the free float market capitalization of the respective investable stock universe by region (Region: Europe)

- *Dow Jones STOXX 50:* it consists of 50 stocks covering the largest supersector leaders in the DJ STOXX 600 Index

The matrix in Table 2 displays a very low correlation when using the DJ STOXX 1800 world index. Such a low correlation might indicate that this index could be too general. This is consistent with the main argument mentioned in several former studies, against using a world index Dominguez and Tesar (2001). As a consequence we chose the Dow Jones STOXX TMI, an equally-weighted index, which represents the total market index for Euro Area. We refer to it as ***DJTMI***. According to the index methodology provided by DJ, the constituents of this index are 525 Euro Area companies covering 95% of the free floating market capitalization of stock markets for the whole Euro Area countries.

Chart 2. Exchange rates and market portfolio indices comparison

The chart shows the two exchange rate indices (*EUR/USD* and *tw21*) and the market portfolio index (*DJ EURO STOXX TMI*) used in our regressions.



According to the arguments presented above, we used two different equations to estimate the residual risk exposure:

$$\text{Reg}_{\text{EUR/USD}}: \quad R_{i,t} = c + ß_{1,t}\,€/\$ + ß_{2,i}\,DJTMI$$

$$\text{Reg}_{\text{tw21}}: \quad R_{i,t} = c + ß_{1,t}\,tw21 + ß_{2,i}\,DJTMI$$

Notes:
Variables are expressed as monthly changes in order to avoid size effects.
Since all our inputs were reported in Euro, we didn't have to perform any currency conversion; therefore we reduced the potential bias/errors caused by exchange rate differences.

3.4.3. Second-stage regression

The second-stage regression is intended to investigate the determinants of the exposure estimated from the first regression. Therefore, as already mentioned, we used the cross sectional model:

$$ß_i = c + \alpha\, x_i + \varepsilon_i$$

Where:

$ß_i$, for i = 1, 2, … N where N = number of companies and $ß_i$ is the residual exposure
c = intercept
x_i = explanatory variable(s) for company i
α = regression coefficients for each variable(s)
ε_i = error term

3.4.3.1 Return horizon

As each exposure was estimated over a five year time basis (2004-2008), we considered the other variables for the same time period in order to maintain consistency. Next, taking into account that audited financial data is reported yearly, we were compelled to use the mean value for each accounting variable. As for the countries' credit rating, we were only able to use the ratings for 2008, since previous years' data were not available.

3.4.3.2 Dependent variable

We have used the exposures estimated from the two regressions ($ß_i$ from $Reg_{EUR/USD}$ and Reg_{tw21}) as dependent variables in order to continue the comparison between the two regressions with the different exchange rate indices and to maintain consistency. Several mathematical transformations are recommended throughout different studies in order to reduce potential biases. Dominguez and Tesar (2001) suggested the usage of the absolute values, logarithm or square root of absolute values of betas with the purpose of reducing biases determined by the occurrence of offsetting positive and negative beta values. However, the models that utilize this kind of modifications present limitations due to the utilization of only dummy variables. The model we apply in our analysis is significantly different since it uses a regression with more and diversified variables. We consider transforming beta values not useful in our case; therefore we employ exactly the same beta values obtained from the first-stage regressions with 205 companies.

3.4.3.4 Independent variables

The range of explanatory variables differs from one study to another, as each researcher tries to add a factor not previously used and add value to former investigations. Nevertheless, as there are several micro and macroeconomic characteristics which are proven to have a significant influence on exchange rate exposure, the difference lies mainly in the choice of specific proxies. Hence, consistent with the theory and previous research, we discuss further the relevant factors and the measures chosen to assess each of them.

A. Company level variables

International operations are the most important determinant of foreign exchange exposure. Various variables have been used so far to express the extent of international activities, resulting in no significant differences in their explanatory power. We selected ***foreign sales*** as variable to describe international activities due to lack of availability of information regarding the other possible variables. Foreign sales data were available for at least two years for our sample of 205 companies. The expected correlation is positive.

The most commonly used and probably the best available proxy for a firm's size is ***total assets***, which is another variable we chose. Economically and also intuitively, company size should have a significant impact on exchange rate exposure. The question is whether the exposure is negatively or positively correlated to size and previous findings are contradictory in this respect. Nevertheless, we tend to support a negative dependency as we take into consideration that larger companies hedge more and benefit from scale economies, advantages that should offset the higher exposure caused by increased international operations.

We have also included in our model two factors that, to our knowledge, were not employed in this context so far. These factors are ***leverage*** and ***investment opportunities***, usually employed in studies focusing on hedging or, more specifically, on analyzing the influence

of the hedging process on firm value. We can assume that the two factors could have a negative correlation with exchange rate exposure. According to data availability, we have used total debt and total investments in order to express the previously mentioned possible determinants. To eliminate size effects, we normalized all the absolute values by dividing them to total assets.

B. Industry level variable

According to our first regression findings, which were inconsistent with the industry classification made by Ganguin (2005) on industry sensitivity to macroeconomic changes, we have taken into consideration other criteria. Several studies used market concentration indices like Herfindahl or markup indexes (Dominguez and Tesar (2001)) in order to quantify relevant industry characteristics like competitiveness and product differentiation.
Due to the lack of recent information of the indices regarding our industries of interest, we decided to classify industries as ***traded goods*** or ***non-traded goods*** according to Behrens' study (2005). The concept of traded goods was mentioned by Dominguez and Tesar (2001) as being related industry competitiveness and concentration measures. Holmes and Stevens (2005) described traded goods as being highly differentiated, customized for different markets and produced by very specialized companies. The concept describes most services and manufactured goods. By contrast, non-tradable goods have low differentiation, being easily substituted. Therefore, we can consider that industries having non tradable goods have a lower competitive advantage and thus facing a higher competition. Consequently, it is more likely for the tradable-good producers to have international operations, thus we should expect a higher exposure for tradable-good producers.
We used a dummy assigning 1 for industries with traded goods and 0 for the other case (Appendix 3).

C. Country level variables

Although various authors tried to assess the exposure of companies according to countries' characteristics, to our knowledge no study have been so far conducted using countries'

credit rating as a variable included in a regression. We consider our analysis unique because the companies of the sample belong to different countries and at the same time to a common commercial, economical and monetary area, the Euro Area. This complex aspect increased our interest in investigating the influence of the country-specific macroeconomic factors on the firms' exchange rate exposure.

The best available quantifiable assessment of a country's economic status is, in our opinion, the ***sovereign rating*** provided by rating agencies. Hence, we have ranked both Moody's and S&P's long term sovereign ratings of the 15 Euro Area countries from 1 to 7 (1 as the lowest rating, 7 as the highest one) and computed the mean for the countries which had different ratings (Appendix 4).

After taking into consideration all the arguments previously mentioned, we chose the variables to be used in the second-stage regression (Table 3).

Table 3. Chosen variables for the second-stage regression

The table shows the chosen variable used in the second-stage regression.

