Exchange rate movements and firm value: Evidence from European firms across the financial crisis period

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Purpose – This study investigates the sensitivity of firm value to exchange rate movements, and the determinants of such exposure for 100 European blue chip companies over 2001-2012.

Design/methodology/approach – We adopt a disaggregated framework that distinguishes between Eurozone and non-Eurozone firms, and between financial and non-financial firms across the pre-crisis, crisis, and post-crisis periods of the recent financial crisis.

Findings – We find no significant difference between Eurozone and non-Eurozone, and financial and non-financial firms. Exposure is found to be higher during the financial crisis, across all sub-samples of firms. In the majority of cases the exposure coefficient is significantly positive, indicating that European firms' stock returns are positively (negatively) affected by depreciation (appreciation) of exchange rates (indirect quotation).

Practical implications – It is recommended that firms' financial plans budget for higher liquidity levels in order to build up, during 'good times', a natural hedge for the higher exposure likely to be faced during periods characterized by greater financial distress.

Originality/value – The main novelty lies in the adoption of a disaggregated framework that discriminates between pre-crisis, crisis and post-crisis periods in order to ascertain the extent to which the recent financial crisis affected the relationship in question.

Keywords Exchange rate risk, Exposure, Firm value, Financial crisis

Paper type Research paper

JEL classification – F31, F23

1. Introduction

Foreign exchange risk is a major concern for both investors and corporate managers because exchange rate (ER) movements can directly or indirectly affect cash flows and the market value of firms, which is how we define the concept of ER exposure (see also Jorion, 1990).

Nevertheless, many empirical studies (e.g., Amihud, 1994; Bartov and Bodnar, 1994; Jorion, 1990; Marston, 2001) indicate that ER movements have little or no impact on the value of firms. This evidence may be explained by either the fact that firms use effective currency risk management techniques to neutralize foreign exchange risk (e.g., through hedging instruments such as ER derivatives) or, alternatively, by the failure of modelling, estimation or

sampling techniques employed in such studies to detect a significant effect of ER movements on firm value.

At a macro level, a number of studies (e.g., Alagidede *et al*., 2010; Giannellis *et al*., 2010; Tabak, 2006; Yau and Nieh, 2009) find a significant relationship between ERs and stock market indices. Bahmani-Oskooee and Sohrabian (1992) found bi-directional causality between stock prices and ERs in the short run (though not in the long run). On the other hand, the results emerging from micro level studies that focus on ER fluctuations and individual stock returns (Agyei-Ampomah *et al*., 2013; Amihud, 1994; Bartov and Bodnar, 1994; Dominguez and Tesar, 2006; Hutson and Stevenson, 2010; Marston, 2001) are mixed.

This leaves the question of the impact of ER exposure (the sensitivity of firm value to ER movements) largely unanswered. The aim of this article is to revisit this question by investigating empirically the sensitivity of 100 Eurozone and non-Eurozone blue chip companies' market value to ER movements. The study also distinguishes between financial and non-financial firms. This distinction appears particularly relevant when considering that some studies (e.g., Kanagaraj and Sikarwar, 2011) now tend to examine solely non-financial firms given the complexity of foreign ER exposure and risk management techniques used by financial firms.

However, the main novelty of the present study lies in the adoption of a disaggregated framework that distinguishes between pre-crisis, crisis and post-crisis periods in order to ascertain the extent to which the recent financial crisis affected the relationship in question; an aspect which has not been given any

attention in prior work. This is particularly striking given that at both the theoretical and empirical level there is already evidence pointing to the possibility that exposure may differ across periods. For example, Solnik (2000) points out that financial crises have a negative effect on both ERs and stock prices, in both developed and emerging markets. Empirically, Yoshida (2009) specifically tested how a financial crisis affects the linkage between foreign exchange markets and stock markets and found that following the financial crisis originating from the collapse of the US housing market in 2007, financial markets, including stock markets and foreign exchange markets, experienced drastic fluctuations during the adjustment stage. He found strong evidence of an abrupt upward shift in correlation in June 2001, and of another, though weaker, upward correlation shift in June 2008. Significantly, he also found evidence indicating a two-way causality effect between the ER and the stock market in Japan. Though limited in scope, the above propositions and related evidence provide a sound justification for investigating whether the sensitivity of firm value to ER movements varies across pre-crisis, crisis and post-crisis periods. To complement the analysis, the study also examines the determinants of significant ER exposure of firms.

2. Brief literature review

Doukas *et al.* (2003) argue that the effect of ER fluctuations on the market value of firms depends upon the ER exposure of the firm. ER exposure can directly affect firms that are involved in international trade. Domestic firms can

also be affected indirectly, through a mechanism whereby ER exposure affects aggregate demand and industry competitiveness and concentration.

Transaction (or direct) exposure is defined by Döhring (2008) as the impact of ER fluctuations on the cash flows from receivables (payables) from exports (imports) and the repatriation of dividends. Transaction exposure from foreign currency denominated imports arises in the same way as from foreign currency denominated exports. On the other hand, indirect exposure mainly depends upon the price elasticity of demand and the degree of substitutability of goods (Agyei-Ampomah *et al*., 2013).

With respect to the determinants of ER exposure, De Jong *et al.* (2006) argue that firms' ER exposure varies across countries. They point out that firms in an open economy such as the Netherlands are more likely to be affected by foreign exchange risk than firms in a closed economy such as North Korea, and show that in the sample of their study, 50% of Dutch firms experience significant exposure. Hutson and Stevenson (2010) also find a significant relationship between country trade openness and ER exposure.

Bodnar and Gentry (1993) argue that firms' ER exposure varies significantly across industries, its extent being dependent upon industry specific factors such as competitiveness. Bodnar *et al.* (2002) add that firms' indirect exposure to ER movements depends on the firm's ability to pass on to customers the increased costs (or prices) as a result of ER fluctuations. Bodnar and Gentry (1993) find that 23% of 39 US, Canadian and Japanese industries in their sample experience significant exposure. Williamson's (2001) study corroborates these findings.

However, other studies (e.g., Doidge *et al*., 2003; Griffin and Stulz, 2001) find only weak evidence of ER exposure. Dominguez and Tesar (2006) suggest that trade measured at industry level has a marginal impact on firms' exposure, and that firms in sectors with a high level of foreign transactions are more likely to hedge.

