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**Foreign Debt Usage in Non-Financial Firms:
A Horse Race between Operating and Accounting Exposure Hedging**

Tom Aabo*, Marianna Andryeyeva Hansen** and Yaz Gulnur Muradoglu***

Abstract

Previous studies show that foreign exchange exposure from international sales can be hedged by foreign debt. We go beyond the foreign sales measure by using a unique database with detailed exposure information on Danish non-financial firms with international operations. Our results indicate that foreign debt is used to hedge foreign assets and subsidiaries (accounting exposure) as opposed to foreign sales (operating exposure). The paper adds to the literature on corporate hedging by highlighting the importance of accounting exposure in the hedging behavior of corporate managers and the perceived need to reduce risks due to currency mismatches between assets and liabilities.

Keywords: exchange rate exposure management; foreign debt; foreign assets; foreign subsidiaries; accounting exposure

JEL Classification: F23, G32

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1. Introduction

Shapiro (1975) shows that one of the major factors affecting a multinational firm's exchange rate risk is sales in export markets. The foreign sales ratio is the standard proxy for openness. It has been used in a number of studies on the management of exchange rate exposure by non-financial firms. A firm that receives revenue in foreign currency has two ways of eliminating such positive (long) foreign exchange exposure by financial means. The first is the use of financial derivatives, such as forward contracts, futures, swaps, and options. The second is the use of debt denominated in foreign currency ("foreign debt"); this can involve either raising new debt or changing the currency denomination of existing debt.¹ The use of the foreign sales ratio as the sole proxy for openness assumes the firm to be a simple exporter. However, many firms are also multinational producers. Proxies for openness for such firms also include foreign costs,² foreign assets, and foreign subsidiaries.

We use a unique database with detailed exchange rate exposure information on Danish non-financial firms to determine whether foreign debt hedges against exposure from foreign revenues or against exposure from physical presence abroad (foreign assets and subsidiaries). Our database enables us to investigate the issue by differentiating the effects of not only revenues and operating costs, but also foreign operating assets and foreign subsidiaries. We find that foreign debt usage among

¹ In exposure terms it makes no difference whether, say, a German firm chooses to hedge a positive cash flow of US\$1 million that it expects to receive in three months based on a sales contract by 1) selling forward today with a settlement of US\$1 million against the euro (EUR) in three months or 2) borrowing an amount in US dollars (instead of borrowing in EUR) today that, together with accrued interest, is settled by paying back exactly US\$1 million in three months. Géczy *et al.* (1997) note that foreign debt can displace the need to hedge with derivatives by acting as a hedge of foreign revenues.

² Foreign debt cannot be used as a hedge against costs in foreign currency because this would create two negative—and thus non-offsetting—cash flows in that particular currency. Thus, foreign costs cannot explain foreign debt usage but are generally correlated with openness.

internationally involved, medium-sized firms is primarily related to foreign operating assets and foreign subsidiaries. Thus, the results of our study indicate that, in its practical hedging application, foreign debt is used predominantly to hedge accounting exposure, as opposed to operating exposure. Yet, it is also possible that foreign debt is used to hedge the flow of expected future revenues and that foreign assets and foreign subsidiaries provide better proxies for the present value of future foreign revenues than the annual foreign revenue reported in last year's annual report. The foreign debt measure we use ignores domestic debt swapped into foreign currency but we address this issue and show that the results are robust.

In spite of the academic focus on operating exposure over accounting exposure³—for example, the focus on cash flows in terms of reducing the risk of financial distress (Smith and Stulz, 1985) or improving the ability to make value-adding investments (Froot *et al.*, 1993)—empirical studies show that accounting concerns do matter in actual managerial decision making (e.g., Lins *et al.*, 2011). A firm that has foreign assets (e.g., in the form of a subsidiary abroad) can hedge its balance sheet by creating an offsetting liability in the form of foreign debt and thus protect its equity from fluctuations caused by unexpected changes in foreign exchange rates.⁴ Such hedging of accounting exposure can be valuable for firms in an asymmetric information framework. Furthermore, unfavorable changes in

³ Foreign exchange exposure is traditionally grouped in three categories: transaction exposure, translation exposure—also called accounting exposure—and economic exposure—also called operating exposure, strategic exposure, or competitive exposure (e.g., Eiteman *et al.*, 2010).

⁴ All listed European Union firms (including Danish firms) have been required to use International Financial Reporting Standards since 2005 and, in terms of foreign debt, these standards do not deviate markedly from those of the Financial Accounting Standards Board (see Statement No. 133 for elaboration). If foreign debt is used to hedge expected future income in foreign currency, accounting rules are unlikely to allow such use of foreign debt to be categorized as a hedge except for the few cases in which the future income is certain (e.g., in the case of transaction exposure). Consequently, unrealized gains and losses on foreign debt caused by changes in exchange rates are likely to affect income statements and create vulnerability in accounting earnings. On the contrary, if foreign debt is used to hedge operating assets in foreign currency, accounting rules allow such use of foreign debt to be categorized as a hedge and unrealized gains and losses on the foreign debt are treated in a way corresponding to the treatment of the underlying asset (in this case the operating assets in foreign currency), thus creating offsetting unrealized gains and losses.

accounting earnings and the balance sheet can cause the firm to violate debt covenants and thus, in the most extreme case, force the firm into bankruptcy. Due to the lack of detailed exposure information, the empirical literature has been vague in addressing whether foreign debt usage is primarily driven by operating or accounting exposures.

Based on a survey of US and Canadian non-financial firms including both small and large firms and both listed and non-listed firms, Graham and Harvey (2001) find that a popular reason for issuing foreign debt is to provide a natural hedge against foreign currency devaluation. The hedging rationale is supported in an international context (e.g., Keloharju and Niskanen, 2001; Aabo, 2006; Clark and Judge, 2009). Three studies suggest that foreign debt usage is positively linked to physical presence abroad. Allayannis and Ofek (2001) investigate the exchange rate exposure management of a sample of Standard & Poor's 500 non-financial firms for 1993 and find that US exporters tend to prefer foreign currency derivatives to foreign debt but that multinational firms with operations abroad have no strong preferences. Aabo (2006) investigates the exchange rate exposure management of a sample of listed non-financial Danish firms and finds that the relative importance of foreign debt compared to derivatives is positively related to the extent of foreign subsidiaries. Finally, Clark and Judge (2009) investigate the exchange rate exposure management of the top 500 non-financial firms in the United Kingdom and find that foreign debt is used to hedge long-term exposure from foreign operations. The results of the three studies could be interpreted as the use of foreign debt for accounting exposure hedging (matching assets and liabilities) but it could also simply signify that operating cash flows from sales abroad are considered more long term (and thus more adequate for hedging through the use of foreign debt) if the firm has a physical presence abroad.