Variable	Level	Proxy for	Type	Expected influence
Intercept	-	Regression slope	-	-
Total Debt / Total Assets	Company	Leverage	Percentage	Negative
Foreign Sales / Total Sales	Company	Foreign operations	Percentage	Positive
Investments / Total Assets	Company	Investment opportunities	Percentage	Negative
Ln (Total Assets)	Company	Size	Logarithm	Negative
Country Credit Rating	Country	Macroeconomic background	Variable [1;7] converting ratings into correspondent numbers	Negative
Industry classification	Industry	Competitiveness / product international demand /differentiation	Dummy assigning 1 if products are 'tradable'	Positive

Hence, our equations for the second-stage regression are:

$$\text{Reg}_{\text{EUR/USD}}: \quad \beta_{EUR/USD,i} = c + \alpha_1 TD/TA_i + \alpha_2 FS/TS_i + \alpha_3 I/TA_i + \alpha_4 ln(TA)_i + \alpha_5 D(CR)_i + \alpha_6 D(IC)_i$$

$$\text{Reg}_{\text{tw21}}: \quad \beta_{tw21,i} = c + \alpha_1 TD/TA_i + \alpha_2 FS/TS_i + \alpha_3 I/TA_i + \alpha_4 ln(TA)_i + \alpha_5 D(CR)_i + \alpha_6 D(IC)_i$$

Where:

$$\text{TD/TA} = \frac{TotalDebt}{TotalAssest}$$

$$\text{FS/TS} = \frac{ForeignSales}{TotalSales}$$

$$\text{I/TA} = \frac{Investments}{TotalAssets}$$

Ln(TA) = ln(*TotalAssets*)

D(CR) = variable for *Countries credit rating*

D(IC) = dummy variable for *Industry classification*

3.5 Methodological Issues

Almost every comprehensive study presents methodological problems until reaching a final, reliable and economically valid result. Our thesis is not subject to an exception. The main criteria which any empirical research should meet are the ability to correctly measure the intended factors (validity) and the extent to which the output can be considered as reliable (reliability).

3.5.1 Validity

The models we followed in our study are consistent with the theoretical and empirical frameworks used to analyze the exchange rate exposure. Moreover, the paper we took as a model for our study, the work of Dominguez and Tesar (2001), is considered to be a

benchmark among the studies that had as research purpose the estimation of exchange rate exposure of both firms and industries.

We haven't encountered in any other undertaken study some of the variables we utilized in our thesis. Therefore, although their validity might be questioned because they haven't been utilized in any similar manner before, we argue that all our choices were theoretically supported due to the usage in scientific literature of correspondent, quantifiable variables. For instance, the variables we selected in our study are particularly used to estimate exposure in Euro Area, and yet we noticed their consistency with other variables used in similar studies. On the other hand, measures such as leverage and investment opportunities haven't been analyzed so far as exchange rate exposure determinants, but instead they are widely employed for hedging analysis. Hence, we deem them to be indirectly related to exposure. Another chosen variable not empirically tested so far in the way we employed it is sovereign ratings. However, since this variable has been used with similar purpose in previous studies, we judge the sovereign ratings to be valid and serve our research goal.

3.5.2 Reliability

In order to properly assess the reliability of this study two main areas had to be scrutinized: the reliability of the collected data and the methods used. Firstly, the collected data used in the regression are taken from the database Datastream and the companies' annual reports. Given the source, we judge the information obtained reliable.

As previously mentioned, we have used OLS estimation performed by EViews software. While the method and software guarantee computational reliability, the regression model must comply with several assumptions in order to obtain robust (BLUE – Best Unbiased Linear Estimators) coefficients. To test the reliability of our regression models, we used several statistical tools available in EViews, for each regression model. Table 4 summarizes all the results from the tests and the regressions where they were applied.

Table 4. Summary of OLS assumptions tests

The table shows the tests applied to the regressions and their results.

Regression model	Test	Result
first-stage (time series) regression	Breusch-Godfrey	no serial correlation
first-stage (time series) regression	correlation matrix	no multicolinearity
cross sectional (second stage)	Jarque-Bera	normally distributed residuals
cross sectional (second stage), $Reg_{EUR/USD}$	White	heteroskedastic
cross sectional (second stage), Reg_{tw21}	White	homoskedastic
cross sectional (second stage)	correlation matrix, Klein's rule of thumb	no multicolinearity

Note: In Appendix section the details of all tests.

Another important factor used for the determination of the statistical significance is the number of observations employed. Although we reduced our initial sample due to the lack of available data, we argue that the number of observations we have corresponds to similar values in other studies.

3.5.3 Further methodological issues

In our thesis we used a relatively short time frame (2004-2008), since it would have been difficult to find relevant financial information for an earlier time period. Next, the lack of data for the beginning year 2004 forced us to reduce our initial sample to only 205 companies. Although initially we wanted to employ in our thesis the most appreciated and reliable measures that would facilitate the analysis of our chosen factors, we had to limit our research criteria according to the availability of input data and consistency with theoretical and empirical frameworks.

Lastly, it has to be mentioned that in order to obtain the results that would best convey the economic aspects we analyzed, a compromise between the choice of the most appropriate data and the choice of the most appropriate available data had to be done in order to keep a satisfactory balance between data reliability and validity.

4. Regression Analysis and Empirical Findings

This chapter presents the regression analysis and the empirical findings for each stage of our study. We discuss their consistency with theoretical foundations and with former similar empirical studies.

4.1 Exchange rate exposure estimation

To estimate company-specific exchange rate exposure, we have conducted time-series regressions for each of the 466 companies of our sample, using both EUR/USD exchange rate and a Euro Area specific trade-weighted exchange rate index. As previously mentioned in the methodology chapter, we used as a proxy for the return on market portfolio an equally-weighted market index for Euro area: the Dow Jones STOXX Total Market Indices (TMI). To ensure that our regression model complies with OLS assumptions, we have tested it against serial correlation, which is common for time series, and we didn't detect it (Appendix 5). Multicollinearity didn't pose a problem, as shown by the correlation matrix displayed in Table 2.

The resulting exposures (Table 5) reflect an overall low level of significant beta values: 5.79% for TW21 and 8.15% for EUR/USD. The results appear to be intriguing if we take into account the soundness of the theoretical approach and the methodology, but hardly surprising when considering the former empirical findings. As stated by Griffin and Stultz (2001), former research highlights a "surprisingly weak evidence of significant exposures". The average exposure shows, as mentioned in the first section of our paper, a bare 10-25% significance level.

Table 5. First-stage regression, summary statistics for 466 companies

The table shows the comparison between the output obtained from the two regressions ($Reg_{EUR/USD}$ and Reg_{tw21}) used during the first-stage regression analysis. 5% significance level. F-statistic: 3.851 (ANOVA single factor analysis).