Doukas *et al.* (2003) emphasize that in addition to macroeconomic variables and industry competitive structure, firm specific characteristics such as foreign currency debt, hedging, firm size, leverage, liquidity and growth opportunities also affect firms' foreign exchange exposure. They show that firms with high exposure are more likely to use foreign currency hedging instruments. They also argue that the extent of hedging is dependent upon its cost, and managers' familiarity with hedging instruments. As such, small firms are less likely to hedge.

Turning to the purely empirical literature, the evidence is conflicting. Whilst the findings by Amihud (1994), Bartov and Bodnar (1994), and Jorion (1990) indicate that ER movements do not affect firm value, the more recent studies by Agyei-Ampomah *et al.* (2013), Choi and Prasad (1995), Dominguez and Tesar (2006), El-Masry (2006), and Hutson and Stevenson (2010) find that firms have significant ER exposure.

There are only a few studies which examine ER exposure of European firms. El-Masry (2006) investigates ER exposure of UK non-financial companies. By splitting the entire sample period into pre-ERM (Exchange Rate Mechanism), in-ERM, and post-ERM, he finds that stock returns of UK firms are more sensitive to ER fluctuations in the pre-ERM and

post-ERM periods. Agyei-Ampomah *et al*. (2013) also examine ER exposure of UK non-financial firms and find that 14.9% of firms are directly or indirectly exposed to ER fluctuations when the standard Jorion's (1990) model is used. However, the estimated exposure increases to 85.13% when using the time-varying regression with orthogonalized market returns.

Among the studies that compare the exposure of Eurozone and non-Eurozone firms, Hutson and Stevenson (2010) find that ER exposure of Eurozone firms is significantly higher than that of non-Eurozone firms in the post-Euro period. However, after controlling for country and firm specific variables, they find no evidence in support of a significant difference. On the other hand, Bartram and Karolyi (2006) find that ER exposure of non-financial Eurozone firms decreases slightly in absolute terms in the post-Euro period.

The above review reveals that the impact of ER movements on the market value of firms is inconclusive. Previous studies also neglect the potential role of financial crises in affecting the relationship in question. Interestingly though, Agyei-Ampomah *et al.* (2013) point out that weak evidence of foreign exchange exposure in most previous studies may be due to Jorion's model assumption that exposure is constant over time, in spite of the fact that, in reality, the firm's 'circumstances' (including the extent of international operations and risk management activities) change over time, making its currency risk exposure also expected to vary over time.

The above proposition makes our study, which benefits from the latest available data, particularly opportune, and its contribution timely, since such 'circumstances' may change even more across pre-crisis, crisis and post-crisis

periods. For example, during a financial crisis a *leverage effect* may cause asymmetric impacts, meaning that a negative shock would exert a greater influence than a positive shock. It is also plausible to suggest that during a financial crisis firms may become more sensitive to ER movements because, being more liquidity constrained, they are forced to reduce risk management activities, which can be expensive.

3. Methodology

Following Jorion (1990), the two factor model used to test for European firms' ER exposure is specified as follows:

$$R_{it} = \alpha_i + \beta_{xi}X_t + \beta_{mi}M_t + e_{it} \quad (1)$$

where R_i represents stock return for firm i; X denotes the percentage change in ER; M is the market return; and $_t$ represents time. α_i is the constant term and e_{it} is the residual error term with a zero mean and a constant variance. Coefficients β_{xi} and β_{mi} represent a measure of sensitivity of stock return, i, to exchange risk and market risk, respectively. The presence of a 'market return' variable in equation (1) has the potential problem of introducing multicollinearity which may arise from the possibility that the market and ER factors are correlated. To deal with this problem, the following procedures are employed. First, 'market return', M, is regressed on ER changes:

$$M_t = \alpha + \gamma X_t + \varepsilon_t \quad (2)$$

Second, the component of the market portfolio return that is orthogonal to the changes in the ER (that is, the component of the market return that is not correlated with ER fluctuations) is obtained from estimation of the following equation:

$$F_t = M_t - (\alpha + \gamma X_t) \quad (3)$$

Finally, ER exposure is estimated by regressing firms' stock return on the orthogonal component of the portfolio returns and on the changes in ERs:

$$R_{it} = \alpha_i + \beta_{xi} X_t + \beta_{Fi} F_t + \upsilon_{it} \quad (4)$$

where R_i represents the stock return of firm i (constituents of Eurofirst 100); X_t denotes the percentage change in ERs (USD - Euro, USD - GBP, NEER Euro and NEER GBP) at time t; F_t is the orthogonal component of the market portfolio returns (Eurofirst 100 index); α_i is a constant term; and υ_{it} is the residual error expected to possess white noise properties.

A significantly positive (negative) sign of $\beta_{\mathbf{xi}}$ means that stock returns increase when the ER depreciates (appreciates), based on the indirect quotation. The standard 't test' is used to measure the statistical significance of the coefficients at the customary 5% level.

The appropriateness of the 'two factors' regression model that we employ is confirmed by the fact that this estimation procedure has been used extensively in previous studies (Agyei-Ampomah *et al*., 2013; Bartov and Bodnar, 1994; Dominguez and Tesar, 2006; El-Masry, 2006; Hutson and Stevenson, 2010; Kanagaraj and Sikarwar, 2011).

Following Agyei-Ampomaha *et al.* (2013) and Hutson and Stevenson (2010), in order to determine the determinants of ER exposure of individual firms, the following equation is estimated:

$$\pi_i = \alpha_i + \gamma_i OP_{j,i} + \delta_i MV_i + \omega_i DA_i + o_i MB_i + \kappa_i QR_i + \mu_i \quad (5)$$

where π_i is the dependent variable measured as the squared root of the absolute value of the ER exposure of firm i (β_{xi}**).** There are five regressors: one country specific (trade openness, 'OP'), and four firm specific ('Market Value'; 'Debt to Asset'; 'Market to Book value'; and 'Quick Ratio'). Trade openness is measured as 'exports plus imports' as a percentage of GDP, with OP_j as the average trade openness of country j. Firm size, financial distress, growth opportunity, and liquidity of firm *i* are measured by market value (MV), Debt to Asset Ratio (DA), Market to Book Value (MB), and Quick Ratio (QR) of firm i, respectively.