Our study is based on a sample of internationally involved medium-sized non-financial Danish firms. Denmark is a small, open economy with its currency, the Danish krone (DKK), pegged to the euro (EUR). Denmark's three main trading partners are Germany (EUR), the United Kingdom (Great British pound) and Sweden (Swedish krona). Danish firms are used to dealing in and being exposed to various currencies and have ready access to foreign debt, primarily through the Danish banking sector.⁵ As in other European Union countries, the International Financial Reporting Standards (IFRS) have been in effect in Denmark since 2005. In the sphere of exchange rate exposure management, medium-sized firms are interesting because they are generally large and sophisticated enough to be exposed to and react to volatile exchange rates but at the same time do not generally possess the large international network of foreign subsidiaries that makes truly multinational firms almost immune to exchange rate changes.⁶

In line with the arguments of Graham and Harvey (2001), we use the survey approach to balance the benefits and problems with large sample analysis and clinical studies. The survey approach is used in numerous studies on foreign exchange rate exposure management in non-financial firms, most notably by Bodnar *et al.* (1998), who investigate publicly traded US firms.

Our study distinguishes itself from others in terms of the depth of information on firm internationalization and the use of foreign debt and derivatives. This rich information enables us to go

⁵ Access to foreign debt in Denmark is not restricted to large firms. This is best exemplified by the heavy borrowing in Swiss francs by Danish farmers. Allayannis *et al.* (2003) find that non-US firms raise a large proportion of their debt in foreign currency.

⁶ Aabo and Simkins (2005) note the importance of real options as a substitute for financial hedging in exchange rate exposure management. For a sample of US multinationals, Lee and Suh (2010) find that the impact of changes in exchange rates on the profitability of foreign operations is not statistically significant in the majority of industries, while Muller and Verschoor (2006) find an impact for a sample of European multinational firms.

deeper than previous studies in investigating the underlying factors for foreign debt usage while at the same time considering the interplay between the use of foreign debt and derivatives. Thus, our study is important for the understanding of foreign debt usage and contributes to the existing literature by expanding such understanding.

The paper proceeds as follows. Section 2 briefly presents the study's methodology. Section 3 reports survey results on internationalization and the results of a univariate analysis on foreign debt usage. Section 4 analyzes the relation between foreign debt usage and firm characteristics through multivariate regression analysis. Section 5 tests for robustness and Section 6 concludes the study.

2. Data and Methodology

This study is based on public information from WEB-DIRECT⁷ and a survey on foreign exchange exposure management. We focus on Danish⁸ medium-sized⁹ unlisted¹⁰ non-financial¹¹ firms.

⁷ WEB-DIRECT is a comprehensive database from Experian A/S containing information on Nordic firms. The database contains information on some 630,000 Danish firms.

⁸ We exclude firms that are subsidiaries of foreign firms.

⁹ We define medium-sized firms as firms fulfilling two criteria: having a balance sheet total of DKK 75 million to DKK 750 million (EUR 10 million to EUR 100 million) and 50 to 499 employees. The European Commission defines medium-sized firms as firms with 50 to 249 employees and either a turnover of EUR 10 million to EUR 50 million or a balance sheet total of EUR 10 million to EUR 43 million. Our definition of medium-sized firms is broader in the upper end. We exclusively use figures on the balance sheet total since many of our target firms do not report turnover figures.

¹⁰ We restrict our sample to unlisted firms that are private limited companies (corresponding to the Danish firm types *Aktieselskab*, or A/S, and *Anpartsselskab*, or ApS) with available accounting numbers. We exclude listed firms because the number of medium-sized listed firms in Denmark is very limited compared to the whole population of medium-sized firms in Denmark (2–3%) and to avoid unnecessary heterogeneity in the sample. The fact that our sample consists of non-listed firms could provide a bias in terms of equity financing but we see no obvious reasons for biases in relation to foreign debt usage.

¹¹ WEB-DIRECT employs the NACE code (Statistical Classification of Economic Activities in the European Community), an industry classification system comparable and equivalent to US North American Industry Classification System code. The NACE code was revised January 1, 2008. It divides industries into 21 main categories. We exclude financial and insurance activities.

For simplicity we exclude NACE economic sectors, which after implementation of the selection criteria comprise fewer than 20 firms. Our final 1055 firms are divided into four economic sectors, as illustrated in Panel A of Table 1.

* Please insert Table 1 approximately here *

These firms were contacted in the last quarter of 2008 via e-mail¹² and asked to complete an online, web-based questionnaire. A total of 368 firms participated in the survey, with a 35% response rate, varying from 31% to 54% across the four economic sectors. There is no significant non-response bias in terms of size (measured by the number of employees and total assets), profitability, or capital structure.

The first question in the questionnaire (see the Appendix) divides firms into those with operating revenue, operating costs, operating assets, and/or financial debt in foreign currency (i.e., firms that are internationally involved) and firms that have none of these items in foreign currency (i.e., firms that are not internationally involved). According to these criteria, 186 firms (51%) are internationally involved and 182 firms (49%) are not, as shown in Panel A of Table 1. The former group of firms was asked to proceed with the questionnaire and the latter group was excluded from answering further questions. Manufacturing (C) has the highest percentage of firms that are involved internationally (71%), while construction (F) has the lowest (18%).

¹² The e-mails were addressed to the financial director whenever possible. Their names and most of the firm e-mail addresses were found in WEB-DIRECT. All in all, personalized mail with the financial director's name was sent to 859 firms (81%), e-mails generally addressed to the financial director were sent to 165 firms (16%), e-mails through the firm webpage were sent to 17 firms (2%), and for 14 firms (1%) no e-mail address could be found and no attempt was made to contact those firms by alternative means. An invitation e-mail and a maximum of four follow-up e-mails were sent to each firm.

The group of firms (182 firms) excluded from answering further questions and also excluded from further analysis comprises firms that have 1) no direct foreign exchange exposure from operating revenues, operating costs, and/or operating assets and, at the same time, 2) no foreign debt. Thus, the excluded group does not comprise firms with foreign debt or firms with a straightforward need for currency hedging in the form of direct exchange rate exposure from operations.¹³

Conversely, the group of firms (186 firms) that is the focus of this study comprises firms that 1) have direct foreign exchange exposure from operating revenues, operating costs, and/or operating assets and 2) may or may not have foreign debt. Since only a single firm has foreign debt without direct foreign exchange exposure from operating revenues, operating costs, or operating assets, for all practical reasons we can say that we have divided the group of respondents into two samples. These samples are more or less of equal size, where 1) one is characterized by firms that have no direct foreign exchange exposure or foreign debt and are therefore excluded from further analysis and 2) the other is characterized by firms that have direct foreign exchange exposure (except for one firm) and is the target for further analysis. By analyzing firms with direct foreign exchange exposure, we are not trying to generalize our results to firms without such direct exposure.

We investigate the following two competing hypotheses.

¹³ Indirect exposure may cause “domestic” firms to have exchange rate exposure (e.g., Aggarwal and Harper, 2010) so that our distinction between firms that have operating revenues, operating costs, operating assets, and/or financial debt in foreign currency and those that do not does not necessarily mean the latter group is comprised of firms without any kind of exchange rate exposure.

