Integrated Foreign Exchange Risk Management: The Role of Import in Medium-Sized, Manufacturing Firms

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Abstract

Empirical research has focused on export as a proxy for the exchange rate exposure and the use of foreign exchange derivatives as the instrument to deal with this exposure. This empirical study applies an integrated foreign exchange risk management approach with a particular focus on the role of import in medium-sized, manufacturing firms in Denmark (a small, open economy). We find a strong, negative relation between import and foreign exchange derivatives usage on the aggregate level. Our findings are consistent with the notion that firms use import to match the foreign exchange exposure created by foreign sales activities.

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Abstract

Empirical research has focused on export as a proxy for the exchange rate exposure and the use of foreign exchange derivatives as the instrument to deal with this exposure. This empirical study applies an integrated foreign exchange risk management approach with a particular focus on the role of import in medium-sized, manufacturing firms in Denmark (a small, open economy). We find a strong, negative relation between import and foreign exchange derivatives usage on the aggregate level. Our findings are consistent with the notion that firms use import to match the foreign exchange exposure created by foreign sales activities.

1. Introduction

Shapiro (1975) shows that one of the major factors affecting the multinational firm's exchange rate risk is sales on export markets. Export as a key ingredient in determining the exchange rate exposure of the firm has been confirmed by numerous theoretical studies (e.g. Marston, 2001) as well as empirical studies (e.g. Allayannis and Ofek, 2001). Smith and Stulz (1985) show that corporate hedging can add value when firms face financial distress costs and/or progressive taxation. Froot, Scharfstein, and Stein (1993) extend the conclusions of Smith and Stulz (1985) to a framework in which external financing is more costly than internally generated funds. Allayannis and Weston (2001) find a positive relation between firm value and the use of foreign exchange derivatives. Based on the above, it seems reasonable to suggest that hedging is linked to the export activities of the firm.

However, foreign exchange derivates usage is not the only avenue for foreign exchange risk management. Guay and Kothari (2003) find that derivatives usage appears to be a small piece of the overall risk profile of non-financial firms. As noted by Nance, Smith and Smithson (1993), a substitute to the use of financial derivatives is an alteration of the debt-equity ratio. Another substitute is to change operations e.g. by matching exports and imports and thus create off-setting cash flows in exposed currencies. The study of the automotive industry by Williamson (2001) is an example of the importance of including change in operations when trying to understand the dynamics of exchange rate exposure management. Miller (1992, 1998) provides a framework for integrated risk management in international business.

Meulbroek (2002) describes how firms fundamentally have three ways of implementing risk management objectives: 1) modify operations; 2) adjust capital structure; and 3) employ targeted financial instruments (financial hedging). Logue (1995) and Chowdhry and Howe (1999) show that operating exposures very often fail to be effectively managed by financial hedging. They recommend that longer-term strategy adjustments involving operational hedges are the optimal way to manage longer-term exposures. Consistent with this view, empirical evidence show that transaction exposures are hedged extensively by financial derivatives while hedging of longer term operating exposures are hedged more sporadically (e.g. Bodnar, Hayt, and Marston, 1998).

Pantzalis, Simkins, and Laux (2001) document the importance of operational hedges for managing exchange rate risk in a U.S. setting. They find that the exposure of non-contractual cash flows is best managed through operational hedging. In their study, they focus on the subsidiary network for providing the means for operational hedging. In a U.K. perspective, Bradley and Moles (2002) find that

more than half of the surveyed firms do occasionally or often source inputs in the same currencies as sales are made as a mean to manage exchange rate risk. In a Danish setting, Aabo and Simkins (2005) find that the firm's size, exports and foreign subsidiaries are positively related to operational hedging.

This study uses an integrated foreign exchange risk management approach in order to understand the foreign exchange risk management strategies of medium-sized, manufacturing firms. We go beyond the export ratio traditionally applied and particularly investigate the role of import. Following the reasoning of Graham and Harvey (2001) we use the survey approach in order to balance between the benefits and problems of large sample analyses and clinical studies. Thus, we obtain and use information that would not be accessible in traditional, large sample analysis and, at the same time, we do not restrict ourselves to clinical studies that tend to produce unique results based on very small samples.

Numerous studies have used the questionnaire approach for analyzing exchange rate exposure management in non-financial firms (e.g. Bodnar and Gebhardt, 1999; Bodnar, Hayt, and Marston,1998; Ceuster, Durinck, Laveern, and Lodewydkx, 2000; Hakkarainen, Joseph, Kasanen, and Puttonen, 1998; Mallin, Ow-Yong, and Reynolds, 2001; Marshall, 2000). The most cited of these studies is Bodnar, Hayt, and Marston (1998) which covers publicly traded US firms. In their study, Bodnar et al. do ask the firms about their percentage of consolidated operating costs in foreign currency; they find find that many firms roughly balance out total foreign currency revenues with foreign currency expenses; and they do note that their results may be indicative of firms using natural hedging as a way of managing foreign exchange exposures. However, in line with other empirical studies Bodnar et al. do not

investigate the aggregate impact of import on the use of foreign exchange derivatives. To the best of our knowledge, no existing study has empirically examined the simple but important question:

What is the aggregate impact of import on the use of foreign exchange derivatives in managing exchange rate risk in manufacturing firms?

On the firm specific level, import may either increase or decrease the need for financial hedging. If a firm has costs in the same currencies as it has revenues, the firm will experience a natural hedge by the match of foreign currency costs with foreign currency revenues and a subsequent decrease in its need for financial hedging. However, if a firm has costs in currencies in which is has no revenues the firm will experience an increase in its exposure and an increase in its need for financial hedging. Whether import increases or decreases the need for financial hedging on an aggregate level is an empirical question to be addressed and serves as the primary motivation for this paper.

Our results are based on a survey of medium-sized, manufacturing firms in a small, open economy (Denmark) and the responses of 215 such firms. Denmark is an interesting country for analyzing integrated foreign exchange risk management practices in medium-sized firms. Denmark is a small, open (the sum of exports and imports equals the GDP) economy with a currency of its own. Denmark is a long time member of the EU and the Danish Krone (DKK) is pegged to the Euro at 7.46 DKK with a band of +/- 2.25 percent. Denmark's three main trading partners are Germany (Euro), Sweden (Swedish Krona), and the U.K. (British Pound). Thus, Danish firms are used to dealing in and being exposed to various currencies.

Our results are based on non-listed, medium-sized firms. This is interesting for two reasons: 1) By focusing on medium-sized firms we provide a unique knowledge about a very important part of the business world that has hitherto often been neglected due to data availability constraints. 2) In an internationalization perspective, medium-sized firms are interesting because they are large enough to be exposed to and react to developments in the international environment; still they lack the international network of multinational firms.

Our results confirm the existence of an integrated risk management approach towards foreign exchange risk in medium-sized, manufacturing firms in Denmark. On the aggregate level we find a strong, negative relation between import and foreign exchange derivatives usage. Our findings are consistent with the notion that firms use import to match the foreign exchange exposure created by foreign sales activities. We furthermore find vague support for the notion that the capital structure of the firm is an important element in an integrated foreign exchange risk management framework. Our results are important in understanding the diversity of "instruments" available to firms in managing their exchange rate risk.

Our study is structured as follows. The next section states the methodology of the study. The third section shows descriptive statistics and univariate analysis. The fourth section reports empirical results from a multivariate regression analysis. The fifth section tests for robustness. The sixth section elaborates on the integrated foreign exchange risk management approach. The last section concludes.

2. Methodology of study

This study is based on public information from WEB-DIRECT[1] and on responses to questionnaires sent to Danish, medium-sized, manufacturing firms. We focus on Danish firms; that is we exclude firms that are subsidiaries of foreign firms[2]. We focus on medium-sized firms; we define medium-sized firms as firms fulfilling two criteria: 1) a balance sheet total of between DKK 50 million and DKK 500 million (EUR 6.7 million – EUR 66.7 million) and 2) a number of employees between 20 and 499[3]. We focus on manufacturing firms; we select firms with a NACE[4] industry code beginning with the letter "D"[5]. Furthermore, we restrict the number of firms to unlisted firms that are private limited companies[6] with accounting numbers available. The total number of firms in our sample is 771 firms.