A significantly positive (negative) sign of γ_i means that exposure increases (decreases) when country openness increases (decreases). A significantly negative (positive) sign of δ_i means that exposure increases (decreases) when firm size (market value) decreases (increases). A significantly positive (negative) sign of ω_i, o_i and κ_i means that exposure increases (decreases) when the firm's financial distress (Debt to Asset), growth opportunity (Market to Book Value), and liquidity (Quick ratio) increases (decreases), respectively.

In order to check the robustness of the estimates from equation (5), the model is extended as follows:

$$\pi_i = \alpha_i + \gamma_i OP_{j,i} + \delta_i MV_i + \omega_i DA_i + o_i MB_i + \kappa_i QR_i + \lambda_i SD_i + \theta_i ID_i + \psi_i ED_i + \upsilon_{i,} \quad (6)$$

where SD_i is a dummy variable taking value 1 when the market value of firm *i* is less than $150 million, and 0 otherwise. Inclusion of this dummy in addition to the MV_i variable, is motivated by the fact that examination of the evidence on ER exposure and firm size suggests that this relation might be non-linear (see, for example, Dominguez and Tesar, 2006). Following Hutson and Stevenson (2010), we use the threshold of $150 million as the break point, as they find a non-linear relationship between exposure and firm size at that point. ID_i is a dummy taking value 1 when firm *i* is a financial firm, and 0 otherwise. ED_i is a dummy taking value 1 when firm *i* is a Eurozone firm, and 0 otherwise. A significant coefficient on SD_i (λ_i) would indicate the existence of a non-linear relationship between exposure and firm size, while a significantly positive coefficient on IDi (EDi) would indicate that financial (Eurozone) firms exhibit significantly higher exposure to foreign ER movements than non-financial (non-Eurozone) firms.

Kanagaraj and Sikarwar (2011) point out that estimation of these models may create biased estimates if not corrected for potential problems of stationarity, multicollinearity, correlation and heteroskedasticity. In the

preliminary testing phase, we checked for the integration and cointegration properties of the series and found that the variables were indeed in a cointegrating relationship. The multicollinearity issue is already alleviated within our estimation framework by the orthogonalization procedure explained above while potential correlation and heteroskedasticity problems are eliminated by correcting the OLS standard errors. Following Hutson and O'Driscoll (2010), the corrective measures we adopted entailed taking the log differences of the variables in equations (1) to (4), the squared root of the absolute value of firms' ER exposure, and the natural log value of 'OP', 'MV', 'DA', 'MB' and 'QR' in equations (5) and (6).

The dataset used in this study consists of weekly prices of 100 European blue chip stocks (constituents of FTSE Eurofirst 100, stock market index (see http://www.ftse.com/Indices/FTSE_Eurofirst_Index_Series/), spot nominal bilateral ERs (Euro per USD and GBP per USD), and nominal effective ERs (NEER Euro and NEER GBP). Following Bartram and Karolyi (2006), and Agyei-Ampomah *et al.* (2013), we use weekly data. We use nominal ERs because of small inflation differentials between the UK, Eurozone and USA during the sample period. Data are obtained from Datastream. The weekly return series are calculated as $R_t = \ln (P_t / P_{t-1})$, where P_t is the weekly price at time t.

The 'Eurofirst 100' index was chosen against available alternatives (e.g., the 'FTSE Eurofirst 80' index) since its larger sample size alleviates potential problems of 'survivorship sample bias' which could stem from constituent firms going in and out of the index year-on-year. Moreover, the

'Eurofirst 100' index, which is based on recursive estimates, already corrects for such a potential problem by balancing its sample selection on the basis of the 60 largest companies ranked by market capitalization in the FTSE Developed Europe Index with 40 additional companies selected for their size and sector representation.

The full sample covers the period from the 3 January 2001 to 26 December 2012, yielding 626 observations. The sample is dictated by data availability as the Eurofirst 100 composite index starts at 2001. The full sample period is divided into three sub-periods: pre-crisis, crisis, and post-crisis. The pre-crisis period covers from 03/01/2001 to 25/07/2007, yielding 343 observations. The crisis period is from 01/08/2007 to 25/03/2009, totalling 87 observations, and the post-crisis period is from 01/04/2009 to 26/12/2012, yielding 196 observations.

The firms are the constituents of the FTSE Eurofirst 100 index. Out of the 100 firms, 63 are from the Eurozone and the remaining 37 are non-Eurozone (UK) firms. The sample includes both financial (20) and non-financial firms (80). Out of the 80 non-financial firms, 49 are Eurozone firms and 31 are non-Eurozone (UK) firms. Among the 20 financial firms, 14 are from the Eurozone and the remaining 6 are from the UK (the full list of firms and respective industry/country is available upon request). Figures I to VI present the plots of the yearly distribution of European Stock Indices (Eurofirst 100), the Euro ER (US Dollar - Euro) and the Pound Sterling ER (US Dollar - GBP), and their respective returns, over the sample period.

< Figures I to VI and Table I here >

Panel A of Table I exhibits the descriptive statistics of weekly return series of stock index, nominal bilateral ERs (USD Euro and USD GBP) and nominal effective ERs (Euro NEER and GBP NEER**)**. Table I shows that the mean returns of the stock index, and ERs are negative. Hence, both stock and foreign currency markets in Europe did not perform well during the sample period. From Table I we can also evince that stock market volatility was higher than foreign currency market volatility, suggesting that transactional risk was higher within the former throughout the sample period.

Panel B of Table I shows the descriptive statistics of country and firm specific variables. Trade openness data are obtained from the Penn World Table (Version 6.2). The original distribution of all the series is negatively skewed, with long left tails. The kurtosis coefficients for all the series are greater than three, suggesting that the series are leptokurtic in nature. Similar characteristics are found for the series pertaining to financial data which display volatility clustering and leptokurtosis. We use impulse dummies to deal with the few outlier observations populating the tails of the distributions that tend to cause non-normality. The Jarque-Bera (J-B) statistics reported in Table I, obtained following the adoption of this corrective measure, show that the residuals pass the normality test, with all J-B statistics being smaller than the 5.99 critical value at the 5% significance level.