H1: Non-financial firms use foreign debt to hedge operating income in foreign currency, in line with an operating exposure hedging hypothesis.

H2: Non-financial firms use foreign debt to hedge operating assets in foreign currency and foreign subsidiaries, in line with an accounting exposure hedging hypothesis.

Section 3 presents company characteristics and a univariate regression analysis and Section 4 presents a multivariate regression analysis. The regression analysis is performed using binary probit and ordinary least squares (OLS) regression analysis where the dependent variables are the use or non-use of foreign debt (binary) and the extent of foreign debt usage (OLS), respectively. The following equation is estimated:

$$\begin{aligned}
 FDEBTBI_{i\text{or}FDEBT}_i = & C + \lambda_1 TOTALASSETS_i + \lambda_2 RETURNEQUITY_i \\
 & + \lambda_3 EQUITYRATIO_i + \lambda_4 FREVENUES_i + \lambda_5 FCOSTS_i + \lambda_6 FASSETS_i \\
 & + \lambda_7 FCOUNTRIES_i + \lambda_8 Sector_i + \omega_i
 \end{aligned} \tag{1}$$

where

$FDEBTBI_i$ measures the use/non-use of foreign debt and is coded as one if the firm has foreign debt and zero otherwise (responses to Question 2),

$FDEBT_i$ measures the extent of foreign debt usage and is the percentage of the firm's consolidated financial debt in foreign currency (responses to Question 2, midpoints of intervals used),

$TOTALASSETS_i$ is the logarithm of total assets of the firm measured in millions of DKK,

$RETURNEQUITY_i$ is the firm's net income divided by its equity,

$EQUITYRATIO_i$ is the firm's equity divided by its total assets,

$FREVENUES_i$ is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 2, midpoints of intervals used),

$FCOSTS_i$ is the percentage of the firm's consolidated operating costs in foreign currency (responses to Question 2, midpoints of intervals used),

$FASSETS_i$ is the percentage of the firm's consolidated operating assets in foreign currency (responses to Question 2, midpoints of intervals used),

$FCOUNTRIES_i$ is the logarithm of the sum of the number of countries in which the firm has subsidiaries (responses to Question 6) plus one, and

$Sector_i$ represents the NACE classification codes F, G, and H+J+M+N, respectively (Manufacturing, C, being the default), coded as one if the firm belongs to the specific sector and zero otherwise.

Dolde and Mishra (2007) argue that firms face two stages of decision regarding the potential hedging of foreign exchange exposures: an initial hedging/no hedging decision based on benefits and costs and a subsequent hedging decision for the subsample of firms that choose to hedge in the first stage. In our context this corresponds to 1) the firms' decision to use or not to use foreign debt and 2) their decision regarding the extent of foreign debt usage. Thus, firms relevant at the second stage are those that choose to use foreign debt in the first stage. This exposes a possible sample selection bias when we investigate the extent decision. To account for this possibility we use Heckman's (1976, 1979) estimation method to calculate a correction term (Mill's lambda).

3. Univariate Analysis of Foreign Debt Usage

The focus group in this study consists of 186 internationally involved firms (Table 1, Panel A). As can be seen from Panel B of Table 1, almost all of our sample firms have revenues and costs in

foreign currency, three-quarters have operating assets in foreign currency, two-thirds use foreign debt, and two-thirds have foreign subsidiaries. As such, our sample of 186 firms is heavily involved internationally, not only in terms of the traditional measure of international involvement (operating revenue in foreign currency) but also more broadly. It is these specific components of broad international involvement and the implications of foreign debt usage that motivate our study and distinguish it from previous work. Table 2 reports descriptive statistics for the 186 sample firms (Panel A) and correlation coefficients for variables used in the subsequent multivariate regression analysis (Panel B).¹⁴

* Please insert Table 2 approximately here *

Table 3 reports the results of univariate analysis (*t*-statistics) on differences in the mean values of variables between the 129 firms (69%) that use foreign debt and the 57 firms (31%) that do not. The groups of users and non-users of foreign debt do not differ significantly with respect to size (total assets) or profitability (return on equity). However, users of foreign debt are more leveraged (lower equity ratio) and more internationally involved in terms of all of our four internationalization measures (operating revenues in foreign currency, operating costs in foreign currency, operating assets in foreign currency, and number of foreign subsidiaries).

* Please insert Table 3 approximately here *

¹⁴ Our subsequent regression analysis uses the number of foreign countries in which the firm has subsidiaries as one of the internationalization measures; alternatively, we could have used the number of foreign subsidiaries. In the present study the two measures are close to identical (with a correlation coefficient of 0.99 for the logarithmic versions of the measures) and the conclusions of subsequent regression analysis are not affected by our choice.

Analyzing a sample of non-financial listed UK firms, Bradley and Moles (2002) find that 84% of the 202 firms that do have foreign subsidiaries use foreign debt, while only 20% of the 87 firms that do not have foreign subsidiaries use foreign debt. The corresponding figures in our sample are 80% of 121 firms and 49% of 65 firms. However, the results are only the reflection of a simple univariate analysis. If we go further and divide our sample into 1) the 31 firms that have neither foreign subsidiaries nor foreign operating assets and 2) the 155 firms that have foreign subsidiaries and/or foreign operating assets, we find that 10 out of 31 firms (32%) and 119 out of 155 firms (77%) use foreign debt.

4. Multivariate Analysis of the Determinants of Foreign Debt Usage

We start the multivariate analysis by investigating separately the two stages of decisions firms make about foreign exchange exposure (Dolde and Mishra, 2007). We first investigate the qualitative decision of whether the benefits of a hedging program exceed its costs by analyzing this decision's determinants. If the benefits exceed the costs, then the firm will decide to manage foreign exposure. In our context this corresponds to the firm's decision to use or not use foreign debt, which is analyzed in Table 4. Dolde and Mishra (2007) argue that the second stage is a quantitative decision on the extent of hedging. In our context this decision corresponds to the amount of foreign debt and is analyzed in Table 5. The empirical findings of Géczy *et al.* (2007) support the separation of the use/non-use and extent decisions.

Table 4 reports the results of the estimations of probit regressions on the determinants of foreign debt usage. Acknowledging possible multicollinearity between foreign exchange exposure variables due to high correlations, we initially use them one at a time (Models 1 to 4), with the last model (Model 5) incorporating all four internationalization variables. The dependent variable (*FDEBTBI*) in Table 4 is a binary variable coded as one if the firm uses foreign debt and zero otherwise.