	$Reg_{EUR/USD}$	Reg_{tw21}
Mean	-0.208	-0.188
Standard Deviation	1.229	0.653
Kurtosis	1.717	3.487
Skewness	0.144	0.313
Range	9.173	5.575
Minimum	-4.589	-2.452
Maximum	4.584	3.122
Significant exposure (%)	8.15	5.79
Negative (%)	9.45	7.51
Positive (%)	6.28	2.89

There are many arguments that try to explain the above mentioned issues, and further on we discuss those ones considered relevant for our research purpose. Firstly, a lower significance level is partially caused by several methodological limitations. More specifically by reducing our sample from 466 to 205 companies and by using the Newey White method to correct the coefficients, we might have lowered the analysis significance. The results of our research and the data availability led to a relatively heterogeneous sample, which is consistent with other findings that generally show an overall low significance level (Prasad and Rajan (1995), Bodnar and Gentry (1993), and Doidge et al. (2002)). Although we intuitively expected a lower significance, we were determined to investigate whether Euro Area companies display any common patterns, being part of a monetary, trading and economic union.

Since one of the most discussed problems we encountered was choosing the most appropriate exchange rate index, we decided to use both the EUR/USD and a trade-weighted exchange rate index and then compare the resulting exposures. As the US dollar has a 23.96% weight in the trade-weighted exchange rate index EER-21, the correlation between the two exchange rate indices is obvious (88% across our entire return horizon).

Hence, we should expect similar exposures. By contrast, most empirical researches display differences between the two estimations: while Dominguez and Tesar (2001) find higher values using a trade-weighted exchange rate index with low significance level, Bodnar and Wong (2003) suggest a better beta estimation using a corrected market index. A trade-weighted exchange rate index seems to be employed in most studies but, on the other hand, some researchers as De Jong (2006) prefer individual currencies. His findings show that there is bias caused by the wrong assumption that firm's characteristics are uniformly related to the national figures (in our case the Euro Area) used for the index calculation. Indeed, we obtained a greater significance for EUR/USD, consistent with the latter argument against using a trade-weighted exchange rate index.

An interesting finding, which is also consistent with our results, is shown in De Jong's study (2006). He points out that a single currency exchange rate and a trade-weighted exchange rate index should be used simultaneously. This complementarity suggested by De Jong (2006) is also highlighted in our findings: out of the total number of 62 companies with significant exposure, only 59 present a significant exposure to only one of the two exchange rate indices analyzed. Nevertheless in the first part of our paper we mentioned the strongest argument which is the difficulty to assess hedging. It has been proven that hedging has a major influence on exposure, as Bartram et al. (2005) pointed out (45% of 7263 non-financial firms in 48 countries around the world use currency derivatives).

Apart from the percentage value of significant exposure, another relevant characteristic is the exposures' current values. Our findings highlight an overall negative exposure: Euro Area companies from chosen industries are losing on average 0.208% in the value of the companies when Euro depreciates with 1% against USD and 0.18% for a 1% depreciation against the TW21. Negative significant exposures follow the same pattern, consisting of 9.45% in the case of EUR/USD and 7.51% for the TW21 index, highlighting that the analyzed companies are more exposed to foreign currencies appreciation. This suggests that, apparently, our companies are net importers. However, a closer analysis would reflect the fact that, although the number of importers and exporters are almost equal, importers

have a higher exposure. The relatively high standard deviation and the significant range of values prove the sample's heterogeneity, as formerly stated (Table 5).

The lack of a common pattern for beta values across our entire sample is surprising, since we would have expected a more meaningful outcome of the industry-level analysis. We have plotted three descriptive statistics for the each of the three industry categories, as Ganguin (2005) classified them according to the sensitivity to the macroeconomic changes (Table 6).

Table 6. Exposures statistics across group of industries for first-stage regression

This table shows the result of the first-stage regression with the first 466 companies. 5% significance level.

Regression models	**$Reg_{EUR/USD}$**			**Reg_{tw21}**		
Group of industries affected by economic changes	**Highly**	**Moderately**	**Slightly**	**Highly**	**Moderately**	**Slightly**
Mean	-0.235	-0.215	-0.224	-0.253	-0.219	-0.029
Standard Deviation	0.770	1.263	1.343	0.373	0.707	0.868
Kurtosis	1.733	0.626	1.778	3.993	1.781	4.293
Skewness	0.124	-0.361	0.260	0.428	0.031	0.637
Range	7.763	3.421	8.455	5.575	8.457	4.969
Minimum	-3.985	-2.088	-3.872	-2.452	-4.589	-2.247
Maximum	3.778	1.333	4.584	3.122	3.868	2.723
Positive exposure (%)	6.35	4.41	8.33	0.00	5.36	2.44
Negative exposure (%)	8.89	6.52	12.90	10.78	7.69	5.26
Significant exposure (%)	7.84	5.63	11.11	7.19	6.88	3.27

One of the hypotheses we attempted to verify was the extent to which the industry sensitivity can be reflected in the differences of the exposure. We were particularly expecting that companies belonging to highly affected industries by macroeconomic changes should have a high exposure, an average sensitivity reflected by median exposures and a low sensitivity due to reduced exposure. As shown in Table 6, the results didn't confirm our hypothesis as the exposures vary differently. We consider the decrease in significant exposures according to the sensitivity level of the tw21 exchange rate index to be only accidental, as the results obtained from the regression with EUR/USD index contradict our hypothesis (the lowest sensitivity category displays the highest percentage, 11.11%).

Most probably, our spurious results are the consequence of a flawed group selection. Although the classification made by Ganguin (2005) might be theoretically and empirically relevant, we believe that it might have been too general. Firstly, the sensitivity to macroeconomic changes is not only related to exchange rate risk but to all the macroeconomic exposures; secondly, being a qualitative classification, its validity can be questioned. However, empirical studies across industry portfolios haven't used so far any similar classification. Dominguez and Tesar (2001) classify industries according to Herfindahl index, tradable goods and trade flows, none of which present a significant influence across all analyzed countries, while Allayanis and Ihrig (2001) find a significant influence of different competitive structures on four industries. The only consensus is that industry competitiveness and product differentiation do influence exchange rate exposure.

4.2 Exposure determinants

Before starting to analyze our regression output, several considerations have to be made regarding our sample. As we were able to use only 205 companies for our second part of the analysis due to unavailability of some data, we compared the distribution of the exposure estimations and the values of our reduced sample with the ones of our initial sample of 466 companies. This was done in order to detect any peculiarities of the selected subsample and to verify whether we could extend the cross-sectional analysis results to our initial sample. The reliability of this second analysis is considerably lower due to a small number of observations.

Table 7. Summary statistics of first-stage regression for the two samples of companies

The tables shows the comparison of the output obtained from the first-stage regressions for the different samples of companies.
5% significance level.
Sample of 466 companies F-statistic: 3.851 (sample of 466 companies)
Sample of 205 companies F-statistic: 3.864 (sample of 205 companies)

	$Reg_{EUR/USD}$ 466 companies	$Reg_{EUR/USD}$ 205 companies	Reg_{tw21} 466 companies	Reg_{tw21} 205 companies
Mean	-0.135	-0.208	-0.153	-0.188
Standard Deviation	0.085	1.229	0.048	0.653
Kurtosis	2.108	1.717	2.487	3.487
Skewness	0.282	0.144	-0.302	0.313
Range	9.173	9.173	5.075	5.575
Minimum	-4.589	-4.589	-2.352	-2.452
Maximum	4.584	4.584	2.723	3.122
Significant exposure (%)	5.62	8.15	6.67	5.79
Negative (%)	6.90	9.45	21.74	7.51
Positive (%)	6.34	6.28	15.12	2.89

After comparing the summary statistics (Table 7) the only relevant conclusion we can reach is that our resulting subsample is significantly different. Hence, we can also expect a less significant output for our second analysis.