4. Results and discussion

Table II presents the regression results of ER (bilateral) exposure of Eurozone vs. non-Eurozone firms, estimated from equation (4). Table II shows that the

percentage of significant β_{xi} coefficients is almost the same for both Eurozone and non-Eurozone firms in all sample periods. Hence, there is no major difference across such firms in terms of ER exposure after controlling for market effects. 18% of Eurozone firms and 16% of non-Eurozone firms are found to have significant exposure in the full sample period. However, ER exposure of both Eurozone and non-Eurozone firms increases to around 25% during the period of the financial crisis, indicating that firms, and their market value, are more sensitive to ER movements during 'bad times'.

One possible explanation for this result is the *leverage effect*, meaning that a negative shock has greater impact than a positive shock. Indeed, a striking and unexpected feature of the financial crisis has been the strong appreciation rather than depreciation of the USD against most currencies globally. Alternatively, the pattern that our data unveils may be rationalized by the fact that during a financial crisis firms become more sensitive to ER movements because, being more liquidity constrained, they are unable to hedge as much.

< Table II here >

The average absolute size of the exposure of Eurozone and non-Eurozone firms is almost the same in all sample periods. Nevertheless, as shown in Panel B of Table I, the magnitude of such exposure increases during the financial crisis for all firms. In terms of the direction of ER exposure, most of the significant β_{xi} coefficients have a positive sign. This indicates that a depreciation/increase (indirect quotation) of USD - Euro and USD - GBP ERs has a positive impact on the market value of both Eurozone and non-Eurozone

(UK) firms. This result is both expected and intuitively plausible given that a depreciation of the local currency increases the competitive advantage of firms (indirect exposure) in the international market.

These results are consistent with those by El-Masry (2006) who found that 15% of UK firms have significant foreign exchange exposure, and those by Hutson and Stevenson (2010) who found that 10% of Eurozone firms have significant ER exposure. The low number of both Eurozone and non-Eurozone firms exposed to ER risk could be explained by the argument put forward by Bodnar *et al.* (2002) and Allayannis and Ofek (2001), according to which European 'Blue chip' companies systematically use financial derivatives to hedge transaction risk.

< Tables III and IV here >

Table III reports the regression results of ER (bilateral) exposure of financial vs. non-financial firms, which indicate that there is no major difference between them. 20% percent of financial firms and 16% of non-financial firms have significant ER exposure across the full sample period. These results align well to those of Bodnar and Gentry (1993), who also fail to find any significant differences. One possible explanation is that both financial and non-financial blue chip companies have equal knowledge and opportunities to hedge ER risk. Significantly, however, our results reveal that exposure increases during the 'bad times' of the financial crisis. This result may also imply that the financial crisis came unexpectedly and these companies, irrespective of whether they were financial or non-financial, were unable to take corrective actions soon enough. Most of the significant β_{xi}

coefficients for both financial and non-financial firms have a positive sign, indicating that a depreciation of the USD-Euro and the USD-GBP ER has a positive impact on the market value of both financial and non-financial firms.

Table IV presents the results of equations (5) and (6), which estimate the determinants of significant ER exposure of European firms for the full sample, and the pre-crisis, crisis and post-crisis sub-periods. The trade openness coefficient is positively significant at the customary 5% level in all sample periods in both equations. There is, therefore, a positive relationship between exposure and country specific trade openness. These findings provide further empirical support to those obtained by Bodnar and Gentry (1993).

Table IV also shows that the coefficient on firm size is negative and significant for equation (5) in the full sample. This indicates that smaller-sized firms are more exposed to ER movements than larger ones. This result is consistent with previous findings in the literature and can be explained by the fact that larger firms are more likely to hedge currency exposure because hedging activities exhibit economies of scale (e.g., Allayannis and Ofek, 2001), and also by the fact that large firms that operate across a greater number of countries are associated with less ER exposure (Pantzalis *et al*., 2001). The significance of the dummy coefficient on 'firm size' in the full sample period also confirms that there is a non-linear relationship between exposure and firm size (the relation is stronger for firms with a market value of less than US$150 million), which is consistent with the findings of Chow *et al.* (1997) and Hutson and Stevenson (2010). However, the results are mixed in other sample periods, especially for equation (6).

With regards to the coefficients on the Debt to Asset, Market to Book Value and Liquidity variables, the findings are mixed. The coefficient on Liquidity is positively significant in the full sample, whereas the coefficients on 'Debt to Asset' and 'Market to Book' value are not significant. The results are mixed in the sub-periods. Overall, there is a weak relationship between exposure and firm specific variables, which is consistent with the findings of Agyei-Ampomah *et al.* (2013).

As shown in Table IV, the coefficients on the industry dummy (θ_i) and the Eurozone dummy (ψ_i) are not statistically significant. Hence, there is no difference between Eurozone and non-Eurozone firms or financial and non-financial firms' exposure to ERs, which confirms the findings of Tables II and III after controlling for market effects.

< Tables V and VI here >

Table V compares the regression results of equations (5) and (6) between Eurozone and non-Eurozone firms. The coefficient on country trade openness is positive and significant at the 5% level for both Eurozone and non-Eurozone firms, in both equations. The firm size coefficient is negative and significant for both Eurozone and non-Eurozone firms in equation (5). The results of other firm specific coefficients are mixed. However, The Eurozone dummy coefficient is not significant in both equations, confirming that there is no difference in exposure between Eurozone and non-Eurozone firms.

Table VI compares the regression test results of equation (5) and (6) between financial and non-financial firms. Like the results presented in Tables IV and V, the coefficient on country trade openness is positively significant for

both financial and non-financial firms in both equations, while the coefficient on firm size is negative and significant. The results for the coefficients on other firm specific variables are mixed across the sub-samples of firms. In addition, the industry dummy coefficient is not significant in both equations (a similar result is obtained by Hutson and O'Driscoll, 2010), corroborating the evidence of insignificant differences between financial and non-financial firms.

To ascertain the robustness of the results reported above, we re-estimated all of the above regressions using the trade weighted Nominal Effective ER (NEER) (results not reported to conserve space but available from the authors upon request). These additional results essentially confirmed our previous findings based on bilateral ERs, with no significant differences in exposure between Eurozone and non-Eurozone or between financial and non-financial firms after controlling for market effects.