[1] WEB-DIRECT is a comprehensive database from Experian A/S containing information on Nordic firms. In a Danish setting the database contains information on some 630,000 Danish firms. Information from WEB-DIRECT was obtained in 2007 covering accounting information from 2005.
[2] We furthermore exclude firms from Greenland and the Faeroe Islands.
[3] The European Commission defines medium-sized firms as firms that have a headcount of between 50 and 249 employees, and either a turnover of between EUR 10 million and EUR 50 million or a balance sheet total of between EUR 10 million and EUR 43 million. As can be seen, our definition of medium-sized firms is a bit broader in both ends. We exclusively use figures on balance sheet total as almost half of our target firms do not report figures for their turnover.
[4] WEB-DIRECT employs the NACE code (Statistical Classification of Economic Activities in the European Community), which is a comparable and equivalent industry classification system as the American NAICS code (North American Industry Classification System).
[5] NACE divides industries into 17 main categories: (A) Agriculture, hunting and forestry; (B) Fishing; (C) Mining and quarrying; (D) Manufacturing; (E) Electricity, gas and water supply; (F) Construction; (G) Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods; (H) Hotels and restaurants; (I) Transport, storage and communication; (J) Financial intermediation; (K) Real estate, renting and business activities, consulting; (L) Public administration and defence; compulsory social security; (M) Education; (N) Health and social work; (O) Other community, social and personal service activities; (P) Activities of households; (Q) Extra-territorial organizations and bodies. We focus on (D) Manufacturing. The classification has recently been changed but the above classification was due during the data collection period.
[6] This corresponds to the Danish firm types "A/S" ("Aktieselskab") and "ApS" ("Anpartsselskab").

These firms were contacted in 2007 via email[7] and asked to complete an online, web-based questionnaire. The questionnaire was divided into three parts of which the first part relates to the present study. The questions in the first part of the questionnaire are listed in the Appendix. 215 firms responded to the survey reaching an overall response rate of 27.9 percent. In the sequel we refer to these 215 responding firms as the sample.

The average firm in the original sample of 771 firms is 42 years old, has total assets of DKK 135 million, a gross profit / total assets ratio of 40 percent, and an equity / total assets ratio of 36 percent. The average firm in the sample of 215 firms that responded is 44 years old, has total assets of DKK 148 million, a gross profit / total assets ratio of 39 percent, and an equity / total assets ratio of 36 percent. Tests for equalities of means between the population firms and the sample firms report (not shown) that only the difference in means for total assets is significantly different from zero (at the 10 percent level). Thus, apart from the sample firms being marginally larger than the firms in the population, our sample firms seem to be representative for the population of medium-sized, manufacturing firms in Denmark.

Survey data for the internationalization of our sample firms are provided in the next section as well as a comparison between users and non-users of foreign exchange derivatives. Subsequent regression

[7] Email addresses were obtained from the WEB-DIRECT database, and verified and completed, where necessary, by web search on the firms' internet homepages. For four firms no email address could be found and no attempt was made to contact those firms by alternative means. Firms were contacted initially by email to ask for the contact details of the financial manager. These emails were addressed to the common firm email address such as company@company.dk or info@firm.dk. These two first contact attempts were answered either positively by responding with the name and email address of the financial manager or negatively by either expressing that the firm did not want to take part in a survey or by not answering at all. At the same time, the firms' internet web pages were searched for usable contact details of the financial manager. The next contact approaches consisted of sending the survey link to the firms. The link to the online survey was directed directly to the financial manager when available. Otherwise, the email was directed to the firm's usual email address with the request of forwarding it to the financial manager. Firms that did not respond or that responded to the last request were contacted at least five times (including the initial contact emails).

analysis is performed using binary probit regression analysis where the dependent variable is the use or the non-use of foreign exchange derivatives.[8] Furthermore, in our elaboration on the integrated foreign risk management approach we employ ordinary least squares (OLS) regression analysis.

3. Descriptive Statistics and Univariate Analysis

This section provides empirical evidence on the internationalization of Danish, medium-sized, manufacturing firms together with further descriptive statistics for our sample firms. Our ultimate interest is the extent to which various factors drive the decision to use or not to use foreign exchange derivatives. A univariate analysis on mean values for users and non-users of foreign exchange derivatives concludes the section.

Denmark is a small, open economy. This is reflected on the firm level even among medium-sized firms in the manufacturing sector. Table I reports information on the internationalization of our sample firms based on responses to the questionnaire (Appendix).

* Please insert Table I approximately here *

[8] The regression analysis is performed with limited dependent variables (here binary). Standard introductory discussion of these models can be found in Greene (2003). In the binary model, the dependent variable may take on only two values, 0 or 1. Estimation is undertaken by maximum likelihood. Our models are (standard) probit models as opposed to logit models. The difference between the two approaches concerns the distribution of the error term, normal versus logistic. In practice, it is difficult to justify the selection of one over the other and our conclusions are not materially affected by our choice. The interpretation of the coefficient values in the binary model is complicated by the fact that the estimated coefficients cannot be interpreted directly as the so-called *marginal effect* on the dependent variable. Interpretation difficulties for probit and logit models are described in Hoetker (2007), among others. We have included the marginal effects in our results for the binary probit regressions. These marginal effects are indeed interpretable.

Table I shows that the median firm in our sample has approximately half of its operating revenue (40-60 percent) and approximately a third of its operating costs (20-40 percent) in foreign currency. The median firm is significantly exposed to 3-5 currencies where the Euro tends to be the most important currency. Finally, the median firm has no production subsidiaries but 1-2 sales subsidiaries abroad.

Table 1 is based on the exact responses to the questions in the questionnaire. Translating the intervals in the questionnaire to point estimates using midpoints and adding accounting variables allows us to report descriptive statistics for our sample firms. This is done in Table II. The variables in capital letters are used in subsequent regression analysis.

* Please insert Table II approximately here *

Table II shows that our average sample firm is 44 years old, has total assets of DKK 148 million, a gross profit / total assets ratio of 39 percent, an equity / total assets ratio of 36 percent, an expenses for R&D / total sales ratio of 4.1 percent, an export ratio of 48 percent (measured as operating revenues in foreign currency divided by total operating revenues), an import ratio of operating costs of 33 percent (measured as operating costs in foreign currency divided by total operating costs), an import ratio of operating revenues[9] of 24 percent (measured as operating costs in foreign currency divided by total operating revenues), 3.1 currencies to which it is significantly exposed, 0.9 production subsidiaries abroad, and 2.0 sales subsidiaries abroad. Finally, 15 percent of our sample firms find the US dollar

[9] In order to transform "import ratio of operating costs" to "import ratio of operating revenues", the former is scaled by (1 - gross profit / turnover) where the difference between gross profit and turnover resembles operating costs. For almost half of the firms in our sample (96 firms), turnover figures were not available from WEB-DIRECT. These firms were scaled by the average scale factor used for the firms for which turnover figures were available. The scaling is done in order to facilitate a more direct comparison between export ratios and import ratios. The scaling does not materially affect the results of subsequent regression analysis.

(USD) to be the most important currency to their firm. We focus on the US dollar because of its high volatility towards the Danish Krone[10].

We want to investigate to which extent the decision to use or not to use foreign exchange derivatives is related to the variables listed in Table II. Table III reports a preliminary univariate analysis on mean values for users and non-users of foreign exchange derivatives.

* Please insert Table III approximately here *

Table III shows that apart from age, capital structure and expenses for R&D, all other variables have significant (at least at a 10 percent level) differences in means between the group of users and the group of non-users of foreign exchange derivatives. The univariate analysis suggests that users of foreign exchange derivatives are larger, are less profitable, are more export and import oriented, are exposed to more currencies, find the US dollar to be the most important currency, and finally have more production and sales subsidiaries abroad than non-users of foreign exchange derivatives.

[10] For the period 2001-2006 using monthly return data, the yearly standard deviation for EUR, USD, GBP, SEK, NOK, JPY vis-à-vis DKK was 0.2 percent, 8.9 percent, 5.6 percent, 4.2 percent, 5.5 percent, and 8.8 percent, respectively.

4. Empirical Results

This section analyzes firm characteristics that can explain the decision to use or not to use foreign exchange derivatives among medium-sized, manufacturing firms. We extend the univariate analysis performed in the last section to a multivariate regression analysis that takes into account the various interdependencies among the independent variables.

Table IV reports the correlation coefficients for the variables used in the subsequent regression analyses. As can be seen from Table IV some of the variables are highly correlated. This is especially true for the correlation between our export and import variables (0.55), our export and number of sales subsidiaries abroad variables (0.46), and our number of production subsidiaries abroad and number of sales subsidiaries abroad variables (0.58). This will be addressed at a later stage.