To test the OLS assumptions, we have used several methods. The common issues presented by cross sectional regressions are multicollinearity and heteroskedasticity. Multicollinearity was tested using both the correlation matrix below (Table 8) and Klein's rule of thumb, which stands for comparing a multivariate regression's R^2 with the R^2 resulted from univariate regressions, run with each of the independent variables. If univariate R^2 are lower that overall R^2, multicollinearity is absent (Table 9).

Table 8. Correlation matrix for the variables of the second-stage regression

Covariance Analysis: Ordinary
Included observations: 205

Correlation	Total Debt / Total Assets	Foreign Sales / Total Sales	Investments / Total Assets	Ln(Total Assets)	Country Rating	Industry Classification
Total Debt / Total Assets	1					
Foreign Sales / Total Sales	-0,00438	1				
Investments / Total Assets	0,016333	-0,04899	1			
Ln(Total Assets)	0,194281	0,159424	0,099946	1		
Country Rating	-0,21396	0,20489	0,077339	-0,01096	1	
Industry Classification	-0,05882	0,06215	0,083104	0,02205	0,067539	1

No evidence of multicollinearity, as a consequence of no large values for correlation.

Table 9. Klein's Rule of Thumb

The table shows the values of R^2 of each variable and the overall R^2, for each regression equation. The resulting values indicate the absence of multicollinearity.

	R^2	
	Reg_{tw21}	**$Reg_{EUR/USD}$**
Total Debt / Total Assets	0.005344	0.010862
Foreign Sales / Total Sales	0.002248	0.002829
Investments / Total Assets	0.003006	0.000004
Ln(Total Assets)	0.003508	0.000360
Country Credit Rating	0.015105	0.001615
Industry classification	0.039576	0.006981
OVERALL	0.075707	0.026209

R^2 of each auxiliary regression (univariate regression run with each variable, Appendix 6a and 6b).
The overall R^2 of Reg_{tw21} and $Reg_{EUR/USD}$ is lower than R^2 of each variable.

Heteroskedasticity was tested using White cross-section (Appendix 7), and it was found for $Reg_{EUR/USD}$. Therefore, we have used White correction for the EUR/USD exposure regression coefficients.

We have also verified the normality of residuals using Jarque-Bera test, which has confirmed a normal distribution for both models (Appendix 8).

Auto correlation is less frequently displayed by cross sectional models and in our case Durbin Watson value confirms the absence of auto correlation (Appendix 9a and 9b).

Regression analysis

Table 10 summarizes the output of our cross sectional regressions, comparing it to our initial assumptions and to previous empirical findings.

Table 10. Cross-sectional analysis

The table shows the most relevant results of the second-stage regression.
The output is compared to our initial assumptions (Expected sign column) and to previous empirical findings (last column).

Exposure estimate	Measure of	Reg_{tw21}			$Reg_{EUR/USD}$			Expected sign	Similar findings (reference)
		Coefficient	t-stat *	R^2 **	Coefficient	t-stat *	R^2 **		
Total Debt / Total Assets	Leverage	-0.378448	-1.101419	0.039576	-1.054600	-1.162657	0.006981	-	He and Ng (1998); Nguyen and Faff (2003);
Foreign Sales / Total Sales	Foreign operations	0.201432	1.001529	0.015105	0.294162	0.749503	0.001615	+	Chow et al (1997); Jorion (1990)
Investments / Total Assets	Growth prospects	-0.979803	-0.675829	0.003508	0.182437	0.087939	0.000360	-	Williamson (2001); Nguyen and Faff (2003)
Ln(Total Assets)	Size	-0.016852	-0.722724	0.003006	0.020448	0.516487	0.000004	-	Dominguez and Tessar (2001);
Country Credit Rating	Domestic market economic status	-0.109046	-2.312624	0.002248	-0.098639	-1.243695	0.002829	-	no existing studies
Industry classification	Competiveness	0.281673	2.950151	0.005344	0.186836	1.084609	0.010862	+	Dominguez and Tessar (2001)

* Calculated with 5% level of significance
** R^2 of each auxiliary regression (univariate regression run with each variable. Appendix)

Table 11. Reg_{tw21} and $Reg_{EUR/USD}$ stats comparison

The table shows the comparison of R^2, standard error, F-statistic and Durbin-Watson values for Reg_{tw21} and $Reg_{EUR/USD}$

	R^2	Adjusted R^2	Standard Error of regression	F-statistic	Durbin-Watson stat
Reg_{tw21}	0,075707	0,0477	0,66711	2,70295	2,115211
$Reg_{EUR/USD}$	0,026209	-0,0033	1,22937	0,88816	2,092559

The results were quite intriguing. First of all, although we were expecting different outputs for the two exposures, the resulting discrepancies were surprisingly high. The regression model Reg_{tw21} having exposure to trade-weighted exchange rate index as a dependent variable is statistically significant according to F-test value, which decreases dramatically for our second model based on EUR/USD exposure. Indeed, F-stat for the second regression is 0.89 (Table 11, in contrast with 2.7 F-stat value for Reg_{tw21}), meaning that the $Reg_{EUR/USD}$'s coefficients do not differ significantly from 0. Accordingly, R-squared values are much lower for $Reg_{EUR/USD}$, meaning that the chosen variables explain only 7.6% of the USD exposure, while their explanatory power accounts for only 2.6% of the trade-weighted index exposure. Moreover, if adjusted for the number of variables, R^2 values are approximately 0. The individual R^2 (calculated by running univariate regressions for each variable), are even lower and considered another evidence of weak explanatory power. Still, a low R^2 should have a similar value in both regression models since it's a result of obviously low explanatory power of the most employed variables.

Because Reg_{tw21} generates a significant output we further detail the analysis of each coefficient of the explanatory variable, comparing it with our initial assumptions and with similar empirical findings. Each coefficient expresses how much the exposure increases at a 1% movement of its specific independent variable, given that all the other variables are constant.

- **Intercept:** the intercept represents the slope of the regression equation and it is deemed not to have a particular significance in exposure-related studies.

- **Total Debt / Total Assets:** the second variable has been employed as a proxy for leverage. As discussed in the methodology chapter, we expect a negative correlation with exposure. The sign of the coefficient corresponds to our assumptions, therefore our variable is theoretically valid. In addition to this our findings are consistent with the ones of Nguyen and Faff (2003), which highlight a negative correlation due to an increased hedging activity. Our variable is not statistically significant as proved in most studies (Nguyen and Faff (2003), He and Ng (1998)).

- **Foreign Sales / Total Sales:** is the percentage of foreign sales to total sales. Intuitively, international activities should be a significant determinant correlated positively with exposure. In our study the sign is consistent with both theoretical and empirical background, but it is not statistically significant. Chow (1997) argues that international operations are usually not accurately reflected in annual reports, hence the lack of statistical significance. By contrast, Jorion's study (1990) highlights the significance of foreign sales.