However, it is worth mentioning that both Eurozone and non-Eurozone firms' value (for both financial and non-financial firms) was found to be more sensitive to trade weighted (NEER) ERs than bilateral ERs. One possible explanation for this result is that the majority of European firms' trade transactions are denominated in currencies other than the US Dollar. As we found when using bilateral ERs, NEER exposure of Eurozone and non-Eurozone firms (both financial and non-financial) increased during the financial crisis. This confirms that firms are more sensitive to ER movements during 'bad times'. These additional estimations also corroborated the finding that a depreciation/increase (indirect quotation) of ERs (NEER Euro and NEER GBP) has a positive impact on the market value of both Eurozone and non-

Eurozone firms as well as financial and non-financial firms. In the majority of cases the sign of significant exposure coefficients was positive, confirming that both Eurozone and non-Eurozone (financial and non-financial) firms benefit from a depreciation of the Euro against bilateral (and NEER) ERs.

The regression results of equation (5) and (6), which re-estimate the determinants of significant ER exposures (using NEER) of European firms (Eurozone and non-Eurozone as well as financial and non-financial) for the full sample, pre-crisis, crisis and post-crisis periods were also broadly in line with the results presented in Tables IV, V and VI.

5. Conclusion

We tested the sensitivity of 100 European blue chip companies' market value to ER movements, and the determinants of such exposure. Using data from 2001 to 2012, we found significant exposure (18% of Eurozone firms and 16% of non-Eurozone firms) with no significant differences in sensitivity across financial firms (20%) and non-financial firms (16%). However, the percentage of significant exposure increases to around 25% during the financial crisis, indicating that firms are more sensitive to ER movements during times of financial distress.

The study also unveiled a positive relationship between ER movements and the market value of firms, indicating that a depreciation of ERs (indirect quotation) is likely to have a positive impact on the market value of European

firms. This result holds across Eurozone and non-Eurozone firms, as well as financial and non-financial firms.

In relation to the determinants of exposure, there is no significant difference between Eurozone and non-Eurozone, and between financial and non-financial firms after controlling for market effects. There is a positive and significant relationship between exposure and country specific trade openness. However, the relationship between exposure and firm specific characteristics is found to be weak, though smaller-sized firms are found to be slightly more exposed to ER movements than larger ones. These results are robust to estimations employing both bilateral and NEER ERs.

The main contribution of our findings lies in highlighting the significant higher levels of ER exposure experienced by firms during the period characterized by the recent financial crisis.

Although with the exception of firm size, there is no evidence that other firm characteristics have strong explanatory power, a clear implication flows from these findings. Given that especially during times of crisis, particularly smaller firms, are found to experience ER exposure, it is recommendable that such firms' financial plans budget for higher liquidity levels in order to build up, during 'good times', a natural hedge for the higher exposure likely to be faced during periods that may be characterized by greater financial distress.

The findings also have interesting implications for investors' decisions in terms of portfolio optimization, particularly at times of financial crises, especially with regards to under- or over-weighting the riskiness of stock pertaining to large multinational corporations vis-à-vis smaller firms.

Despite the value of our contribution, a few caveats ought to be borne in mind when interpreting our findings. First, given that no 'non-Eurozone' firm in the Eurofirst 100 index was from a country other than the UK, the UK was the only non-Eurozone country included in the analysis. Although the UK constitutes the largest and most important European market that is not part of the Eurozone, future research intending to extend our analysis may consider including more non-Eurozone firms from countries other than the UK. Second, future work may investigate further the reason why some firms appear not to experience foreign exchange risk by specifically testing whether this may be due to the use of derivatives or, alternatively, whether it is because foreign exchange exposure is short-lived, in which case a comparative time-varying risk approach, similar to that of Agyei-Ampomah *et al.* (2013), might also be usefully employed.

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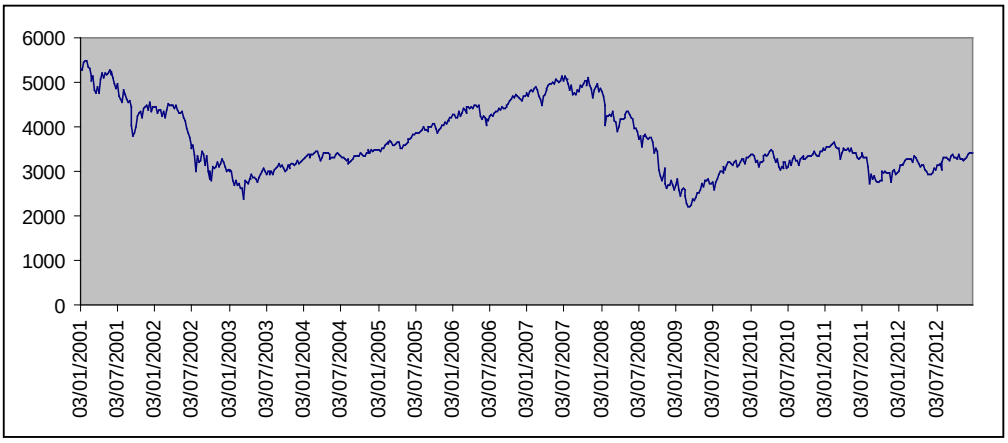

Figure I. European Stock Indices (Eurofirst 100)