* Please insert Table IV approximately here *

As previously noted, we want to model the decision to use or not to use foreign exchange derivatives at the firm level. Following the conventional wisdom of the foreign exchange risk management literature, we expect

1) no *positive* nor *negative* relation between the age of the firm (AGE) and the use of foreign exchange derivatives[11].

[11] We include AGE in our model because our sample consists of medium-sized firms (as compared to large firms in most other studies). In a sample of medium-sized firms, some of the firms could be young, high growth firms with a different attitude towards risk management than older, more value-based firms.

2) either a *positive* relation between the size of the firm (TA) and the use of foreign exchange derivatives based on the economies of scale argument or a *negative* relation based on the financial distress argument (small firms have disproportionately high financial distress costs). Nance, Smith, and Smithson (1993) emphasize both arguments but find empirically that the economies of scale argument dominates the (disproportionately high) financial distress argument.

3) a *negative* relation between the profitability (GPTA) of the firm and the use of foreign exchange derivatives based on the financial distress argument (profitable firms do not need to hedge as they have financial slack). Géczy, Minton, and Schrand (1997) find that firms with tighter financial constraints are more likely to use foreign exchange derivatives.

4) a *negative* relation between the equity ratio (EQTA) of the firm and the use of foreign exchange derivatives based on the financial distress argument (solid firms in a capital structure sense do not need to hedge as they have financial slack). Nance, Smith and Smithson (1993) notes that altering the debt-equity ratio is a substitute to the use of financial derivatives. Géczy, Minton, and Schrand (1997) and Purnanandam (2008) find that firms with tighter financial constraints / higher leverage are more likely to use foreign exchange derivatives. Almeida and Philippon (2007) empirically estimate financial distress costs and show that these costs are non-trivial.

5) either a *positive* relation between R&D expenses (RD) and the use of foreign exchange derivatives based on the growth option argument[12] (firms with high R&D expenses have growth options that they want to be sure to be able to finance in the future) or a *negative* relation based on the uncertainty argument (the more the value of a firm is tied to growth options as opposed to assets in place, the more uncertain the future cash flows, and the more likely it is that what was intended to be a hedge turns into

[12] Our sample consists of unlisted firms. Thus, we cannot use Tobin's Q that has been used in earlier studies (e.g. Guay and Kothari, 2003; Kedia and Mozumdar, 2003) as a proxy for a firm's growth opportunities.

a speculation because the underlying business rational disappears). Géczy, Minton, and Schrand (1997) find that firms with greater growth opportunities are more likely to use foreign exchange derivatives.

6) a *positive* relation between the export ratio (EXPORT) of the firm and the use of foreign exchange derivatives based on the exposure argument. Allayannis and Ofek (2001) find that the level of derivatives used is positively related to the firm's exposure through foreign sales and trade.

7) either a *positive* relation between the import ratio (IMPORT) and the use of foreign exchange derivatives based on the exposure argument (firms import in currencies where they do not have corresponding export) or a *negative* relation based on the matching argument (firms import in currencies where they do have corresponding export).

8) either a *positive* relation between the number of currencies to which the firm is significantly exposed (NOCUR) based on the exposure argument or a *negative* relation based on the diversification argument.

9) a *positive* relation between US dollar being the most important currency for the firm (USD) and the use of foreign exchange derivatives based on the volatility argument (the more volatility, the more uncertainty, and the more need for hedging). Smith and Stulz (1985) note that the probability of encountering financial distress is related to the firm's cash flow volatility.

10) either a *positive* relation between number of production subsidiaries abroad (NOPSUB) and the use of foreign exchange derivatives based on the commitment argument (the more committed to a foreign market, the more certain the exposure, and the more scope for financial hedging) or a *negative* relation based on the matching argument (production costs offset revenues in the same currency). Caves (1971) uses subsidiaries abroad as a proxy for commitment and exposure to a foreign market. Pantzalis, Simkins, and Laux (2001) show how a subsidiary network provides means for operational hedging.

11) a *positive* relation between number of sales subsidiaries abroad (NOSSUB) and the use of foreign exchange derivatives based on the commitment argument (the more committed to a foreign market, the more certain the exposure, and the more scope for financial hedging). As noted above, Caves (1971) uses subsidiaries abroad as a proxy for commitment and exposure to a foreign market and Pantzalis, Simkins, and Laux (2001) show how a subsidiary network provides means for operational hedging.

The following binary probit regression is analyzed:

$$FXDUSE_i^* = C_i + \beta_1 AGE_i + \beta_2 TA_i + \beta_3 GPTA_i + \beta_4 EQTA_i + \beta_5 RD_i + \beta_6 EXPORT_i + \beta_7 IMPORT_i + \beta_8 NOCUR_i + \beta_9 USD_i + \beta_{10} NOPSUB_i + \beta_{11} NOSSUB_i + \omega_i \quad (1)$$

where:

FXDUSE* is a continuous latent variable (an unobserved index) which is regressed on the explanatory variables and assumed to represent the propensity to use foreign exchange derivatives. As we do not observe the propensity to use foreign exchange derivatives, but only whether the firm uses foreign exchange derivatives or not, we define the observed choice as $FXDUSE = \begin{cases} 1 \text{ if } FXDUSE^* \geq 0 \\ 0 \text{ if } FXDUSE^* < 0 \end{cases}$, hence

FXDUSE is a binary variable coded as 1 if the firm is a user of foreign exchange derivatives and 0 otherwise (responses to Question 7).[13]

C is a constant.

AGE is the logarithm of the sum of age of the firm plus 1.

TA is the logarithm of total assets of the firm.

GPTA is the gross profit of the firm divided by the total assets of the firm.

[13] See for example Greene (2003) for an exposition of binary index function models.

EQTA is the equity of the firm divided by the total assets of the firm.

RD is the R&D expenses in percent of the turnover of the firm (responses to Question 4; midpoints of intervals and a max. of 30 percent used).

EXPORT is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used).

IMPORT is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used; scaled by (1 - gross profit / turnover) in order to transform from a percentage of costs to a percentage of revenues).

NOCUR is the logarithm of the sum of the number of currencies to which the firm is significantly exposed plus 1 (responses to Question 2a; midpoints of intervals and a max. of 12 used).

USD is a dummy variable coded as 1 if the most important currency to the firm is the US dollar and 0 otherwise (responses to Question 2b).

NOPSUB is the logarithm of the sum of the number of production subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used).

NOSSUB is the logarithm of the sum of the number of sales subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used).

ω is the error term which is assumed to be standard normally distributed according to the probit model.

As mentioned previously, the interpretation of the β's in equation (1) is not as straightforward as the interpretation of the corresponding mean marginal effects. The mean *marginal effect* of an explanatory variable on the propensity to use foreign exchange derivatives is simply the average expected marginal

change of the probability of using foreign exchange derivatives caused by a marginal increase in the given explanatory variable. Writing for example the binary probit model with dependent variable *Y* and explanatory variables ***x*** as

$$\mathrm{P}(Y = 1 \mid \mathbf{x}) = \Phi(\mathbf{x}'\boldsymbol{\beta}), \tag{2}$$

where Φ is the cumulative distribution function for the standard normal distribution, the marginal effect of the *j*'th explanatory variable is $\phi(\mathbf{x}'\boldsymbol{\beta})\beta_j$. If the *j*'th explanatory variable $x_{(j)}$ is a binary (0-1) variable, the appropriate marginal effect for this variable is calculated as

$$\mathrm{P}(Y = 1 \mid \bar{\mathbf{x}}_{(j)}, x_j = 1) - \mathrm{P}(Y = 1 \mid \bar{\mathbf{x}}_{(j)}, x_j = 0), \tag{3}$$

where $\bar{\mathbf{x}}_{(j)}$ denotes the mean of all the other variables in the model[14]. Note that the sign of a marginal effect is the same as the sign of the corresponding β coefficient. In Table V and Table VI the mean marginal effects of all explanatory variables are reported in place of the estimated β's.

Table V reports results of the binary regression analysis. Analysis is conducted on a traditional model (Model 1) which only includes the export ratio as the internationalization parameter; an extended model (Model 2) which includes more internationalization parameters; a full model (Model 3) which includes all internationalization parameters; a full model (Model 4) with four variables reduced to two new variables (EXPORT-IMPORT: the difference between EXPORT and IMPORT; NOSUBTOTAL: the sum of NOPSUB and NOSSUB) due to high correlation coefficients (Table IV); and a full model, Model 5, which is equivalent to Model 4 except that information on import is excluded.