- **Growth opportunities:** have been measured as total investments divided by total assets. Our hypothesis of negative correlation with exposure is confirmed this time as well, but we encounter the same lack of significance. Nguyen and Faff (2003) findings are consistent with ours, reflecting the same statistically significant relation with exposure. In the case of investments growth is deemed to be primarily related to hedging, hence it might not have a noticeable impact on firm's exposure. Moreover, Williamson (2001) argues on the fact that smaller firms would rather hedge when faced with increased bankruptcy costs. Therefore, growth is assumed to have an opposite sign. Nevertheless most studies fail to find a significant growth variable.

- **Ln (Total Assets):** logarithm of total assets, is commonly used as a proxy for size. According to He and Ng (1998) arguments we assume that the influence of size on exposure is negative, since larger companies hedge more. The resulting coefficient is also consistent with our assumptions, although it is not significant. As mentioned before, an opposite correlation between size and hedging is suggested by different authors. On the other hand, intuitively, a large company with increasing foreign operations should have increasing exposure. Nevertheless, we consider that an increased hedging activity and availability of scale economies should offset the effects of internationalization. In this respect, Chow (2007) found evidence of significant negative influence of size on exchange rate exposure.

- **Sovereign rating:** as a country-specific variable, we assign to each country a number corresponding to its respective credit rating. Afterward we apply that number for each company belonging to the respective country. As we have never encountered this variable in previous similar studies, we expected poor coefficient values. Surprisingly, the variable is statistically significant and, moreover, has the expected sign. This reflects correctly the economic reasons that a more economically stable domestic market should decrease exposure. Therefore we judge our choice to be valid, even if it hasn't been previously used in similar empirical studies.

- **Industry classification:** lastly we employed a classification of industries according to tradable and non-tradable products, which is an indirect measure of competitiveness and product differentiation. By assigning a binary dummy, we have obtained again a statistically and economically sound coefficient. Dominguez and Tesar (2001) reached the same conclusion regarding the industry dummy sign, but with no significance.

Compared to Reg_{tw21}, $Reg_{EUR/USD}$ has overall lower regression coefficients even if most of them have same signs (Table 10). Exceptions consist of higher values of leverage and growth corresponding to higher t-values, but still below our significance level of 5%. Size

and growth variables, instead, change their sign, contradicting our assumptions. Since both variables are related to hedging activities, we can only conclude that large companies or, more specifically, hedgers, are more exposed to USD. Other exceptions are represented by the change of sign for size. Nevertheless, it is impossible to find a theoretical or economical reason of this situation. Since most studies employ only one dependent variable for the cross-sectional analysis, we can't compare our differences with the ones found in similar researches. Therefore, we don't consider $Reg_{EUR/USD}$ as being relevant.

To sum up, we believe that our results are grounded on a sound theoretical and logical background. These results are consistent with a significant number of previous findings and all the arguments are valid enough (Table 10). Therefore, we argue that the peculiarity of our output comes as a consequence of several methodological limitations and as a matter of choosing variables and samples that haven't been previously employed for similar purposes.

5. Conclusion

This last chapter displays the conclusions of our undertaken study, along with the implications that we identified during our analysis. We also offer some recommendations for further research.

The objective of this thesis is to perform an analysis of exchange rate exposure of companies and industries of the Euro Area. In the first part of our analysis we want to estimate company-specific exchange rate exposures. More specifically, the first part of our study aims to analyze the exchange rate exposure across listed companies having a common currency (EUR), but belonging to different countries and industries. The second part aims to investigate the extent to which different company-, industry- and country-level variables influence the exchange rate exposure. In this part, we investigate the extent to which several internal and external factors influence corporate exchange rate exposure. Unanticipated exchange rate movements are considered to be a fundamental feature of the international economic environment and it is widely believed that exchange rates have been increasingly affecting the value of the firms during the latest years.

One of the hypotheses we wanted to test is the extent to which the industry sensitivity can be reflected in the differences of the exposure. We were particularly expecting that companies belonging to highly affected industries by macroeconomic changes should have a high exposure, an average sensitivity reflected by median exposures and a low sensitivity due to reduced exposure. However, the results didn't confirm our hypothesis. We consider that this inconsistency is due to a possible flawed group selection, but also due to a lack of preciseness in Ganguin's (2005) classification.

Our results show that the resulting exposures reflect an overall low level of significant exposure: 5.79% for the trade-weighted exchange rate index (tw21) and 8.15% for the EUR/USD exchange rate. In order to estimate company-specific exchange rate exposure in

the first stage of our regression, we have conducted time-series regressions for each of the 466 companies of our sample, using both EUR/USD exchange rate and a Euro Area specific trade-weighted exchange rate index. The findings resulted to be consistent with previous results showing surprisingly weak evidence. Moreover, our results highlighted an overall negative exposure: the Euro Area companies from the chosen industries are losing on average 0.208% in value when Euro depreciates with 1% against USD and 0.18% for a 1% depreciation against the tw21. Negative significant exposures follow the same pattern, consisting of 9.45% in the case of EUR/USD and 7.51% for the tw21 index, highlighting that the analyzed companies are more exposed to foreign currencies appreciation.
The second-stage analysis indicates statistical significance only for the regression which used the exposure to the trade-weighted exchange rate index. As all the regression proved to have coefficients with the expected signs, our chosen variables were consistent with the theoretical background. In spite of this, only two variables were statistically significant (country credit rating and industry classification).

We believe that our results are grounded on a sound theoretical and logical background, consistent with a significant number of previous findings and thus, considered valid enough. Therefore, we argue that the peculiarity of our output comes as a consequence of several methodological limitations and as a matter of choosing variables and samples that haven't been previously employed for similar purposes. Assessing the companies' sensitivity to exchange rate changes has been one of the most challenging issues in international financial management over the last two decades. As such, in spite of the peculiarity of our results, we believe that our study meets the criteria of a valuable exchange rate exposure assessment and thus we have accomplished our research purpose.

5.1 Further research

Due to the lack of data availability and limited time at our disposal, we were able to conduct research only on a small sample of companies of the Euro Area. In order to properly analyze the implications of Optimum Currency Areas (OCA) and the extent to which the European Economic ad Monetary Union (EMU) reaches its aims, we suggest a

comprehensive comparison between the levels of exposure of European countries before and after joining EMU.

Moreover, we consider that an analysis of EMU impact on non-Euro currency exposures would be relevant to assess the validity of one of EMU's objectives, which is the decrease of the member states' currency exposure. A worthy future research purpose would be this analysis between the exposure of Euro Area members and non Euro Area ones.