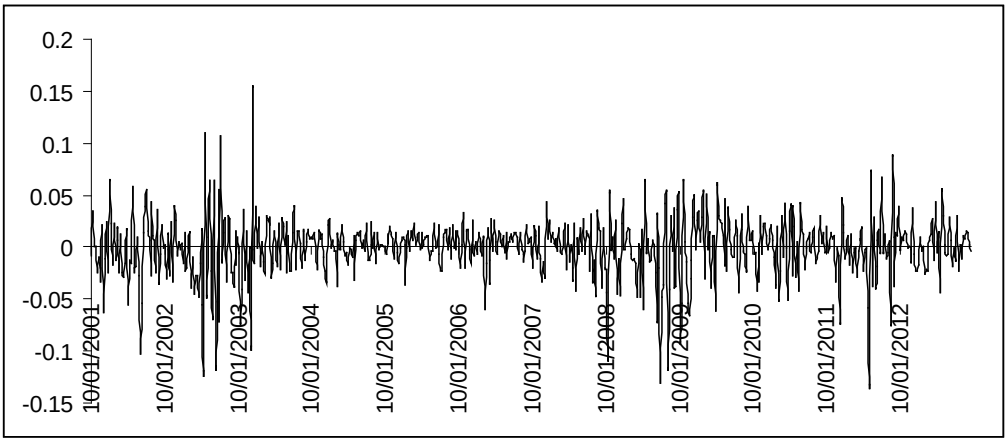

Figure II. Returns on European Stock Indices

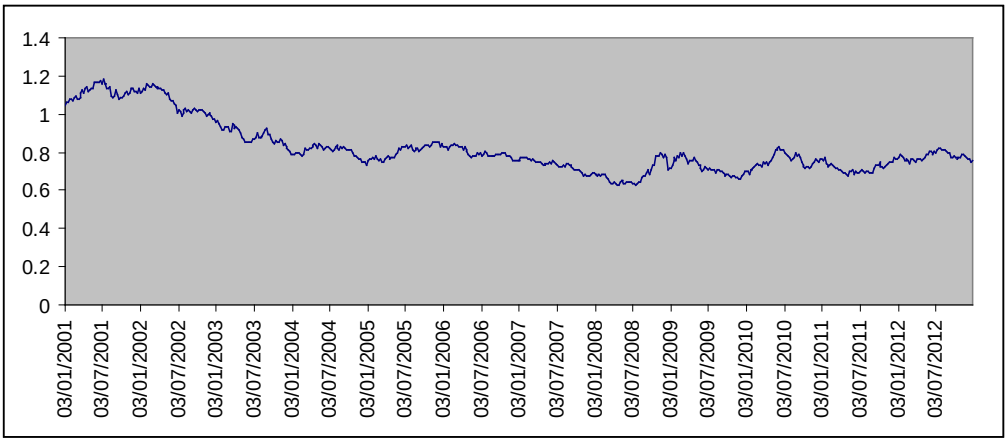

Figure III. Euro Exchange Rate (US Dollar - Euro)

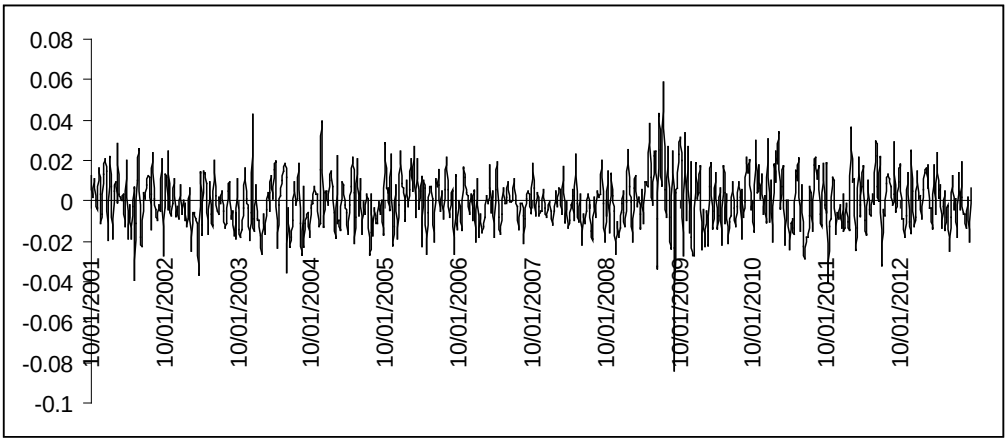

Figure IV. Returns on Euro Exchange Rate

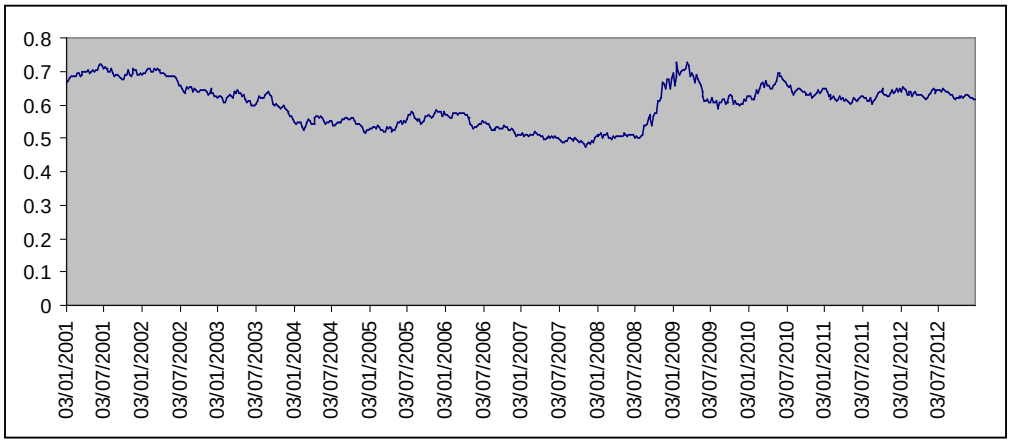

Figure V. UK Exchange Rate (US Dollar - GBP)

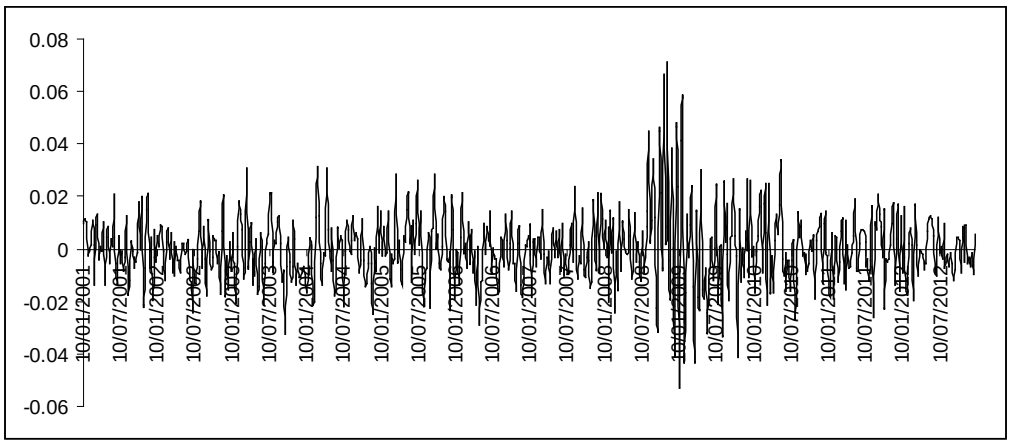

Figure VI. Returns on UK Exchange Rate

Table I.