* Please insert Table V approximately here *

[14] See for example Greene (2003) for an explanation of how to calculate marginal effects.

As shown in Model 1, the results indicate that only EXPORT is important in explaining the decision to use foreign exchange derivatives. Once we extend the model to our Model 2, GPTA turns significant and the new internationalization parameters (IMPORT, NOCUR, and USD) are all significant at least at a 10 percent level. Further extending the model to our full Model 3, all previously significant variables keep their significance levels (except NOCUR) whereas the new variables related to foreign subsidiaries (NOPSUB and NOSSUB) are not significant. Once we try to take account of high correlation coefficients in our Model 4, one of the new internationalization variables (EXPORT-IMPORT) is highly significant whereas the variable that sums the numbers of production and sales subsidiaries abroad is not significant. In our last model, Model 5, which excludes the import information, the explanatory power (McFadden R^2) is reduced and GPTA loses its significance compared to Model 4.

As is expected, Table V indicates no significant relation between AGE and the decision to use foreign exchange derivatives. Our difference in means test in Table III indicates that larger firms (TA) are more likely to use foreign exchange derivatives (thus supporting the economies of scale argument). However, once we go to the multivariate analysis in Table V, this relation cannot be confirmed. Table V suggests that in relation to size (TA), the economies of scale argument and the financial distress argument (that small firms have disproportionally large financial distress costs) either cancel each other out or are both negligible at least within our sample of medium-sized firms. The negative signs of the coefficients for profitability (GPTA) and equity (EQTA) in Table V unanimously support the financial distress argument (profitable and solvent firms do not need to hedge), but only in the case of GPTA these results are sometimes significant (thus to some degree supporting the immediate results of the

univariate analysis in Table III). The results in relation to R&D expenses show no significance although the negative signs of the coefficients point to a support for the uncertainty argument. In Table V, export is by no comparison the statistically most significant variable in explaining the use or the non-use of financial exchange derivatives as it consistently reports a strong, positive relation with the use of foreign exchange derivatives at a one percent significance level.

The remaining five variables (IMPORT, NOCUR, USD, NOPSUB, and NOSSUB) in Table 5 resemble an elaboration of the international involvement of the firm beyond the scope of the export ratio. These five variables all show a significantly – at least at the 10 percent level – higher mean for the sub-sample of foreign exchange derivatives users as compared to the sub-sample of foreign exchange derivatives non-users in Table III. In a multivariate setting, Table V confirms this observation in terms of direction with one major exception, IMPORT. Table III suggests a *positive* relation between import ratio and the use of foreign exchange derivatives while Table V shows a significant and *negative* relation between import ratio and the use of foreign exchange derivatives. This conflicting evidence highlights the inadequateness of a univariate analysis. Table V shows that, on the aggregate level, import serves as a match to exposures created by export activities rather than creating new foreign exchange exposures on its own. The preliminary and opposite result from Table III in relation to the import ratio and its relation to the use of foreign exchange derivatives shall be seen in connection with the high correlation between import and export ratio in Table IV. Thus, the positive relation between import ratio and the use of foreign exchange derivatives in Table III has no causable meaning. In order to address the potential multicollinearity problem in relation to the high correlation between import and export ratio, Model 4 includes the difference between the export ratio and the import ratio (EXPORT-IMPORT) rather than including them as separate variables. The coefficient to this new variable has the expected

sign and is statistically significant at the one percent level. It is estimated that an increase in the difference between the export ratio and the import ratio of 1 percentage point on average will result in an increase in the probability of using foreign exchange derivatives of 0.54 percentage point.

The sign for the coefficients of number of currencies (NOCUR) support the exposure argument rather than the diversification argument but not in a significant way. The coefficients for the US dollar being the most important currency to the firm are consistently significant at the five percent level and support the volatility argument (the more volatile the currency, the more need for hedging). The sign for the coefficients for production and sales subsidiaries abroad (NOPSUB and NOSSUB) support – whether taken separately or together (NOSUBTOTAL) in order to address a potential multicollinearity problem – the commitment argument but not significantly so.

The most interesting interpretations from the *magnitude* of the marginal effects figures in Table V relate to the export, the import and the most important currency variables. If the EXPORT variable is increased by 1 percentage point, then the estimated probability of using foreign exchange derivatives increases by somewhere between 0.38 percentage point (Model 5) and 0.62 percentage point (Model 2). Following our full model (Model 3) this means that if a firm has an export ratio of 10 percent as opposed to 0 percent (or 50 percent as opposed to 40 percent) such a firm is on average 5.6 percentage points more likely to be a user of foreign exchange derivatives. Correspondingly, if the IMPORT variable is increased by 1 percentage point, then the estimated probability of using foreign exchange derivatives decreases by 0.45-0.46 percentage point. This means that if a firm has an import ratio (as measured by percent of operating revenues) of 10 percent as opposed to 0 percent (or 50 percent as opposed to 40 percent) such a firm is on average approximately 4.6 percentage points less likely to be a

user of foreign exchange derivatives. Given the fact that both EXPORT and IMPORT are measured in percent of operating revenues, we can translate this into monetary terms. Following the coefficients of our full model (Model 3), the effect of 1 U.S. dollar (or 1 Euro) more in export on the probability to be a user of foreign exchange derivatives is cancelled out in the magnitude of four fifths (4.6/5.6=0.8) by 1 U.S. dollar (or 1 Euro) more in import. Furthermore, Table V shows a remarkable dependence on the USD being the most important currency. The probability of being a foreign exchange derivate user is between 22 percentage points (Model 2) and 30 percentage points higher for firms where the most important currency is USD than for firms where another currency is the most important. Thus, the volatility of the most important currency is an important parameter for a firm's decision to be a user of foreign exchange derivatives or not.

To summarize, Table V shows that Danish, medium-sized, manufacturing firms' usage of foreign exchange derivatives is positively related to these firms' export activities (EXPORT) and the volatility of the currencies to which they are exposed (USD) but negatively related to the firms' import activities (IMPORT) and to some degree to the profitability of the firms (GPTA). The purpose of the next section is to further analyze these relationships and check for robustness.

5. Robustness Considerations

The last section showed that import reduces the need for the use of foreign exchange derivatives. Seen in an integrated risk management perspective, import acts as a substitute for derivatives usage in dealing with the exposure created by the firms' international sales activities. This is true at the

aggregate level. However, on the firm-specific level the situation may be quite different. One extreme would be that the firm in question imports in currencies in which it has no exports whatsoever (0 percent matching) thus creating a new exposure on top of the exposure created by export. Another extreme would be that the firm in question exclusively imports in currencies in which it has export (100 percent matching). Nine out of ten firms in our sample are net exporters but for the firms in the last decile, the net importers, import is likely to increase rather than decrease the need for financial hedging. Furthermore, although matching is an established way of dealing with exchange rate exposures, even firms vigorously pursuing a matching strategy may find that some imports have to be done in currencies in which the firms has no exports whether for economic, physical, or geographical reasons.

In order to support (or disqualify) the above reasoning, the regression analysis performed in Table V is repeated but with a restricted group of sample firms. The firms most likely to experience difficulties in terms of being net importers or in terms of not being able to match imports to exports, are firms that either do not export at all or only export very little. Excluding these non-exporters and marginal-exporters should – not taking into consideration the impact of a smaller sample on the significance levels – give more significant results for our import variable if the above reasoning is correct. Table VI reports the results of the exact same regression analysis as in Table V but excluding the firms that have less than 20 percent of their consolidated operating revenues in foreign currency. That is we exclude the 60 (11 plus 49) firms which state that they have either 0 percent or 1-20 percent of their operating revenues in foreign currency (Table 1).

* Please insert Table VI approximately here *

Table VI supports the above reasoning in relation to the import variable (IMPORT). Excluding the non-exporters and the marginal-exporters, the coefficients for the import variable gain in statistical significance (although still at the five percent level) in spite of being based on a smaller sample than Table V. The conclusions as to the remaining variables remain more or less the same as for Table V apart from a loss of significance for our profitability variable (GPTA) and some loss of significance for our export variable (EXPORT). The latter loss shall be seen in connection with a restricted sample that has reduced the variability of the export variable by eliminating the lower portion of observations.