Appendices

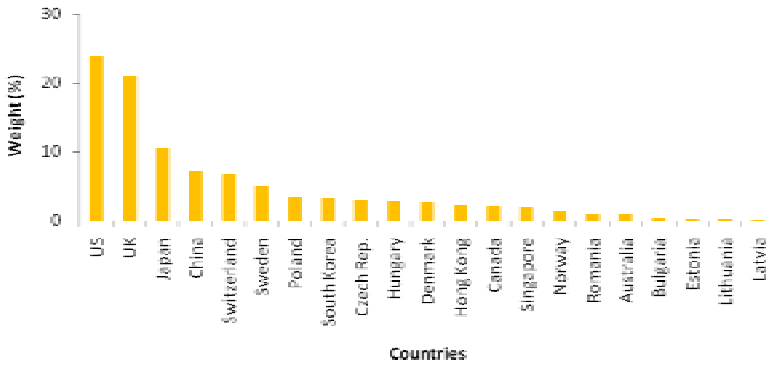
Appendix 1. Number of chosen companies per industry

The table shows the classification of the industries according to the impact of economic changes. More precisely, the table presents a comparison between the two samples of companies used in the first-stage regression (466 and 205 companies).

Group of industries	Industry	466 sample	205 sample
Highly affected by economic changes	Basic Materials	67	32
	Oil & Gas	31	14
	Retail	55	26
		153	72
		(32,8%)	*(35,1%)*
Moderately affected by economic changes	Broadcasting & Entertainment	20	6
	Industrial Engineering	54	30
	Technologies	69	27
	Telecommunications	17	9
		160	72
		(34,4%)	*(35,1%)*
Slightly affected by economic changes	Healthcare & Pharmaceuticals	55	21
	Personal Goods & Households Products	54	26
	Utilities	44	14
		153	61
		(32,8%)	*(29,8%)*

Appendix 2. Countries belonging to the EER-21 index

The table shows the 21 main trading partners of the Euro Area in 2008 that form the EER-21 trade-weighted index.



Source: European Central Bank, http://www.ecb.int/mopo/eaec/trade/html/index.en.html

Appendix 3. Industry classification

The table shows the industry classification based on the nature of goods traded in each industry. The dummy variable is 1 for the industries with tradable goods and 0 for the industries with non-tradable goods.

Industry	Attribute	Dummy
Broadcasting & Entertainment Retail Basic Materials Healthcare & Pharmaceuticals	Non-tradable goods	0
Industrial Engineering Personal Goods & Household Products Telecommunications Technology Utilities Oil & Gas	Tradable goods	1

Appendix 4. Country credit rating

The table shows the countries' credit ratings according to S&P's and Moody's rankings and to the numeric value we assigned them (S&P's: AAA=7, A-=1 ; Moody's: Aaa=7, A1=3). The second-stage regressions use the average between those values.

Euro Area country	S&P's rating	Value	Moody's rating	Value	Average
Austria	AAA	7	Aaa	7	**7**
Finland	AAA	7	Aaa	7	**7**
France	AAA	7	Aaa	7	**7**
Germany	AAA	7	Aaa	7	**7**
Luxembourg	AAA	7	Aaa	7	**7**
Netherlands	AAA	7	Aaa	7	**7**
Ireland	AA+	6	Aaa	7	**6,5**
Spain	AA+	6	Aaa	7	**6,5**
Belgium	AA+	6	Aa1	6	**6**
Slovenia	AA	5	Aa2	5	**5**
Italy	A+	3	Aa2	5	**4**
Portugal	A+	3	Aa2	5	**4**
Cyprus	A+	3	Aa3	4	**3,5**
Malta	A	2	A1	3	**2,5**
Greece	A-	1	A1	3	**2**

Appendix 5. Breusch-Godfrey Serial Correlation LM Tests

The table shows the results of the Breusch-Godfrey test.

Reg_{tw21}: note Breusch-Godfrey Serial Correlation LM Test: null hypothesis is accepted both for 1 and 2 lags, hence serial correlation doesn't represent an issue

2 lags

F-statistic	0.541857	Prob. F(2,55)	0.5847
Obs*R-squared	1.159390	Prob. Chi-Square(2)	0.5601

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2004M01 2008M12
Included observations: 60

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.040851	2.305606	0.017718	0.9859
TW_21	9.428391	191.6432	0.049198	0.9609
DJ_EURO_STOXX_TMI	1.478188	55.08011	0.026837	0.9787
RESID(-1)	0.141105	0.136409	1.034431	0.3055
RESID(-2)	0.000265	0.140337	0.001887	0.9985

1 lag

F-statistic	1.103415	Prob. F(1,56)	0.2980
Obs*R-squared	1.159386	Prob. Chi-Square(1)	0.2816

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2004M01 2008M12
Included observations: 60

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.040682	2.283199	0.017818	0.9858
TW_21	9.410136	189.6822	0.049610	0.9606
DJ_EURO_STOXX_TMI	1.460619	53.80044	0.027149	0.9784
RESID(-1)	0.141134	0.134357	1.050436	0.2980

$Reg_{EUR/USD}$: note Breusch-Godfrey Serial Correlation LM Test: null hypothesis is accepted both for 1 and 2 lags, hence serial correlation doesn't represent an issue

2 lags

F-statistic	0.416579	Prob. F(2,55)	0.6614
Obs*R-squared	0.895336	Prob. Chi-Square(2)	0.6391

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2004M01 2008M12
Included observations: 60

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007535	2.292904	0.003286	0.9974
EUR_USD	-9.717179	105.3805	-0.092210	0.9269
DJ_EURO_STOXX_TMI	2.968582	53.15927	0.055843	0.9557
RESID(-1)	0.122193	0.136982	0.892037	0.3763
RESID(-2)	0.012002	0.139226	0.086202	0.9316

1 lag

F-statistic	0.840626	Prob. F(1,56)	0.3631
Obs*R-squared	0.887351	Prob. Chi-Square(1)	0.3462

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2004M01 2008M12
Included observations: 60

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002172	2.269750	-0.000957	0.9992
EUR_USD	-10.66329	103.8744	-0.102656	0.9186
DJ_EURO_STOXX_TMI	2.204882	51.94923	0.042443	0.9663
RESID(-1)	0.123595	0.134803	0.916857	0.3631

Appendix 6a. Auxiliary regressions of $Reg_{EUR/USD}$

Dependent Variable: EUR/USD_DJTMI

EUR/USD_DJTMI = 0.0899910357576 - 0.894166296984*TotalDebt/TotalAssets

	Coefficient	Standard Error	t-Statistic	Probability
C	0.089991	0.225470	0.399126	0.6902
TotalDebt/TotalAssets	-0.894166	0.842368	-1.061491	0.2897
R^2	**0.010862**		Adjusted R^2	0.005990
S.E. of regression	1.223665		Sum squared resid	303.9631
F-statistic	2.229249		Prob(F-statistic)	0.136972

EUR/USD_DJTMI = -0.270571972655 + 0.270261517725*ForeignSales/TotalSales

	Coefficient	Standard Error	t-Statistic	Probability
C	-0.270572	0.215513	-1.255479	0.2107
ForeignSales/TotalSales	0.270262	0.394417	0.685218	0.4940
R^2	**0.002829**		Adjusted R^2	-0.002083
S.E. of regression	1.228624		Sum squared resid	306.4317
F-statistic	0.575952		Prob(F-statistic)	0.448784