Descriptive statistics

Panel A.	Stock Market	USD Euro	USD GBP	Euro NEER	GBP NEER
Mean	-0.0007	-0.0005	-0.0004	-0.0002	-0.0003
S.D.	0.0294	0.0142	0.0137	0.0145	0.0125
Skewness	-0.4439	-0.0271	-0.5589	-0.5601	-0.341
Kurtosis	6.891	4.9201	5.1793	4.517	5.3702
J-B	4.13	3.96	2.39	4.42	4.09
Panel B.	Openness	Market Value	Debt to Asset	Market to Book value	Quick Ratio
Mean	23.6	3015	0.27	3.59	1.01
S.D.	0.343	18.5	0.0945	0.2034	0.0145
Skewness	-0.3702	-0.211	1.6723	4.1301	-0.0679
Kurtosis	3.507	4.3002	3.6734	5.7812	5.9120
J-B	2.36	3.49	5.14	5.31	4.10

Notes: 'S.D.' and 'J-B' denote standard error and the Jarque-Bera test, respectively. J-B tests the null hypothesis that the residuals are normally distributed (by testing for the coefficients of skewness and excess kurtosis being jointly equal to zero). The statistic follows a Chi-squared distribution with two degrees of freedom. The critical value at the 5% significance level is 5.99.

Table II.

Exchange rate (bilateral) exposure of Eurozone vs. non-Eurozone firms

	No. of firms	Mean β_{xi}	Mean $\lvert \beta_{xi} \rvert$	No. of sig. negative signs	No. of sig. positive signs	Total no. of significant	% significant
Panel A. Full Sample. January 2001 – December 2012							
Eurozone	63	0.24	0.48	4	7	11	18
Non-Eurozone	37	-0.35	0.52	2	4	6	16
Total	100	0.03	0.49	6	11	17	17
Panel B. Pre-crisis period. January 2001 – July 2007							
Eurozone	63	0.28	0.32	3	10	11	17
Non-Eurozone	37	-0.41	0.38	3	5	8	22
Total	100	0.03	0.34	6	16	19	19
Panel C. Crisis period. August 2007 – March 2009							
Eurozone	63	-0.18	0.54	5	11	16	25
Non-Eurozone	37	-0.45	0.57	4	5	9	24
Total	100	-0.31	0.55	9	16	25	25
Panel D. Post-crisis period. April 2009 – December 2012							
Eurozone	63	0.56	0.43	4	5	9	14
Non-Eurozone	37	-0.13	0.35	2	4	6	16
Total	100	0.31	0.40	6	9	15	15

Notes: The 't test' is used to measure the statistical significance of the coefficient $\boldsymbol{\beta_{xi}}$ in equation (4). $\boldsymbol{\lvert \beta_{xi} \rvert}$ denotes the absolute value of $\boldsymbol{\beta_{xi}}$, which indicates the magnitude of the exposure. The coefficients are estimated from the weekly time-series regressions of stock returns on the orthogonal component of market portfolio and ER returns. Bilateral ERs are USD-Euro for Eurozone firms, and USD-GBP for non-Eurozone (UK) firms. Statistics are given at the 5% significance level.

Table III.

Exchange rate (bilateral) exposures of financial vs. non-financial firms

	No. of firms	Mean β_{xi}	Mean $\lvert \beta_{xi} \rvert$	No. of sig. negative signs	No. of sig. positive signs	Total no. of significant	% significant
Panel A. Full Sample. January 2001 – December 2012							
Financial	20	0.21	0.31	1	3	4	20
Non-financial	80	0.18	0.35	6	7	13	16
Total	100	0.19	0.34	7	10	17	17
Panel B. Pre-crisis period. January 2001 – July 2007							
Financial	20	0.27	0.30	1	3	4	20
Non-financial	80	0.31	0.28	5	10	15	19
Total	100	0.30	0.29	6	13	19	19
Panel C. Crisis period. August 2007 – March 2009							
Financial	20	-0.28	0.44	2	4	6	30
Non-financial	80	-0.31	0.49	4	15	19	24
Total	100	-0.30	0.48	6	19	25	25
Panel D. Post-crisis period. April 2009 – December 2012							
Financial	20	0.26	0.33	2	2	4	20
Non-financial	80	0.19	0.35	4	7	11	14
Total	100	0.21	0.35	6	9	15	15

Notes: The 't test' is used to measure the statistical significance of the coefficient $\boldsymbol{\beta_{xi}}$ in equation (4). The coefficients are estimated from the weekly time series regressions of stock returns on the orthogonal component of market portfolio and ER returns. Bilateral ERs are USD-Euro for Eurozone financial firms, and USD-GBP for non-Eurozone (UK) financial firms. Statistics are given at the 5% significance level.

Table IV.

Determinants of exchange rate (bilateral) exposure of European firms

	Full Sample		Pre-crisis		Crisis		Post-crisis	
	Equation 5	Equation 6	Equation 5	Equation 6	Equation 5	Equation 6	Equation 5	Equation 6
α	-0.06 (0.00)	-0.12 (0.00)	0.27 (0.01)	-0.22 (0.00)	-0.23 (0.00)	0.30 (0.03)	-0.12 (0.01)	-0.9 (0.00)
γ	0.23 (0.01)	0.20 (0.00)	0.12 (0.03)	0.13 (0.05)	0.23 (0.00)	0.24 (0.04)	0.12 (0.00)	0.07 (0.01)
δ	-0.04 (0.00)	0.03 (0.10)	-0.10 (0.00)	-0.18 (0.72)	-0.20 (0.00)	-0.10 (0.20)	0.12 (0.00)	-0.08 (0.02)
ω	0.02 (0.22)	0.17 (0.15)	-0.12 (0.03)	0.27 (0.50)	0.21 (0.12)	0.01 (0.00)	0.13 (0.05)	-0.09 (0.14)
o	0.13 (0.10)	0.09 (0.07)	-0.11 (0.11)	0.03 (0.00)	0.14 (0.03)	-0.19 (0.10)	0.20 (0.01)	0.07 (0.02)
κ	0.17 (0.05)	0.12 (0.03)	0.08 (0.00)	0.10 (0.12)	0.17 (0.00)	0.03 (0.13)	0.04 (0.01)	0.09 (0.05)
λ		0.10 (0.22)		-0.01 (0.00)		0.23 (0.00)		0.08 (0.11)
θ		0.03 (0.14)		0.02 (0.10)		0.16 (0.30)		0.06 (0.12)
ψ		-0.08 (0.40)		0.02 (0.17)		0.05 (0.24)		0.03 (0.19)
Adj. R^2	0.23	0.12	0.18	0.31	0.27	0.19	0.21	0.17