When looking into the *magnitude* of the marginal effects in Table VI, it is interesting to note that the coefficients for our EXPORT and IMPORT variables are of the same absolute magnitude in our full model (Model 3). This suggests that the effect of 1 U.S. dollar (or 1 Euro) more in export on the probability to be a user of foreign exchange derivatives is fully cancelled out by 1 U.S. dollar (or 1 Euro) more in import when we restrict the sample to export firms as opposed to only a four fifths cancelling out effect in relation to the full sample in Table V.

A competing explanation for not finding a *positive* relation between import and the use of foreign derivatives could be that import is generally done from countries where relevant derivatives are not available. Although this could be the case in some instances and for some firms, we can reject this explanation by using the trade statistics from Statistics Denmark. The two most important countries in terms of import of goods to Denmark are by no comparison Germany and Sweden followed by Netherlands, China, and the UK. Only in the case of China, there might be some rationale to the argument.

Another competing explanation for not finding a positive relation between import and the use of foreign derivatives could be that a high degree of import is associated with a high number of countries from which a firm imports thus creating some degree of diversification. However, if this reasoning was correct, we also would have expected to find some support for the diversification argument in relation to the number of currencies to which the firm is significantly exposed (NOCUR). We did not find such support.

6. Elaboration on Integrated FX Risk Management

In order to elaborate on the role of import in an integrated foreign exchange risk management framework, Table VII divides the sample firms into export groups (exposure) and reports information on proxies for the three elements of an integrated risk management approach: 1) changing operations, 2) changing capital structure, and 3) using targeted, financial instruments. In this context, changing operations is our import variable (IMPORT); changing capital structure is our capital structure variable (EQTA); and using targeted, financial instruments is our foreign exchange derivatives usage variable (FXDUSE).

* Please insert Table VII approximately here *

Table VII gives a preliminary view of the relationship between the three elements of integrated risk management and the foreign exchange exposure by showing the average equity ratio, import ratio, and

probability of being a foreign exchange derivative user across various export ratios (resembling various foreign exchange exposures). Table VII does not indicate a clear, uniform relationship between the export ratio and the capital structure of the firm (EQTA). A clear, uniform relationship can, however, be seen between the export ratio and the import ratio. A higher export ratio is consistently associated with a higher import ratio. As regards the use of foreign exchange derivatives, there is also a positive relationship – although more erratic.

We have previously (Table V and Table VI) elaborated on the extent to which the export ratio, the import ratio, the capital structure, and further firm characteristics affect the propensity to use foreign exchange derivatives. Thus, we have previously focused on one of the three elements of an integrated foreign exchange risk management approach - the use or non-use of foreign exchange derivatives – as the dependent variable. Table VIII widens this focus and elaborates on the integrated approach by focusing on the two other elements in the integrated approach - the import ratio and the capital structure - as the dependent variables. Thus, Table VIII reports results of an OLS regression analysis on the import ratio (IMPORT) and the equity ratio (EQTA) as dependent variables. Model 1 and Model 3 cover the full sample of firms (in line with Table V) whereas Model 2 and Model 4 cover only export firms (in line with Table VI). The independent variables are in line with the variables used in previous regression analysis on foreign exchange derivatives usage (Table V and Table VI).

* Please insert Table VIII approximately here *

Model 1 and Model 2 both have the import ratio, IMPORT, as the dependent variable. In order of significance the variables explaining the import ratio are the export ratio (EXPORT), the use of foreign

exchange derivatives (FXDUSE), the number of foreign production subsidiaries (NOPSUB), and to some extent number of currencies (NOCUR) and profitability (GPTA). The immediate view from Table VII of a strong relationship between the export ratio and the import ratio is thus confirmed in Table VIII. A 1 percentage point increase in the export ratio is associated with a 0.39 percentage point in the import ratio (or in monetary terms, a 1 U.S. dollar increase in exports is associated with a 39 cents increase in imports). According to traditional internationalization theory we would expect that the dominating causal effect would be from exports generating a need/desire for imports but for some firms imports may very well generate a need/desire for exports.

Table V and Table VI show that import reduces the probability that the firm is a foreign exchange derivatives user. Table VIII illustrates that this relationship is also working the other way around. If the firm is a foreign exchange user, the import ratio is ceteris paribus on average reduced by 7 to 9 percentage points. Table VIII shows a positive relation between the number of foreign production subsidiaries and the import ratio which makes intuitive sense. In terms of capital structure, Table VIII suggests a negative relation between the equity ratio and the import ratio but not in a significant way.

Model 3 and Model 4 have the equity ratio, EQTA, as their dependent variable. Table VIII suggest that older firms have a higher equity ratio but apart from this relationship no significant relationships is detected. In an integrated risk management approach, it is interesting to note that a higher import ratio as well as the status of a foreign exchange derivatives user is associated with a higher equity ratio (in support of an integrated risk management approach) but these relationships are not significant.

In summary, Table VIII and the previous tables show that the integrated risk management approach towards exchange rate exposures in medium-sized, manufacturing firms in Denmark is strongly confirmed in relation to two of the three elements. Thus, changing operations (IMPORT) and using foreign exchange derivatives (FXDUSE) are interacting and are tightly linked to the exposure parameter export ratio (EXPORT) and to a lesser extent to the volatility of the currencies to which the firm is exposed (USD). The third element in the integrated risk management approach, changing capital structure (EQTA), does not show significant interaction with the two other elements of an integrated risk management approach nor with the exposure parameters – although all the signs unanimously support the existence of an integrated foreign exchange risk management approach.

6. Conclusions

In this study we generally expand the knowledge about import, exchange rate derivatives usage, capital structure and their interaction with internationalization parameters. Specifically, we go beyond the export ratio traditionally applied and investigate the role of import. On the firm specific level import may increase (if import is conducted in currencies in which the firm has no export) or decrease (if import is conducted in currencies in which the firm has matching export) the need for financial hedging. On the aggregate level we find that import is an important element in an integrated risk management approach towards exchange rate risk in medium-sized, manufacturing firms – an element that reduces the need for financial hedging. Changes in capital structure being an important element in a integrated foreign exchange risk management approach is only supported vaguely.

Our results are important in understanding the diversity of "instruments" available to firms in managing their exchange rate risk. Unduly restricting an analysis to cover the use of financial derivatives gives a partial and potentially biased picture of the real world. Furthermore, focusing on medium-sized firms gives a unique knowledge about a very important part of the business world – a part that has often been neglected in prior research due to the tendency to focus on populations of large, listed firms as these firms pose less of a challenge in regard to data availability.

Our results are based on medium-sized, manufacturing firms in a small, open economy. Thus, our results are not likely to be readily transferable to medium-sized firms in large, more closed economies like the US. However, we see no reason why the results should not be transferable to medium-sized firms in other open economies. Furthermore, provided globalization is not put on hold, the present results from medium-sized, manufacturing firms in a small, open economy are likely to be representative for medium-sized, manufacturing firms in larger, more closed economies in the future.

Appendix

Part I of the Questionnaire

I. INTRODUCTION: COMPANY CHARACTERISTICS, FINANCIAL RISKS, AND GENERAL USE OF DERIVATIVES

1. Approximately what percentage of your company's consolidated operating revenues and costs are in foreign currency?

(Please choose the option closest to your estimate)

	0%	1-20%	20-40%	40-60%	60-80%	80-99%	100%
▪ Consolidated revenues	❍	❍	❍	❍	❍	❍	❍
▪ Consolidated costs	❍	❍	❍	❍	❍	❍	❍

2. To how many currencies is your company significantly exposed, and which are the three most important ones?

(Please choose appropriate option)

2a)	0	1-2	3-5	6-9	> 9
▪ Number of currencies significantly exposed to	❍	❍	❍	❍	❍

(Please choose one option per row, or write the currency in the field provided)

2b)	€ Euro	$ Dollar	£ Pound	SEK	NOK	¥ Yen	other
▪ Most important	❍	❍	❍	❍	❍	❍	❍
If other, please state:	**Currency 1:**			_____			
▪ 2nd most important	❍	❍	❍	❍	❍	❍	❍
If other, please state:	**Currency 2:**			_____			
▪ 3rd most important	❍	❍	❍	❍	❍	❍	❍
If other, please state:	**Currency 3:**			_____			

3. Does your company have subsidiaries abroad?

(Please choose appropriate option)

	0	1-2	3-5	6-9	> 9
▪ Production subsidiaries abroad	❍	❍	❍	❍	❍
▪ Sales subsidiaries abroad	❍	❍	❍	❍	❍

4. What are your company's expenses for R&D (research & development) as percentage of turnover / total sales?

Explanation: This question is used to analyze dependencies between (internal) growth opportunities and risk attitudes.