* Please insert Table 4 approximately here *

Table 4 shows a negative relation between equity ratio and foreign debt usage, which could be interpreted as support for a financial distress argument. Thus, Purnanandam (2008) finds that firms with tighter financial constraints/higher leverage are more likely to use foreign exchange derivatives for hedging purposes. However, George and Hwang (2010) show that firms with high financial distress costs choose low leverage and vice versa. The significant and negative relation between the equity ratio and foreign debt usage may simply reflect the fact that a certain amount of financial debt is a prerequisite for the issuance of foreign debt—a sort of convenience argument in line with the arguments of Clark and Judge (2008)—rather than being an argument for a low equity ratio triggering strong hedging needs. Thus, in relation to capital structure and its impact on foreign debt usage, we follow the reasoning that the tail does not wag the dog. We are aware that hedging (e.g., in the form of foreign debt) can increase a firm's optimal leverage by increasing debt capacity. However, such an increase does not depend on foreign debt per se because foreign exchange derivatives can lead to the exact same reduction in foreign exchange risk. Thus, we maintain that we have no serious simultaneity

issue here and suggest that *if* the firm has financial debt in its capital structure, the firm may want to have some of it denominated in foreign currency to manage its exchange rate exposure.

In Table 4, the coefficient estimates for all four of our internationalization variables are positive and strongly significant for Models 1 to 4. However, the significance seems to be due to omitted variable bias. Once we include all four internationalization parameters, Model 5 shows that the choice of whether to use foreign debt or not is only significantly linked to the number of countries in which the firm has foreign subsidiaries (*FCOUNTRIES*).¹⁵

Table 5 reports the results of the estimations of OLS regressions on the determinants of the extent of foreign debt usage. As previously mentioned, Table 5 excludes the 57 firms that have no foreign debt to strictly delineate between the use/non-use decision (Table 4) and the extent decision (Table 5). The structure of Table 5 follows that of Table 4 except that the new Model 6 is equivalent to Model 5 but includes Mill's lambda to account for potential selection bias.

* Please insert Table 5 approximately here *

Table 5 shows that the coefficient estimates for all our internationalization variables are positive and strongly significant for Models 1 to 4 (except for foreign subsidiaries) but Model 5 shows that once we reduce the omitted variable bias, foreign assets become the important explaining variable. In Tables 4 and 5 we follow, as already mentioned, the reasoning of Dolde and Mishra (2007), who argue that

¹⁵ We control for economic sector in Table 4 and subsequent tables. The coefficient estimates for the sector dummies do not exhibit a uniform pattern and the economic sector dummies do not seem to have an important impact on foreign debt usage. We therefore refrain from further comments on economic sectors and their possible impact on foreign debt usage.

firms face two stages of decisions about foreign exchange exposures: 1) a qualitative decision of whether the benefits of a hedging program exceed the costs (to use foreign debt or not; see Table 4) and 2) a quantitative decision on the extent of hedging (the amount of foreign debt; see Table 5). Thus, our second question is only measurable (and relevant) for the firms that choose to use foreign debt in the first stage. This could indicate a selection bias problem¹⁶ and to correct for such bias we use Heckman's (1976, 1979) two-step estimation method. We first estimate the selection equation using a probit model and calculate a correction term (Mill's lambda) that accounts for the probability that the firm is being included in the subsample of firms that choose to use foreign debt.¹⁷ We include this correction term in Model 6 in Table 5. As can be seen from this model, Mill's lambda is insignificant, which indicates that there is no significant selection bias and that the previous conclusions hold.

¹⁶ One may argue that in this case there is no potential sample selection problem. Heckman (1979) gives an example (among others) of migrant wages and states (page 153) that the "wages of migrants do not, in general, afford a reliable estimate of what nonmigrants would have earned had they migrated" and (pages 153-4) that "wage and earnings functions estimated on selected samples do not, in general, estimate population (i.e. random sample) wage functions. Comparisons of the wages of migrants with the wages of nonmigrants ... result in a biased estimate of the effect of a *random* "treatment" of migration". There is an intuitive logic to this example. It may be that only the very intelligent or the very hungry emigrate. Whatever the reason, people who choose to migrate are not necessarily representative of those who choose not to migrate. Thus, it is misleading to assume that the nonmigrating person would have done just as well or as poorly as the migrant had the nonmigrant chosen to migrate. In the example above we cannot generalize the credentials of the sample of persons who chose to migrate to the entire population of migrants and nonmigrants. However, in our case of the use/non-use of foreign debt and extent of foreign debt usage, we are only interested in investigating the decisions of firms for which the extent decision is relevant. We are not interested in transferring our results to firms that choose, in their first stage, not to use foreign debt.

¹⁷ To account for potential sample selection bias, we use Heckman's (1976, 1979) two-step estimation method, wherein we first estimate the selection equation using the probit model $USER_i = Constant + \lambda_1 TOTALASSETS_i + \lambda_2 RETURNEQUITY_i + \lambda_3 EQUITYRATIO_i + \lambda_4 FREVENUES_i + \lambda_5 FCOSTS_i + \lambda_6 FASSETS_i + \lambda_7 FCOUNTRIES_i + \lambda_8 Sector_i$, where the sample selection indicator variable, $USER_i$, takes the value of one if the firm uses foreign debt and zero otherwise. The probit model is equivalent to Model 5 in Table 4. After estimating the above probit model using the entire population of firms (186 firms), we calculate a correction term (Mill's lambda) that accounts for the probability that the firm is being included in the sample (129 firms). Mill's lambda is the ratio of the probability density function over the cumulative distribution function of a distribution. The magnitude and significance of Mill's lambda indicate sample selectivity. We include Mill's lambda as an independent variable in the regression on the extent of foreign debt usage (Model 6 in Table 5). An insignificant lambda coefficient implies there is no selection bias, that is, that the probability of using foreign debt has no bearing on the coefficients of the independent variables in the extent of foreign debt usage model. A significant coefficient of Mill's lambda in the regression indicates selection bias and that the coefficients of the model are biased. However, when we include Mill's lambda, the coefficients of the variables are unbiased. We calculated and included Mill's lambda for alternative models and tables with the same result as for Model 6 in Table 5, that is, no indication of selection bias and the results remain the same (not shown here for the sake of brevity but available from the authors on request).

5. Robustness of Results

This section tests the robustness of our results reported in the previous section. The first test transforms our internationalization variables (*FREVENUES*, *FCOSTS*, *FASSETS*, and *FCOUNTRIES*) into binary variables and log-transformed variables (Table 6). The second test calculates alternative estimations for large and small firms separately (not tabulated here¹⁸). The third test uses alternative measures of foreign debt usage as our independent variable (foreign debt usage within the last year) and addresses potential bias from derivatives usage (Table 7).

First, we transform our four foreign exposure variables (*FREVENUES*, *FCOSTS*, *FASSETS*, and *FCOUNTRIES*) into four binary variables and re-estimate all equations using the structure of Model 5 from Tables 4 and 5. The results are reported for Models 1 and 2 in Table 6. Model 1 concerns the use/non-use decision (binary) and Model 2 concerns the extent decision (OLS). Foreign revenues (*FREVENUES*), foreign costs (*FCOSTS*), and foreign assets (*FASSETS*) are each coded as zero if they are less than 20% and one otherwise and foreign countries in which the firm has subsidiaries (*FCOUNTRIES*) are coded as zero if the firm has no foreign subsidiaries and one otherwise. Foreign subsidiaries and foreign assets comprise the most significant internationalization parameters, respectively, for the use/non-use of foreign debt and extent of foreign debt usage decisions.