Notes: The 't test' is used to measure the statistical significance of the coefficients in equation (5) and (6) at the 5% level. π_i is the dependent variable, measured as the squared root of the absolute value of ER exposure of firm i (β_{xi}**).** Independent variables are Country Openness (OP) and Firm's Market Value (MV), Debt to Asset Ratio (DA), Market to Book Value (MB) and Quick Ratio (QR) in equation (5). In equation (6), Size Dummy (SD) takes value 1 for firm's market value of less than $150 million, and 0 otherwise. Industry Dummy (ID) is 1 for financial firms, and 0 otherwise. Eurozone Dummy (ED) is 1 for Eurozone firms and 0 otherwise. A significant positive (negative) sign of the coefficients γ, δ, ω, o and κ means that the firm's ER exposure increases (decreases) when country trade openness, firm size (Market Value), financial distress (Debt to Asset), growth opportunity (Market to Book Value), and liquidity (Quick ratio) increases (decreases), respectively. Significant coefficients of the dummy variables (λ for size dummy, θ for industry

dummy, and ψ for Eurozone dummy) indicate non-linear relationships between firms' ER exposure and dummy variables. P values are in parenthesis.

Table V.

Determinants of exchange rate (bilateral) exposure of Eurozone vs. non-Eurozone firms

	Eurozone firms		Non-Eurozone firms	
	Equation 5	Equation 6	Equation 5	Equation 6
α	-0.01 (0.00)	-0.07 (0.00)	-0.09 (0.00)	-0.11 (0.00)
γ	0.24 (0.00)	0.19 (0.00)	0.22 (0.00)	0.09 (0.00)
δ	-0.06 (0.00)	-0.17 (0.00)	-0.05 (0.00)	0.10 (0.14)
ω	0.07 (0.17)	0.06 (0.25)	-0.09 (0.10)	0.08 (0.27)
ο	0.10 (0.08)	0.14 (0.02)	-0.17 (0.20)	0.19 (0.03)
κ	0.12 (0.11)	-0.12 (0.00)	0.10 (0.08)	0.18 (0.29)
λ		0.10 (0.10)		0.15 (0.07)
θ		0.06 (0.30)		0.10 (0.29)
ψ		0.12 (0.30)		0.02 (0.20)
Adj. R^2	0.15	0.10	0.17	0.17

Notes: The 't test' is used to measure the statistical significance of the coefficients in equation (5) and (6). π_i is the dependent variable, measured as the squared root of the absolute value of ER exposure of firm i (β_{xi}**).** Independent variables are Country Openness (OP) and Firm's Market Value (MV), Debt to Asset Ratio (DA), Market to Book Value (MB) and Quick Ratio (QR) in equation (5). In equation (6), Size Dummy (SD) takes value 1 for firm's market value of less than $150 million, and 0 otherwise. Industry Dummy (ID) is 1 for financial firms, and 0 otherwise. Eurozone Dummy (ED) is 1 for Eurozone firms, and 0 otherwise. A significant positive (negative) sign of the coefficients γ, δ, ω, ο and κ means that the firm's ER exposure increases

(decreases) when country trade openness, firm size (Market Value), financial distress (Debt to Asset), growth opportunity (Market to Book Value), and liquidity (Quick ratio) increases (decreases), respectively. Significant coefficients of the dummy variables (λ for size dummy, θ for industry dummy and ψ for Eurozone dummy) indicate non-linear relationships between firms' ER exposure and dummy variables. P values are presented in parenthesis.

Table VI.

Determinants of exchange rate (bilateral) exposure of financial vs. non-financial firms

	Financial firms		Non-financial firms	
	Equation 5	Equation 6	Equation 5	Equation 6
α	-0.05 (0.00)	-0.08 (0.00)	-0.09 (0.00)	-0.05 (0.00)
γ	0.14 (0.00)	0.17 (0.00)	0.25 (0.00)	0.28 (0.00)
δ	-0.09 (0.00)	-0.04 (0.27)	-0.08 (0.04)	-0.06 (0.20)
ω	0.10 (0.15)	0.08 (0.06)	0.06 (0.08)	0.04 (0.01)
o	0.06 (0.09)	-0.15 (0.00)	0.17 (0.09)	-0.25 (0.06)
κ	0.10 (0.12)	0.07 (0.09)	0.06 (0.07)	0.05 (0.23)
λ		0.19 (0.03)		0.08 (0.13)
θ		0.05 (0.24)		0.15 (0.16)
ψ		-0.03 (0.31)		-0.15 (0.26)
Adj. R^2	0.33	0.21	0.29	0.07

Notes: The 't test' is used to measure the statistical significance of the coefficients in equation (5) and (6). π_i is the dependent variable, measured as the squared root of the absolute value of ER exposure of firm i (β_{xi}**).** Independent variables are Country Openness (OP) and Firm's Market Value (MV), Debt to Asset Ratio (DA), Market to Book Value (MB) and Quick Ratio (QR) in equation (5). In equation (6), Size Dummy (SD) takes value 1 for firm's market value of less than $150 million, and 0 otherwise.

Industry Dummy (ID) is 1 for financial firms, and 0 otherwise. Eurozone Dummy (ED) is 1 for Eurozone firms and 0 otherwise. A significant positive (negative) sign of the coefficients γ, δ, ω, o and κ means that the firm's ER exposure increases (decreases) when country trade openness, firm size (Market Value), financial distress (Debt to Asset), growth opportunity (Market to Book Value), and liquidity (Quick ratio) increases (decreases), respectively. Significant coefficients of the dummy variables (λ for size dummy, θ for industry dummy and ψ for Eurozone dummy) indicate non-linear relationships between firms' ER exposure and dummy variables. P values are presented in parenthesis.