EUR/USD_DJTMI = -0.125106211108 + 0.0731774614*Investments/TotalAssets

	Coefficient	Standard Error	t-Statistic	Probability
C	-0.125106	0.101319	-1.234779	0.2183
Investments/TotalAssets	0.073177	2.030760	0.036035	0.9713
R^2	**0.000004**		Adjusted R^2	-0.004922
S.E. of regression	1.230363		Sum squared resid	307.2999
F-statistic	0.000773		Prob(F-statistic)	0.977848

EUR/USD_DJTMI = -0.286146872039 + 0.0111390238646*ln(TotalAssets)

	Coefficient	Standard Error	t-Statistic	Probability
C	-0.286147	0.564257	-0.507122	0.6126
ln(TotalAssets)	0.011139	0.037978	0.293305	0.7696
R^2	**0.000360**		Adjusted R^2	-0.004564
S.E. of regression	1.230144		Sum squared resid	307.1905
F-statistic	0.073097		Prob(F-statistic)	0.787155

EUR/USD_DJTMI = 0.187008486289 - 0.047309371073*CountryRating

	Coefficient	Standard Error	t-Statistic	Probability
C	0.187008	0.533526	0.350514	0.7263
CountryRating	-0.047309	0.080055	-0.590964	0.5552
R^2	**0.001615**		Adjusted R^2	-0.003304
S.E. of regression	1.229372		Sum squared resid	306.8050
F-statistic	0.328281		Prob(F-statistic)	0.567307

EUR/USD_DJTMI = -0.245049844259 + 0.207643324864*IndustryClassification

	Coefficient	Standard Error	t-Statistic	Probability
C	-0.245050	0.131288	-1.866513	0.0634
IndustryClassification	0.207643	0.173172	1.199060	0.2319
R^2	**0.006981**		Adjusted R^2	0.002089
S.E. of regression	1.226063		Sum squared resid	305.1558
F-statistic	1.427107		Prob(F-statistic)	0.233631

Appendix 6b. Auxiliary regressions of Reg_{tw21}

Dependent Variable: tw21_DJTMI

TW21_DJTMI = -0.0628098264062 - 0.349334402756* TotalDebt/TotalAssets

	Coefficient	Standard Error	t-Statistic	Probability
C	-0,06281	0,093043	-0,675062	0,5004
TotalDebt/TotalAssets	-0,349334	0,334495	-1,044364	0,2976
R^2	**0,005344**		Adjusted R-squared	0,000444
S.E. of regression	0,68346		Sum squared resid	94,82474
F-statistic	1,090697		Prob(F-statistic)	0,297559

TW21_DJTMI = -0.2192379306 + 0.134185023948* ForeignSales/TotalSales

	Coefficient	Standard Error	t-Statistic	Probability
C	-0,219238	0,11808	-1,856684	0,0648
ForeignSales/TotalSales	0,134185	0,198408	0,676307	0,4996
R^2	**0,002248**		Adjusted R^2	-0,002667
S.E. of regression	0,684522		Sum squared resid	95,1199
F-statistic	0,457392		Prob(F-statistic)	0,499615

TW21_DJTMI = -0.12111870575 - 1.14529908407* Investments/TotalAssets

	Coefficient	Standard Error	t-Statistic	Probability
C	-0,121119	0,05756	-2,104228	0,0366
Investments/TotalAssets	-1,145299	1,463855	-0,782386	0,4349
R^2	**0,003006**		Adjusted R^2	-0,001905
S.E. of regression	0,684262		Sum squared resid	95,04761
F-statistic	0,612127		Prob(F-statistic)	0,4349

TW21_DJTMI = 0.136570534456 - 0.0193673301173*ln(TotalAssets)

	Coefficient	Standard Error	t-Statistic	Probability
C	0,136571	0,337935	0,404133	0,6865
ln(TotalAssets)	-0,019367	0,022912	-0,845305	0,3989
R^2	**0,003508**		Adjusted R^2	-0,001401
S.E. of regression	0,68409		Sum squared resid	94,99983
F-statistic	0,714541		Prob(F-statistic)	0,398936

TW21_DJTMI = 0.382775619193 - 0.0805972963635* IndustryClassification

	Coefficient	Standard Error	t-Statistic	Probability
C	0,382776	0,303547	1,26101	0,2088
CountryRating	-0,080597	0,045679	-1,764444	0,0792
R^2	**0,015105**		Adjusted R^2	0,010253
S.E. of regression	0,680098		Sum squared resid	93,89423
F-statistic	3,113264		Prob(F-statistic)	0,079161

TW21_DJTMI = -0.307411195033 + 0.275371955494*TRADED_G

	Coefficient	Standard Error	t-Statistic	Probability
C	-0,307411	0,072845	-4,220086	0
IndustryClassification	0,275372	0,09521	2,892245	0,0042
R^2	**0,039576**		Adjusted R^2	0,034845
S.E. of regression	0,671596		Sum squared resid	91,56123
F-statistic	8,365081		Prob(F-statistic)	0,004242