* Please insert Table 6 approximately here *

¹⁸ Generally, results that are not tabulated / shown are available from authors on request.

When these binary internationalization variables are used, the coefficient estimate for foreign revenue becomes significant. To investigate this further and try to balance between not being too influenced by potential outliers, on the one hand, and not being too crude (the transformation to binary variables), on the other hand, we transform all our internationalization variables to a logarithmic version (logarithm of the sum of the original variable plus one) and re-estimate all the models. The results are reported for Models 3 and 4 in Table 6 and are similar to the original results for Model 5 in Tables 4 and 5.

Second, to test for robustness in relation to size, we re-estimate our models in two different size (*TOTALASSETS*) subsamples, i.e. for firms belonging to the half of our sample with the smallest firms and for firms belonging to the half of our sample with the largest firms. The results (not tabulated here for the sake of brevity) do not seem to be unduly driven by any one of the size segments. This finding suggests that our results may be transferable to firms that are either smaller or larger than the firms in our sample.

Third, we use alternative measures of foreign debt usage to test the robustness of our definition of the dependent variable in our regressions. Specifically, for Model 1 in Table 7, we investigate the determinants of whether a firm issued debt in foreign currency during the last year (as opposed to whether it has any foreign debt whatsoever).¹⁹ Thus, we re-estimate our use/non-use model (Model 5 in

¹⁹ We also try an alternative approach in which we conduct an ordered probit regression analysis of the responses from Question 8 in the questionnaire. Specifically, the dependent variable in this approach is *FDEBTImportance_i*, which measures the importance of foreign debt usage as an ordered variable, where 1 = unimportant, 2 = somewhat unimportant, 3 = neither important nor unimportant, 4 = somewhat important, and 5 = important (according to the wording of Question 8).

Table 4) with a dependent variable coded as one if the firm issued foreign debt during the last year to manage foreign exchange risk and zero otherwise (Question 13). In our sample, 129 out of 186 firms (69%) use foreign debt (Table 4). Of these 129 firms, 92 (49% of the 186 firms) issued foreign debt during the last year. Thus, 37 firms (20% of the 186 firms) use foreign debt but did not issue foreign debt during the last year. The results of this different approach are in line with previous results. If we include a dummy for short-term currency derivatives usage (Question 13) in Model 1, it is insignificant. However, if we include a dummy for long-term currency derivatives usage (Question 13) in Model 1, it is positive and significant. Thus, while there seems to be no significant relation between the use of short-term currency derivatives and foreign debt (two “different” worlds), there seems to be one between long-term currency derivatives (most notably swaps) and foreign debt. If we run a regression with only the 47 firms that use long-term currency derivatives, none of our internationalization variables is statistically significant.

* Please insert Table 7 approximately here *

Model 1 in Table 7 indicates that the size of the firm (*TOTALSSETS*) is not a significant factor in deciding foreign debt usage. This is in line with the ready access to foreign debt that is provided through the Danish banking sector even for small firms (e.g., Danish farmers) and individuals (mortgages). However, if we run Model 1 with derivatives usage (Question 13) as the dependent variable, we find the size of the firm is significant at the 5% level in explaining the use of short- and/or

The independent variables are identical to the variables of Model 1 in Table 7. We obtain qualitatively the same results as for Model 1 with significant coefficients for *EQUITYRATIO* (negative), *FASSETS* (positive), and *FCOUNTRIES* (positive) and insignificant coefficients for *FCOSTS* and *FASSETS*.

long-term derivatives. Thus, size (economies of scale) seems to be an unimportant barrier in terms of foreign debt usage but not in term of derivatives usage.

Models 2 and 3 in Table 7 use the setup from Model 1 for two subsamples of our 186 sample firms: the 139 firms that do not use long-term derivatives (Model 2) and the 72 firms that use neither short-term nor long-term derivatives (Model 3). Model 2 tests concerns of potential bias related to the use of currency swaps in our sample firms. Our previous analysis focuses on foreign debt (debt denominated in foreign currency) exclusively. However, debt denominated in home currency can be swapped into foreign currency through the use of foreign currency swaps. Conversely, debt denominated in foreign currency can be swapped into home currency debt.²⁰ We argue that our exclusion of currency swaps does not pose a serious challenge in our analysis. *First*, Danish medium-sized firms have ready access to home currency debt as well as foreign debt through banks. *Second*, the answers to Question 13 in the questionnaire allow us to investigate whether our results are unduly biased. Thus, the answers to Question 13 divide our 186 sample firms into 47 firms that used long-term currency derivatives (most notably currency swaps) within the last year and 139 firms that did not. Thus, the 139 firms are firms for which we know the use of currency swaps has not changed home currency debt into foreign debt or vice versa. The results for these 139 firms are reported in Model 2 and are for all practical purposes identical to those of Model 1.

²⁰ We focus on currency swaps (long-term currency derivatives) since these instruments are frequently used to convert debt denominated in one currency to debt effectively denominated in another currency. However, for very short-term debt forward contracts could serve the same purpose.

In Model 3 in Table 7 we further restrict our sample and only investigate foreign debt usage for the minority of firms (72 firms) that used neither short-term nor long-term derivatives within the last year (Question 13). The model is not significant.²¹

We use the setup from Model 1 in Table 7 to further highlight differences in foreign debt usage, as opposed to the use of short-term (Model 4) and long-term (Model 5) currency derivatives. Specifically, in Models 4 and 5 we investigate the determinants of whether the firm used short-term or long-term currency derivatives during the last year (Question 13). In our sample, 102 out of 186 firms (55%) used short-term currency derivatives and 47 out of 186 firms (25%) used long-term currency derivatives during the last year. Model 4 shows that the use of short-term currency derivatives is significantly linked to firm size. Furthermore, Model 4 shows a positive relation between the use of short-term derivatives and foreign revenue, a negative relation between the use of short-term derivatives and foreign assets, and a positive relation between the use of short-term derivatives and foreign subsidiaries. Model 5 in Table 7 reports no significant coefficients (except the constant term).

Foreign debt usage could be influenced by factors other than foreign exchange exposure management concerns. If a large part of Danish foreign investments target less developed and more unstable countries, such factors could be a desire to reduce political risk and/or the availability of subsidized loans from host governments. However, figures from the Danish National Bank (Danmarks

²¹ Model 3 is not significant. However, it indicates that the 72 firms that use neither short-term nor long-term derivatives use foreign debt to hedge foreign revenues. Difference-in-means tests (not shown for the sake of brevity) show that these 72 firms are significantly smaller and significantly less internationally involved (on three out of four internationalization measures) than the 114 firms that use short-term and/or long-term derivatives. In line with the reasoning of Dolde and Mishra (2007), these 72 firms choose not to use derivatives based on a cost/benefit analysis, given their limited size and exposure. We found previously that firm size is an important factor regarding derivatives usage but not foreign debt usage. Thus, these 72 firms choose foreign debt as their sole hedging instrument and hedge foreign revenues whereas the majority of firms (the 114 firms that also use derivatives) use foreign debt to hedge foreign assets and foreign subsidiaries.