(Please choose the option closest to your estimate)

	0%	1-5%	5-10%	10-15%	15-20%	20-25%	> 25%
▪ R&D expenses (% of turnover)	❍	❍	❍	❍	❍	❍	❍

5. What are the characteristics of the management and ownership structure of your company?

(Please choose one option per row)

5a)	**Yes**	**No**
▪ Is the founder of your company or members of his/her family **active in the management team** of your company?	❍	❍
▪ Is the founder of your company or members of his/her family **present in the board of directors** of your company?	❍	❍
▪ Is the founder of your company or members of his/her family **shareholder(s) of your company**?	❍	❍

5b)	**Founder or his/her family**	**Other person[1]**	**Financial institution[2]**	**Industrial foundation**	**Other (industrial) firm**
▪ Who is the **largest shareholder** in your company (according to the number of votes)?	❍	❍	❍	❍	❍

[1] Other person (not founder or member of his/her family)
[2] Financial institution, such as investment or equity funds, or similar financial investors

6. In general, which financial risks are important to your company's operations?

(Please choose one option per row)

	Very important	**Important**	**Somewhat important**	**Less important**	**Not important**
▪ Foreign exchange (FX) risk	❍	❍	❍	❍	❍
▪ Interest rate risk	❍	❍	❍	❍	❍
▪ Commodity price risk	❍	❍	❍	❍	❍

7. Has your company used derivatives (financial instruments such as forwards, swaps, options, or futures) during the last year? (Forwards = *terminskontrakter* in Danish)

(Please choose one option per row)

	Yes	**No**
▪ Foreign exchange (FX) derivatives	❍	❍
▪ Interest rate derivatives	❍	❍
▪ Commodity price derivatives	❍	❍

→ Please continue with the following 9 questions, if your company is using derivatives or foreign debt <u>to manage exchange rate exposures</u> at least to some extent:

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Table I Internationalization Information for Sample Firms

This table reports information on the internationalization of the 215 sample firms. The information is obtained from responses to the questionnaire (Appendix). *Export* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1). *Import (of operating costs)* is the percentage of the firm's consolidated operating costs in foreign currency (responses to Question 1). *No. of currencies* is the number of currencies to which the firm is significantly exposed (responses to Question 2a). *Most important currency* is the currency most important to the firm (responses to Question 2b). EUR is the Euro. USD is the US Dollar. GBP is British Pound. SEK is Swedish Krona. NOK is Norwegian Krone. JPY is Japanese Yen. *No. of production subsidiaries* is the number of production subsidiaries abroad (responses to Question 3). *No. of sales subsidiaries* is the number of sales subsidiaries abroad (responses to Question 3). The numbers in the cells refer to the number of firms which chose the specific response option. The last column (N) refers to the number of firms responding to the particular question in the questionnaire.

	Percent							
	0	1-20	20-40	40-60	60-80	80-99	100	N
Export	11	49	29	32	48	42	1	212
Import (of operating costs)	5	83	44	35	27	9	0	203
			0	1-2	3-5	6-9	≥9	N
No. of currencies			7	82	112	10	1	212
	EUR	USD	GBP	SEK	NOK	JPY	Other	N
Most important currency	151	32	10	8	1	1	11	214
			0	1-2	3-5	6-9	≥9	N
No. of production subsidiaries			128	56	9	3	3	199
No. of sales subsidiaries			93	58	37	12	7	207

Table II Descriptive Statistics for Sample Firms

This table reports descriptive statistics for the 215 sample firms. The information is obtained from WEB-DIRECT and from responses to the questionnaire (Appendix). Variables used in subsequent regression analysis are in capital letters. *Age (years)* is the age of the firm. *AGE* is the logarithm of the sum of *Age (years)* plus 1. *Total Assets* is the total assets of the firm measured in million DKK. *TA* is the logarithm of *Total Assets*. *GPTA* is the gross profit of the firm divided by the total assets of the firm. *EQTA* is the equity of the firm divided by the total assets of the firm. *RD* is the R&D expenses in percent of the turnover of the firm (responses to Question 4; midpoints of intervals and a max. of 30 percent used). *EXPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used). *Import (of operating costs)* is the percentage of the firm's consolidated operating costs in foreign currency (responses to Question 1; midpoints of intervals used). *IMPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used; scaled by (1 - gross profit / turnover) in order to transform from a percentage of costs to a percentage of revenues). *No. of currencies* is the number of currencies to which the firm is significantly exposed (responses to Question 2a; midpoints of intervals and a max. of 12 used). *NOCUR* is the logarithm of (*No. of currencies* + 1). *USD* is a binary variable coded as 1 if the most important currency to the firm is the US dollar and 0 otherwise (responses to Question 2b). *No. of production subsidiaries* is the number of production subsidiaries abroad (responses to Question 3; midpoints in intervals and a max. of 12 used). *NOPSUB* is the logarithm of the sum of *No. of production subsidiaries* plus 1. *No. of sales subsidiaries* is the number of sales subsidiaries abroad (responses to Question 3; midpoints in intervals and a max. of 12 used). *NOSSUB* is the logarithm of the sum of *No. of sales subsidiaries* plus 1.

	Mean	Mediam	Maximum	Minimum	Std. Dev.
Age (years)	44	34	170	1	35
AGE	3.48	3.56	5.14	0.69	0.90
Total Assets (million DKK)	148	108	489	50	106
TA	4.79	4.68	6.19	3.91	0.62
GPTA	39%	35%	128%	-15%	19%
EQTA	36%	33%	92%	-12%	19%
RD	4.1%	3.0%	30.0%	0.0%	3.6%
EXPORT	48%	50%	100%	0%	31%
Import (of operating costs)	33%	30%	90%	0%	25%
IMPORT	24%	21%	77%	0%	19%
No. of currencies	3.1	4.0	12.0	0.0	1.74
NOCUR	1.31	1.60	2.56	0	0.45
USD	0.15	0.00	1.00	0.00	0.36
No. of production subsidiaries	0.9	0.0	12.0	0.0	1.9
NOPSUB	0.40	0.00	2.56	0.00	0.60
No. of sales subsidiaries	2.0	1.5	12.0	0.0	2.8
NOSSUB	0.76	0.92	2.56	0.00	0.79

Table III Comparison of Mean Values between Users and Non-Users of FX Derivatives

This table reports univariate analysis (t-statistics) on differences in mean values of variables between two sub-samples of the 215 sample firms: 1) Users of foreign exchange derivatives and 2) Non-Users of foreign exchange derivatives (responses to Question 7; two firms did not respond to this particular question). Information on variables is obtained from WEB-DIRECT and from responses to the questionnaire (Appendix). Variables used in subsequent regression analysis are in capital letters. *Age (years)* is the age of the firm. *AGE* is the logarithm of the sum of *Age (years)* plus 1. *Total Assets* is the total assets of the firm measured in million DKK. *TA* is the logarithm of *Total Assets*. *GPTA* is the gross profit of the firm divided by the total assets of the firm. *EQTA* is the equity of the firm divided by the total assets of the firm. *RD* is the R&D expenses in percent of the turnover of the firm (responses to Question 4; midpoints of intervals and a max. of 30 percent used). *EXPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used). *Import (of operating costs)* is the percentage of the firm's consolidated operating costs in foreign currency (responses to Question 1; midpoints of intervals used). *IMPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used; scaled by (1 - gross profit / turnover) in order to transform from a percentage of costs to a percentage of revenues). *No. of currencies* is the number of currencies to which the firm is significantly exposed (responses to Question 2a; midpoints of intervals and a max. of 12 used). *NOCUR* is the logarithm of (*No. of currencies* + 1). *USD* is a dummy variable coded as 1 if the most important currency to the firm is the US dollar and 0 otherwise (responses to Question 2b). *No. of production subsidiaries* is the number of production subsidiaries abroad (responses to Question 3; midpoints in intervals and a max. of 12 used). *NOPSUB* is the logarithm of the sum of *No. of production subsidiaries* plus 1. *No. of sales subsidiaries* is the number of sales subsidiaries abroad (responses to Question 3; midpoints in intervals and a max. of 12 used). *NOSSUB* is the logarithm of the sum of *No. of sales subsidiaries* plus 1. *, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent levels respectively.