Appendix 7. White – cross Heteroskedasticity Test

Dependent Variable: RESID^2. Included observations: 205

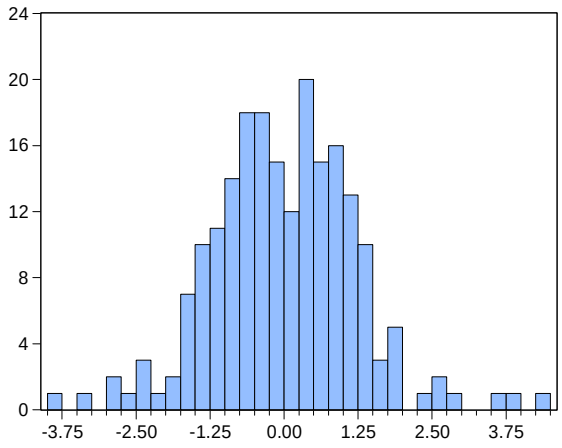
	Reg_{tw21}				$Reg_{EUR/USD}$			
	Coefficient	**Standard Error**	**t-Statistic**	**Probabiliy**	**Coefficient**	**Standard Error**	**t-Statistic**	**Probability**
C	0.145339	4.868459	0.029853	0.9762	9.694025	12.14446	0.798226	0.4258
D_A	0.838483	5.887023	0.142429	0.8869	4.144979	14.68528	0.282254	0.7781
D_A^2	2.045592	2.427688	0.842609	0.4006	38.36516	6.055911	6.335159	0.0000
D_A*FOREIGN_SALES_SALES	2.038943	2.350629	0.867403	0.3869	-11.92350	5.863685	-2.033449	0.0435
D_A*INVESTMENTS_TOTAL_ASSETS	10.98505	19.64193	0.559266	0.5767	45.01844	48.99713	0.918797	0.3594
D_A*LN_TOTAL_ASSETS_	-0.080739	0.272511	-0.296277	0.7674	-2.174725	0.679783	-3.199144	0.0016
D_A*RATING_D	-0.253791	0.641648	-0.395529	0.6929	1.737128	1.600603	1.085296	0.2793
D_A*TRADED_G	-0.689385	1.089766	-0.632599	0.5278	-2.213103	2.718440	-0.814108	0.4167
FOREIGN_SALES_SALES	-4.624399	3.240308	-1.427148	0.1553	-13.16697	8.083005	-1.628969	0.1051
FOREIGN_SALES_SALES^2	-0.383228	1.265549	-0.302816	0.7624	2.824826	3.156935	0.894800	0.3721
FOREIGN_SALES_SALES*INVESTMENTS_TOTAL_ASSETS	4.498630	16.85202	0.266949	0.7898	-0.879778	42.03765	-0.020928	0.9833
FOREIGN_SALES_SALES*LN_TOTAL_ASSETS_	0.204620	0.204652	0.999842	0.3187	0.671937	0.510509	1.316210	0.1898
FOREIGN_SALES_SALES*RATING_D	0.266180	0.279752	0.951486	0.3426	0.738044	0.697846	1.057603	0.2917
FOREIGN_SALES_SALES*TRADED_G	-0.478258	0.617745	-0.774201	0.4398	-1.941425	1.540975	-1.259868	0.2094
INVESTMENTS_TOTAL_ASSETS	2.410093	28.94310	0.083270	0.9337	-17.26641	72.19908	-0.239150	0.8113
INVESTMENTS_TOTAL_ASSETS^2	7.032322	36.92801	0.190433	0.8492	56.89569	92.11758	0.617642	0.5376
INVESTMENTS_TOTAL_ASSETS*LN_TOTAL_ASSETS_	0.198397	1.295561	0.153136	0.8785	-0.217606	3.231801	-0.067333	0.9464
INVESTMENTS_TOTAL_ASSETS*RATING_D	-1.332746	4.089303	-0.325910	0.7449	1.420085	10.20084	0.139213	0.8894
INVESTMENTS_TOTAL_ASSETS*TRADED_G	-3.529784	8.735050	-0.404094	0.6866	-15.79172	21.78973	-0.724732	0.4696
LN_TOTAL_ASSETS_	0.097098	0.390589	0.248593	0.8040	0.130632	0.974331	0.134073	0.8935
LN_TOTAL_ASSETS_^2	-0.007570	0.008966	-0.844292	0.3996	-0.027437	0.022366	-1.226722	0.2215
LN_TOTAL_ASSETS_*RATING_D	-0.002086	0.047970	-0.043482	0.9654	0.112550	0.119663	0.940557	0.3482
LN_TOTAL_ASSETS_*TRADED_G	0.089558	0.090417	0.990498	0.3233	0.248966	0.225548	1.103830	0.2712
RATING_D	0.222216	0.960275	0.231409	0.8173	-2.376942	2.395423	-0.992285	0.3224
RATING_D^2	-0.015356	0.079168	-0.193964	0.8464	0.027905	0.197487	0.141299	0.8878
RATING_D*TRADED_G	-0.047670	0.177661	-0.268321	0.7888	-1.024690	0.443179	-2.312139	0.0219
TRADED_G	-0.499917	1.665952	-0.300079	0.7645	5.252463	4.155746	1.263904	0.2079

	Reg_{tw21}	$Reg_{EUR/USD}$
R^2	0.047882	0.285056
Adjusted R^2	-0.091192	0.180626
Sum squared resid	157.5167	980.1664
Standard error of regression	0.940705	2.346605
Obs* R^2	9.815712	58.43657
Scaled explained SS	19.99801	85.54588
F-statistic*	**0.344289**	**2.729642**
Prob(F-statistic)	**0.998910**	**0.000054**
Prob. Chi-Square(26)	0.9983	0.0003
Prob. Chi-Square(26)	0.7917	0.0000

Appendix 8. Jarque-Bera normality tests

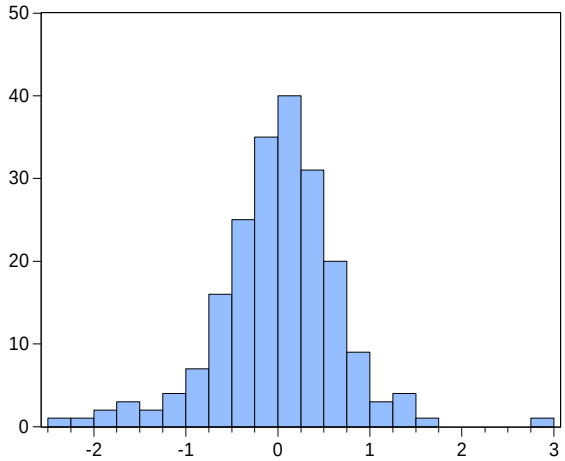
Jarque-Bera normality test for $Reg_{EUR/USD}$ and Reg_{tw21}

Jarque-Bera normality test for $Reg_{EUR/USD}$ - null hyphotesis is accepted, thus the residuals are normally distributed



Series: Residuals	
Sample 1 205	
Observations 205	
Mean	-7.91e-17
Median	-0.076581
Maximum	4.288591
Minimum	-3.763328
Std. Dev.	1.211156
Skewness	0.191986
Kurtosis	4.138497
Jarque-Bera	12.33084
Probability	0.002101

Jarque-Bera normality test for Reg_{tw21} - null hyphotesis is accepted, thus the residuals are normally distributed



Series: Residuals	
Sample 1 205	
Observations 205	
Mean	-9.86e-17
Median	0.045904
Maximum	2.776251
Minimum	-2.319033
Std. Dev.	0.657225
Skewness	-0.300525
Kurtosis	5.367895
Jarque-Bera	50.97828
Probability	0.000000

Appendix 9a. Reg_{tw21} summary output

Dependent Variable: tw21
Number of Observations: 205
No correction.

	Coefficient	Standard Error	t-Statistic	Probability
Intercept	0.652900	0.453996	1.438118	0.1520
Total Debt / Total Assets	-0.378448	0.343600	-1.101419	0.2721
Foreign Sales / Total Sales	0.201432	0.201125	1.001529	0.3178
Investments / Total Assets	-0.979803	1.449780	-0.675829	0.4999
Ln(Total Assets)	-0.016852	0.023318	-0.722724	0.4707
Country Credit Rating	-0.109046	0.047153	-2.312624	0.0218
Industry classification	0.281673	0.095478	2.950151	0.0036

R^2	Adjusted R^2	Standard Error of regression	F-statistic	Durbin-Watson stat
0.075707	0.047698	0.667109	2.702950	2.115211

Appendix 9b. $Reg_{EUR/USD}$ summary output

Dependent Variable: EUR/USD
Number of Observations: 205
White Heteroskedasticity-Consistent Standard Errors & Covariance.

	Coefficient	Standard Error	t-Statistic	Probability
Intercept	0.203701	0.755190	0.269734	0.7876
Total Debt / Total Assets	-1.054600	0.907061	-1.162657	0.2464
Foreign Sales / Total Sales	0.294162	0.392477	0.749503	0.4544
Investments / Total Assets	0.182437	2.074587	0.087939	0.9300
Ln(Total Assets)	0.020448	0.039590	0.516487	0.6061
Country Credit Rating	-0.098639	0.079312	-1.243695	0.2151
Industry classification	0.186836	0.172261	1.084609	0.2794

R^2	Adjusted R^2	Standard Error of regression	F-statistic	Durbin-Watson stat
0.026209	-0.003300	1.229370	0.888160	2.092559

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