Nationalbank) do not support such reasoning. Approximately three-fourths of the stock of Danish direct investments abroad is in Europe and one-tenth is in the United States. This leaves approximately 15% for the rest of the world, including Canada, Australia, and Japan. We do not have specific data on our sample firms but see no reason why our sample firms should deviate markedly from the country-level data.

6. Conclusions

We investigate foreign debt usage among a sample of 186 internationally involved, medium-sized non-financial Danish firms through primary and secondary data. We find that for the majority of firms foreign debt usage is related to foreign operating assets and foreign subsidiaries, as opposed to foreign operating revenues. Our empirical results are consistent with the hypothesis that the majority of firms use foreign debt to hedge accounting exposure (foreign assets and subsidiaries) as opposed to operating exposure.

We discuss two alternative explanations that rely on potential data problems in relation to the right- and left-hand sides of Equation 1, respectively. First, foreign assets and foreign subsidiaries are important variables in determining foreign debt usage in the regressions but this does not necessarily imply that firms hedge accounting exposure. Under a Millerian²² explanation firms hedge operating exposure, but in a present value sense rather than in a flow sense. Foreign assets and subsidiaries may then be better proxies for the present value of foreign net cash flows than the foreign sales ratio. An

²² Culp and Miller (1994) argue that when hedging cash flows, one can deal with each cash flow separately or hedge their combined present value and that these methods are comparable.

objection to this line of reasoning is that present value hedging is more complicated and imperfect. However, also under a flow hedging perspective, exposure is measured with considerable imprecision. Thus, firm hedging is not related to last year's foreign revenue but, rather, to accounts receivables in foreign currency plus expected foreign sales net of foreign costs in a relevant but not readily defined future period. A second potential problem in relation to the right-hand side of the equation lies in the differential scaling, which can obscure the link between the non-scaled amounts. Thus, foreign operating revenue is scaled by total operating revenue, foreign financial debt is scaled by total financial debt, and foreign operating costs are scaled by total operating costs. Finally, foreign revenue is significant when we measure it with a dummy. The potential data problem in relation to the left-hand side of the equation lies in the foreign debt variable that ignores domestic debt swapped into foreign currency via either a swap or a forward sale. Thus, we investigate the firms that do not use currency derivatives and show that our results are robust.

In summary, the majority of firms seem to use foreign debt to hedge accounting exposure as opposed to operating exposure. However, given the potential data problems, we cannot discard alternative explanations. Thus, firms may hedge based on a present value perspective and we find that foreign assets and foreign subsidiaries are better proxies for such present values than current foreign sales.

Appendix

Questions from the Questionnaire

1. Think about your company's operating revenues, operating costs, operating assets, and financial debt. Is at least one of these four categories to any degree denominated in a currency other than DKK? Yes/No.

2. What percentage of your company's consolidated operating revenues, operating costs, operating assets, and financial debt is in foreign currency? (Please check the option in each row that is closest to your estimate.)

	0%	1–20%	21–40%	41–60%	61–80%	81–99%	100%
Operating revenues	<input type="checkbox"/>						
Operating costs	<input type="checkbox"/>						
Operating assets	<input type="checkbox"/>						
Financial debt	<input type="checkbox"/>						

6. What is the number of foreign countries in which your company has subsidiaries?
(Please select one answer.)

8. In order to manage the impact of exchange rate fluctuations on your company's operating cash flows or competitive position (i.e., operating exposure), how important are the following financial means for your company? (Please check one option in each row.)

	Important	Somewhat important	Neither important or unimportant	Somewhat unimportant	Unimportant
Short-sighted currency derivatives (forward contracts (= "termiskontrakter" in Danish), options)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Long-sighted currency derivatives (swaps)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Choice of the currency in which the company's debt is denominated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. During the last year, has your company used currency derivatives or issued debt in foreign currency in order to manage foreign exchange risk? (Please check the appropriate option in each row.)

	Yes	No
Short-sighted currency derivatives (forward contracts (= "termiskontrakter" in Danish), options)	<input type="checkbox"/>	<input type="checkbox"/>
Long-sighted currency derivatives (swaps)	<input type="checkbox"/>	<input type="checkbox"/>
Debt in foreign currency	<input type="checkbox"/>	<input type="checkbox"/>

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Table 1. Summary statistics for the survey.

Panel A: Response rates

This panel lists survey results for Danish medium-sized non-financial firms. The firms are classified by economic sector (NACE). The population consists of 1055 firms; 368 firms responded, for a response rate of 35%. Of these 368 firms, 186 firms (51%) are internationally involved and 182 firms (49%) are not (Question 1). The relevant sample for the remainder of the paper comprises the 186 firms that responded to the questionnaire that are internationally involved. Other services (H+J+M+N) include transportation and storage (H), information and communication (J), professional, scientific, and technical activities (M), and administrative and support service activities (N).

<u>Economic sector</u>	<u>Pop.</u>	<u>Resp.</u>	<u>Response</u>	<u>International operations</u>			
			<u>rate</u>	<u>Yes</u>		<u>No</u>	
Manufacturing (C)	455	140	31%	99	71%	41	29%
Construction (F)	62	33	53%	6	18%	27	82%
Wholesale and retail trade; Repair of motor vehicles and motorcycles (G)	308	98	32%	44	45%	54	55%
Other services (H+J+M+N)	230	97	42%	37	38%	60	62%
Total	1055	368	35%	<u>186</u>	51%	182	49%

Panel B: Summary statistics on international operations

This panel reports information on the internationalization of the firms in our sample. Information on variables is from responses to Questions 2 and 6 of the questionnaire (see the Appendix).

	<u>Percent in foreign currency</u>							<u>N</u>
	<u>0</u>	<u>1–20</u>	<u>21–40</u>	<u>41–60</u>	<u>61–80</u>	<u>81–99</u>	<u>100</u>	
Operating revenues	13	37	22	36	36	38	4	186
	7%	20%	12%	19%	19%	20%	2%	100%
Operating costs	7	65	41	45	18	10	0	186
	4%	35%	22%	24%	10%	5%	0%	100%
Operating assets	49	61	32	23	14	6	1	186
	26%	33%	17%	12%	8%	3%	1%	100%
Financial debt	57	51	31	26	13	8	0	186
	31%	27%	17%	14%	7%	4%	0%	100%
	<u>Number of countries</u>							
	<u>0</u>	<u>1</u>	<u>2–3</u>	<u>4–6</u>	<u>7–10</u>	<u>11–25</u>	<u>26–50</u>	<u>N</u>
Foreign subsidiaries	65	35	33	29	17	5	2	186
	35%	19%	18%	16%	9%	3%	1%	100%

Table 2. Company characteristics.