(mean values)	Users of FX derivatives (89 firms)	Non-Users of FX derivatives (124 firms)	Mean difference	
Age (years)	46	43	3	
AGE	3.55	3.44	0.11	
Total Assets (million DKK)	169	134	34	**
TA	4.90	4.71	0.19	**
GPTA	35%	42%	-7%	**
EQTA	36%	35%	1%	
RD	4.4%	3.9%	0.5%	
EXPORT	60%	39%	20%	***
Import (of operating costs)	36%	30%	6%	*
IMPORT	27%	22%	5%	*
No. of currencies	3.5	2.8	0.6	***
NOCUR	1.43	1.23	0.20	***
USD	0.22	0.10	0.13	***
No. of production subsidiaries	1.3	0.6	0.7	**
NOPSUB	0.56	0.27	0.29	***
No. of sales subsidiaries	2.4	1.6	0.8	**
NOSSUB	0.94	0.61	0.33	***

Table IV Correlation Coefficients for Variables Used in Regression Analysis

This table reports correlation coefficients for the 215 sample firms for variables used in regression analysis. Information on variables is obtained from WEB-DIRECT and from responses to the questionnaire (Appendix). *AGE* is the logarithm of the sum of age of the firm plus 1. *TA* is the logarithm of total assets of the firm. *GPTA* is the gross profit of the firm divided by the total assets of the firm. *EQTA* is the equity of the firm divided by the total assets of the firm. *RD* is the R&D expenses in percent of the turnover of the firm (responses to Question 4; midpoints of intervals and a max. of 30 percent used). *EXPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used). *IMPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used; scaled by (1 - gross profit / turnover) in order to transform from a percentage of costs to a percentage of revenues). *NOCUR* is the logarithm of the sum of the number of currencies to which the firm is significantly exposed plus 1 (responses to Question 2a; midpoints of intervals and a max. of 12 used). *USD* is a dummy variable coded as 1 if the most important currency to the firm is the US dollar and 0 otherwise (responses to Question 2b). *NOPSUB* is the logarithm of the sum of the number of production subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used). *NOSSUB* is the logarithm of the sum of the number of sales subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used).

	AGE	TA	GPTA	EQTA	RD	EXPO	IMPO	NOCU	USD	NOPS	NOSS
AGE	1.00										
TA	0.16	1.00									
GPTA	0.06	-0.31	1.00								
EQTA	0.17	0.09	0.09	1.00							
RD	0.02	0.14	-0.01	0.13	1.00						
EXPORT	-0.02	0.18	-0.16	0.10	0.30	1.00					
IMPORT	-0.02	0.25	-0.28	-0.06	0.17	0.55	1.00				
NOCUR	0.11	0.31	-0.19	-0.02	0.22	0.39	0.39	1.00			
USD	-0.08	0.14	-0.07	-0.01	0.12	0.07	0.15	0.10	1.00		
NOPSUB	0.11	0.27	-0.10	0.09	0.16	0.34	0.30	0.31	0.09	1.00	
NOSSUB	0.16	0.34	-0.06	0.15	0.23	0.46	0.35	0.40	0.09	0.58	1.00

Table V Binary Regression Analysis on the Use of FX Derivatives

This table reports results of binary regression analyses on the use of foreign exchange derivatives among the 215 sample firms. The figures in the table are the estimated marginal effects, and below these in parentheses the *p*-values indicating whether the corresponding effects are significant or not. As the constant term is a nuisance parameter here, we have omitted the reporting of this term in the models. Note that the marginal effects for the binary variable USD are calculated according to formula (3). Information on variables is obtained from WEB-DIRECT and from responses to the questionnaire (Appendix). The dependent variable, *FXDUSE*,* is a continuous latent variable which is regressed on the explanatory variables and assumed to represent the propensity to use foreign exchange derivatives (Equation 1). *FXDUSE* is a binary variable coded as 1 if the firm is a user of foreign exchange derivatives and 0 otherwise (responses to Question 7). *AGE* is the logarithm of the sum of age of the firm plus 1. *TA* is the logarithm of total assets of the firm. *GPTA* is the gross profit of the firm divided by the total assets of the firm. *EQTA* is the equity of the firm divided by the total assets of the firm. *RD* is the R&D expenses in percent of the turnover of the firm (responses to Question 4; midpoints of intervals and a max. of 30 percent used). *EXPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used). *IMPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used; scaled by (1 - gross profit / turnover) in order to transform from a percentage of costs to a percentage of revenues). *NOCUR* is the logarithm of the sum of the number of currencies to which the firm is significantly exposed plus 1 (responses to Question 2a; midpoints of intervals and a max. of 12 used). *USD* is a dummy variable coded as 1 if the most important currency to the firm is the US dollar and 0 otherwise (responses to Question 2b). *NOPSUB* is the logarithm of the sum of the number of production subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used). *NOSSUB* is the logarithm of the sum of the number of sales subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used). *EXPORT-IMPORT* is the difference between *EXPORT* and *IMPORT*. *NOSUBTOTAL* is the sum of *NOPSUB* and *NOSSUB*. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5
AGE	0.038	0.022	0.0113	0.0091	0.027
	(0.3007)	(0.5372)	(0.7754)	(0.8093)	(0.4764)
TA	0.42	0.0074	0.0021	0.0027	-0.0017
	(0.4531)	(0.8949)	(0.9721)	(0.9643)	(0.9779)
GPTA	-0.20	-0.36 **	-0.35 **	-0.38 **	-0.21
	(0.1925)	(0.0279)	(0.0358)	(0.0207)	(0.1874)
EQTA	-0.054	-0.084	-0.077	-0.086	-0.045
	(0.7550)	(0.6160)	(0.6611)	(0.6220)	(0.8009)
RD	-0.22	-0.90	-0.66	-0.61	-0.44
	(0.8114)	(0.3299)	(0.4788)	(0.5186)	(0.6411)
EXPORT	0.48 ***	0.62 ***	0.56 ***		0.38 ***
	(0.0000)	(0.0000)	(0.0001)		(0.0027)
IMPORT		-0.45 **	-0.46 **		
		(0.0338)	(0.0377)		
NOCUR		0.15 *	0.11	0.12	0.067
		(0.0621)	(0.1880)	(0.1688)	(0.4503)
USD		0.22 **	0.29 **	0.30 **	0.27 **
		(0.0438)	(0.0161)	(0.0115)	(0.0204)
NOPSUB			0.070		
			(0.2983)		
NOSSUB			0.020		

			(0.7186)		
EXPORT-IMPORT				0.54 ***	
				(0.0001)	
NOSUBTOTAL				0.063	0.049
				(0.1398)	(0.2675)
N = 0	120	115	105	105	109
N = 1	88	80	72	72	76
N	208	195	177	177	185
Mean dependent variable	0.4231	0.4103	0.4068	0.4068	0.4108
S.D. dependent variable	0.4952	0.4931	0.4926	0.4926	0.4933
McFadden R^2	0.1003	0.1699	0.1769	0.1746	0.1300
LR statistic	28.42 ***	44.86 ***	42.30 ***	41.75 ***	32.57 ***
Probability (LR stat)	0.0001	0.0000	0.0000	0.0000	0.0002

Table VI Binary Regression Analysis on the Use of FX Derivatives for Export Firms