Panel A: Descriptive statistics

This panel reports descriptive statistics for the 186 sample firms. Information on the variables is from WEB-DIRECT and from responses to the Questionnaire (see the Appendix). The variable *Total assets* is the total assets of the firm measured in millions of DKK, *TOTALASSETS* is the logarithm of *Total assets*, *RETURNEQUITY* is the net income of the firm divided by equity, *EQUITYRATIO* is the equity of the firm divided by total assets, *FREVENUES* is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 2, midpoints of intervals used), *FCOSTS* is the percentage of the firm's consolidated operating costs in foreign currency (responses to Question 2, midpoints of intervals used), *FASSETS* is the percentage of the firm's consolidated operating assets in foreign currency (responses to Question 2, midpoints of intervals used), *FDEBT* is the percentage of the firm's consolidated financial debt in foreign currency (responses to Question 2, midpoints of intervals used), *Foreign countries* is the number of countries in which the firm has subsidiaries (responses to Question 6), and *FCOUNTRIES* is the logarithm of the sum of *Foreign countries* plus one. Descriptive statistics are mean (mean), median (med.), minimum (min.), maximum (max.), standard deviation (std.d.), kurtosis (kur.), Jarque-Bera (JB), Jarque-Bera probability (JB pr.), and number of observations (N).

	<u>Mean</u>	<u>Med.</u>	<u>Min.</u>	<u>Max.</u>	<u>Std.D.</u>	<u>Skew</u>	<u>Kur.</u>	<u>JB</u>	<u>JB pr.</u>	<u>N</u>
Total assets	222	173	76	745	149	1.53	5.01	104.0	0.000	186
TOTALASSETS	5.2	5.2	4.3	6.6	0.6	0.40	2.31	8.5	0.014	186
RETURNEQUITY	0.16	0.18	-4.09	5.51	0.74	0.04	27.57	4680.2	0.000	186
EQUITYRATIO	0.37	0.30	-0.31	0.94	0.20	0.37	3.97	11.5	0.003	186
FREVENUES	0.49	0.50	0.00	1.00	0.32	-0.10	1.65	14.4	0.001	186
FCOSTS	0.34	0.30	0.00	0.90	0.25	0.60	2.41	14.0	0.001	186
FASSETS	0.23	0.10	0.00	1.00	0.25	1.12	3.29	39.23	0.000	186
FDEBT	0.23	0.10	0.00	0.90	0.26	1.03	3.02	32.85	0.000	186
Foreign countries	3.0	1.0	0.0	45.0	5.0	4.56	32.68	7469.6	0.000	186
FCOUNTRIES	0.94	0.69	0.00	3.83	0.88	0.58	2.60	11.9	0.003	186

Panel B: Correlation coefficients

This panel reports the correlation coefficients for variables used in the regression analysis for the 186 sample firms. Information on the variables is from WEB-DIRECT and from responses to the Questionnaire (see the Appendix). The variables are defined in Panel A.

	TA	ROE	EQT	FREV	FCOS	FASS	FCOU	FDEBT
TOTALASSETS	1	0.05	0.11	0.24	0.23	0.23	0.28	0.11
RETURNEQUITY	0.05	1	-0.07	-0.11	0.03	-0.03	0.11	0.01
EQUITYRATIO	0.11	-0.07	1	0.05	0.06	0.09	0.01	0.09
FREVENUES	0.24	-0.11	0.05	1	0.45	0.48	0.38	0.33
FCOSTS	0.23	0.04	0.06	0.45	1	0.50	0.33	0.41
FASSETS	0.23	-0.03	0.09	0.48	0.50	1	0.34	0.50
FCOUNTRIES	0.28	0.11	0.01	0.38	0.33	0.34	1	0.28
FDEBT	0.11	0.01	0.09	0.33	0.41	0.50	0.28	1

Table 3. Comparison of users and non-users of foreign debt.

This table reports the results of univariate analysis (*t*-statistics) of the differences in the mean values of the variables between the two subsamples of the 186 firms: 1) users of foreign debt and 2) non-users of foreign debt (responses to Question 2). Information on the variables is from WEB-DIRECT and from responses to the questionnaire (see the Appendix). The variables are defined in Table 2. The superscripts *, **, and *** indicate significance (t-test) at the 10%, 5%, and 1% levels, respectively.

(Mean values)	Users of foreign debt (129 firms)	Non-users of foreign debt (57 firms)	Mean difference	
Total assets	225	216	9	
TOTALASSETS	5.2	5.2	0.1	.
RETURNEQUITY	0.16	0.16	0.00	
EQUITYRATIO	0.32	0.38	-0.06	**
FREV	0.56	0.35	0.21	***
FCOSTS	0.38	0.25	0.13	***
FASSETS	0.27	0.14	0.13	***
Foreign countries	3.6	1.5	2.1	***
FCOUNTRIES	1.12	0.52	0.61	***

Table 4. Determinants of use versus non-use of foreign debt.

This table reports the results of binary probit regression analysis on the use/non-use of foreign debt for the 186 sample firms. Information on the variables is from WEB-DIRECT and from responses to the Questionnaire (see the Appendix). The dependent variable is $FDEBTBI_i$, which measures foreign debt usage/non-usage and it is coded as one if the firm has foreign debt and zero otherwise (responses to Question 2). The independent variables are defined in Table 2. The superscripts *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>	<u>Model 5</u>
	(binary)	(binary)	(binary)	(binary)	(binary)
C	0.1826 (0.8387)	0.0864 (0.9240)	0.3688 (0.6854)	0.5657 (0.5429)	0.5677 (0.5524)
TOTALASSETS	0.0776 (0.6677)	0.1299 (0.4686)	0.1035 (0.5657)	0.0324 (0.8605)	-0.0438 (0.8191)
RETURNEQUITY	0.0137 (0.9296)	-0.0540 (0.7077)	-0.0328 (0.8261)	-0.1181 (0.4650)	-0.0865 (0.5874)
EQUITYRATIO	-1.1893** (0.0217)	-1.2087** (0.0184)	-1.2249** (0.0177)	-1.1639** (0.0254)	-1.2473** (0.0179)
FREVENUES	1.1480*** (0.0008)				0.3454 (0.4058)
FCOSTS		1.4498*** (0.0017)			0.6390 (0.2296)
FASSETS			1.5741*** (0.0006)		0.8457 (0.1193)
FCOUNTRIES				0.5446*** (0.0001)	0.4090*** (0.0045)
Sector dummies	Yes	Yes	Yes	Yes	Yes
N=0	57	57	57	57	57
N=1	129	129	129	129	129
N	186	186	186	186	186
McFadden R ²	0.1164	0.1117	0.1222	0.1441	0.1865
LR statistic	26.6868	25.6101	28.0232	33.0417	42.7446
Prob(LR stat.)	0.0004	0.0006	0.0002	0.0000	0.0000

Table 5. Determinants of the extent of foreign debt usage.