This table reports results of binary regression analysis on the use of foreign exchange derivatives among the 215 sample firms excluding the firms that have less than 20 percent of their consolidated operating revenues in foreign currency (11+49=60 firms, Table 1). The figures in the table are the estimated marginal effects, and below these in parentheses the *p*-values indicating whether the corresponding effects are significant or not. Note that the marginal effects for the binary variable USD are calculated according to formula (3). Information on variables is obtained from WEB-DIRECT and from responses to the questionnaire (Appendix). The dependent variable, *FXDUSE*,* is a continuous latent variable which is regressed on the explanatory variables and assumed to represent the propensity to use foreign exchange derivatives (Equation 1). *FXDUSE* is a binary variable coded as 1 if the firm is a user of foreign exchange derivatives and 0 otherwise (responses to Question 7). *AGE* is the logarithm of the sum of age of the firm plus 1. *TA* is the logarithm of total assets of the firm. *GPTA* is the gross profit of the firm divided by the total assets of the firm. *EQTA* is the equity of the firm divided by the total assets of the firm. *RD* is the R&D expenses in percent of the turnover of the firm (responses to Question 4; midpoints of intervals and a max. of 30 percent used). *EXPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used). *IMPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used; scaled by (1 - gross profit / turnover) in order to transform from a percentage of costs to a percentage of revenues). *NOCUR* is the logarithm of the sum of the number of currencies to which the firm is significantly exposed plus 1 (responses to Question 2a; midpoints of intervals and a max. of 12 used). *USD* is a dummy variable coded as 1 if the most important currency to the firm is the US dollar and 0 otherwise (responses to Question 2b). *NOPSUB* is the logarithm of the sum of the number of production subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used). *NOSSUB* is the logarithm of the sum of the number of sales subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used). *EXPORT-IMPORT* is the difference between *EXPORT* and *IMPORT*. *NOSUBTOTAL* is the sum of *NOPSUB* and *NOSSUB*. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5
AGE	0.043	0.030	0.025	0.022	0.041
	(0.3686)	(0.5188)	(0.6130)	(0.6427)	(0.4162)
TA	0.10	0.072	0.071	0.068	0.069
	(0.1337)	(0.3079)	(0.3544)	(0.3799)	(0.3740)
GPTA	-0.0058	-0.24	-0.24	-0.29	-0.055
	(0.9767)	(0.2511)	(0.2625)	(0.1778)	(0.7874)
EQTA	-0.067	-0.091	-0.092	-0.099	-0.071
	(0.7498)	(0.6531)	(0.6659)	(0.6395)	(0.7476)
RD	-0.28	-0.92	-0.67	-0.63	-0.45
	(0.7821)	(0.3958)	(0.5189)	(0.5574)	(0.6715)
EXPORT	0.40 **	0.69 ***	0.63 ***		0.35 *
	(0.0319)	(0.0010)	(0.0040)		(0.0838)
IMPORT		-0.60 **	-0.62 **		
		(0.0187)	(0.0206)		
NOCUR		0.13	0.11	0.10	0.027
		(0.2808)	(0.3862)	(0.4450)	(0.8367)
USD		0.26 **	0.31 **	0.32 **	0.28 **
		(0.0232)	(0.0134)	(0.0111)	(0.0242)
NOPSUB			0.11		
			(0.1621)		
NOSSUB			-0.024		

			(0.7223)		
EXPORT-IMPORT				0.61 ***	
				(0.0021)	
NOTOTALSUB				0.049	0.043
				(0.3543)	(0.4139)
N = 0	72	68	62	62	66
N = 1	76	70	63	63	66
N	148	138	125	125	132
Mean dependent variable	0.5135	0.5072	0.5040	0.5040	0.5000
S.D. dependent variable	0.5015	0.5018	0.5020	0.5020	0.5019
McFadden R^2	0.0454	0.1136	0.1281	0.1206	0.0775
LR statistic	9.32	21.72 ***	22.20 **	20.90 **	14.19
Probability (LR stat)	0.1566	0.0098	0.0229	0.0131	0.1157

Table VII Preliminary Analysis on Integrated FX Risk Management

This table reports information on the integrated FX risk management of the 200 sample firms for which the relevant information is available (common sample). The information is obtained from responses to the questionnaire (Appendix). Firms are divided into export groups according to the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1) similar to the division in Table I. *EQTA* is the equity of the firm divided by the total assets of the firm. *Import (of operating costs)* is the percentage of the firm's consolidated operating costs in foreign currency (responses to Question 1). *IMPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used; scaled by (1 - gross profit / turnover) in order to transform from a percentage of costs to a percentage of revenues). *FXDUSE* is a binary variable coded as 1 if the firm is a user of foreign exchange derivatives and 0 otherwise (responses to Question 7). The numbers in the cells in the first row (N) refers to the number of firms in the specific export group. The numbers in the following rows refer to the average number for the specific export group.

	Export percent							
	0	1-20	20-40	40-60	60-80	80-99	100	Total
N	11	48	27	32	45	36	1	200
EQTA	33%	32%	41%	34%	35%	42%	25%	36%
Import (of operating costs)	9%	15%	26%	34%	42%	52%	70%	32%
IMPORT	6%	11%	19%	25%	29%	39%	51%	24%
FXDUSE	0%	23%	22%	50%	64%	56%	0%	41%

Table VIII OLS Regression Analysis on Integrated FX Risk Management

This table reports results of OLS regression analysis on the import ratio (IMPORT) and the equity ratio (EQTA) among the 215 sample firms (Model 1 and Model 3) and among the 155 sample export firms. The sample export firms are the sample firms excluding the firms that have less than 20 percent of their consolidated operating revenues in foreign currency (11+49=60 firms, Table 1). The figures in the table are the estimated beta coefficients, and below these in parentheses the *p*-values indicating whether the corresponding effects are significant or not. Information on variables is obtained from WEB-DIRECT and from responses to the questionnaire (Appendix). The dependent variable is *IMPORT* (Model 1 and Model 2) measured as the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used; scaled by (1 - gross profit / turnover) in order to transform from a percentage of costs to a percentage of revenues) or *EQTA* (Model 3 and Model 4) measured as the equity of the firm divided by the total assets of the firm. *C* is a constant. *FXDUSE* is a binary variable coded as 1 if the firm is a user of foreign exchange derivatives and 0 otherwise (responses to Question 7). *AGE* is the logarithm of the sum of age of the firm plus 1. *TA* is the logarithm of total assets of the firm. *GPTA* is the gross profit of the firm divided by the total assets of the firm. *RD* is the R&D expenses in percent of the turnover of the firm (responses to Question 4; midpoints of intervals and a max. of 30 percent used). *EXPORT* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 1; midpoints of intervals used). *NOCUR* is the logarithm of the sum of the number of currencies to which the firm is significantly exposed plus 1 (responses to Question 2a; midpoints of intervals and a max. of 12 used). *USD* is a dummy variable coded as 1 if the most important currency to the firm is the US dollar and 0 otherwise (responses to Question 2b). *NOPSUB* is the logarithm of the sum of the number of production subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used). *NOSSUB* is the logarithm of the sum of the number of sales subsidiaries abroad plus 1 (responses to Question 3; midpoints in intervals and a max. of 12 used). *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels respectively.

	Model 1 (all firms)	Model 2 (export firms)	Model 3 (all firms)	Model 4 (export firms)
Dependent variable:	IMPORT	IMPORT	EQTA	EQTA
C	-0.02	0.03	0.21	0.16
	(0.8690)	(0.8646)	(0.1337)	(0.3777)
EQTA	-0.09	-0.10		
	(0.2470)	(0.3311)		
IMPORT			-0.09	-0.09
			(0.2475)	(0.3311)
FXDUSE	-0.07*	-0.09 **	-0.02	-0.01
	(0.0543)	(0.0307)	(0.6313)	(0.7178)
AGE	-0.01	-0.02	0.03 *	0.03
	(0.7153)	(0.3364)	(0.0881)	(0.1695)
TA	0.04	0.04	0.01	0.03
	(0.2057)	(0.3248)	(0.7699)	(0.4608)
GPTA	-0.10	-0.19 *	0.03	0.15
	(0.1584)	(0.0586)	(0.6480)	(0.1224)
RD	-0.20	-0.13	0.38	0.20
	(0.6425)	(0.7910)	(0.3724)	(0.6664)
EXPORT	0.39 ***	0.39 ***	0.09	-0.03
	(0.0000)	(0.0001)	(0.1405)	(0.8000)
NOCUR	0.07 *	0.10	-0.03	-0.02

	(0.0710)	(0.1176)	(0.3202)	(0.7044)
USD	0.07	0.09	-0.03	-0.04
	(0.1385)	(0.1250)	(0.4598)	(0.4966)
NOPSUB	0.05 *	0.06 *	0.00	0.01
	(0.0844)	(0.0853)	(0.9341)	(0.7454)
NOSSUB	0.00	-0.00	0.03	0.02
	(0.9213)	(0.9652)	(0.2500)	(0.5430)
N	177	125	177	125
Mean dependent variable	0.3186	0.3912	0.3530	0.3729
S.D. dependent variable	0.2476	0.2456	0.1986	0.2048
R-squared	0.3906	0.2897	0.0738	0.0898
Adjusted R-squared	0.3499	0.2205	0.0121	0.0012
F-statistic	9.31 ***	4.19 ***	1.19	1.01
Prob(F-statistic)	0.0000	0.0000	0.2935	0.4391