This table reports results of OLS regression analysis on the extent of foreign debt usage for the 129 sample firms that use foreign debt. Information on the variables is from WEB-DIRECT and from responses to the Questionnaire (see the Appendix). The dependent variable is $FDEBT_i$, which measures the extent of foreign debt usage and is the percentage of the firm's consolidated financial debt in foreign currency (responses to Question 2, midpoints of intervals used). The independent variables are defined in Table 2. Model 6 is equivalent to Model 5 except that we include Mill's lambda following Heckman's (1976, 1979) two-step estimation method to account for potential selection bias. The superscripts *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>	<u>Model 5</u>	<u>Model 6</u>
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(Mills)
C	0.0602 (0.7550)	0.2004 (0.2904)	0.1967 (0.2597)	0.1115 (0.5817)	0.1972 (0.2746)	0.4680 (0.1892)
TOTALASSETS	0.0171 (0.6488)	-0.0032 (0.9306)	0.0024 (0.9427)	0.0287 (0.4698)	-0.0000 (0.9996)	0.0139 (0.7195)
RETURNEQUITY	0.0153 (0.5590)	-0.0025 (0.9211)	0.0087 (0.7072)	-0.0012 (0.9651)	0.0092 (0.7027)	0.0134 (0.5873)
EQUITYRATIO	0.0213 (0.8674)	-0.0410 (0.7412)	-0.1084 (0.3504)	0.0126 (0.9240)	-0.1104 (0.3482)	0.0235 (0.9024)
FREVENUES	0.2394*** (0.0029)				0.0136 (0.8749)	-0.0468 (0.6712)
FCOSTS		0.3574*** (0.0000)			0.0996 (0.3227)	0.0376 (0.7589)
FASSETS			0.4844*** (0.0000)		0.4362*** (0.0000)	0.3771*** (0.0021)
FCOUNTRIES				0.0288 (0.2808)	-0.0168 (0.5010)	-0.0528 (0.2700)
Mill's lambda						-0.7559 (0.3771)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	129	129	129	129	129	129
R ²	0.1248	0.1793	0.2963	0.0669	0.3049	0.3096
Adjusted R ²	0.0741	0.1318	0.2556	0.0129	0.2460	0.2447
F-statistic	2.4639	3.7764	7.2785	1.2396	5.1770	4.7693
Prob(F-statistic)	0.0213	0.0010	0.0000	0.2865	0.0000	0.0000

Table 6. Robustness test for alternative definitions of internationalization variables.

This table reports the robustness results for binary probit regression analysis of the use/non-use of foreign debt (Models 1 and 3) and those for OLS regression analysis of the extent of foreign debt usage (Models 2 and 4) for all 186 sample firms (Models 1 and 3) and for the 129 sample firms that use foreign debt (Models 2 and 4). The results correspond to those for Model 5 in Table 4 (Models 1 and 3) and Table 5 (Models 2 and 4). Information on the variables is from WEB-DIRECT and from responses to the Questionnaire (see the Appendix). The dependent variable is $FDEBTBI_i$, which measures foreign debt usage/non-usage (Models 1 and 4), and $FDEBT_i$, which measures the extent of foreign debt usage (Models 2 and 4). The variable $FDEBTBI_i$ is coded as one if the firm has foreign debt and zero otherwise (responses to Question 2); $FDEBT_i$ is the percentage of the firm's consolidated financial debt in foreign currency (responses to Question 2, midpoints of intervals used); $FREVENUES$ binary is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 2), coded as zero if foreign revenues are less than 20% and one otherwise; $FCOSTS$ binary is the percentage of the firm's consolidated operating costs in foreign currency (responses to Question 2), coded as zero if foreign costs are less than 20% and one otherwise; $FASSETS$ binary is the percentage of the firm's consolidated operating assets in foreign currency (responses to Question 2), coded as zero if foreign assets are less than 20% and one otherwise; $FCOUNTRIES$ binary is the number of foreign countries in which the firm has subsidiaries (responses to Question 6), coded as zero if the firm has no foreign subsidiaries and one otherwise; $FREVENUES$ log is the percentage of the firm's consolidated operating revenues in foreign currency (responses to Question 2, midpoints of intervals used), coded as the logarithm of the sum of $FREVENUES$ plus one; $FCOSTS$ log is the percentage of the firm's consolidated operating costs in foreign currency (responses to Question 2, midpoints of intervals used), coded as the logarithm of the sum of $FCOSTS$ plus one; $FASSETS$ log is the percentage of the firm's consolidated operating assets in foreign currency (responses to Question 2, midpoints of intervals used), coded as the logarithm of the sum of $FASSETS$ plus one. $FCOUNTRIES$ and the remaining independent variables are defined in Table 2. The superscripts *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>
	(binary)	(OLS)	(binary)	(OLS)
C	-0.0053 (0.9955)	0.0338 (0.8596)	0.5026 (0.5997)	0.1479 (0.4174)
TOTALASSETS	0.0208 (0.9110)	0.0196 (0.5826)	-0.0455 (0.8121)	0.0046 (0.8980)
RETURNEQUITY	-0.1087 (0.9110)	0.0161 (0.5228)	-0.0809 (0.6136)	0.0110 (0.6520)
EQUITYRATIO	-1.1074** (0.0386)	0.0202 (0.8763)	-1.234** (0.0192)	-0.0958 (0.4217)
FREVENUES binary	0.6183** (0.0227)	0.1204* (0.0655)		
FCOSTS binary	0.1291 (0.5777)	-0.0187 (0.7050)		
FASSETS binary	0.2634 (0.2928)	0.1648*** (0.0010)		
FCOUNTRIES binary	0.6589*** (0.0053)	-0.0274 (0.5859)		
FREVENUES log			0.5933 (0.3248)	0.0506 (0.6951)
FCOSTS log			0.7632 (0.2838)	0.1191 (0.3957)
FASSETS log			1.11416	0.5665***

			(0.1094)	(0.0001)
FCOUNTRIES			0.3980***	-0.0187
			(0.0059)	(0.4610)
Sector dummies	Yes	Yes	Yes	Yes
N=0	57		57	
N=1	129		129	
N	186	129	186	129
McFadden R ²	0.1859		0.1884	
LR statistic	42.6232		43.1925	
Prob(LR stat.)	0.0000		0.0000	
R ²		0.2121		0.2899
Adjusted R ²		0.1454		0.2297
F-Statistic		3.1769		4.8170
Prob(F-stat.)		0.0012		0.0000

Table 7. Robustness test with alternative dependent variables and sample.

This table reports the robustness results for binary probit regression analysis of the use/non-use within the last year of foreign debt (Models 1 to 3), short-term currency derivatives (Model 4), and long-term currency derivatives (Model 5) for the 186 sample firms. Information on the variables is from WEB-DIRECT and from responses to the Questionnaire (see the Appendix). The dependent variable in Models 1 to 3 is *FDEBT-One-Year_i*, which measures foreign debt usage/non-usage and is coded as one if the firm issued foreign debt during the last year to manage foreign exchange risk and zero otherwise (responses to Question 13). Model 2 is equivalent to Model 1 except for the exclusion of 47 firms that used long-term currency derivatives (responses to Question 13). Model 3 is equivalent to Model 1 except for the exclusion of 114 firms that used either short-term or long-term currency derivatives (responses to Question 13). The dependent variables in Tables 4 and 5 are *SHORTDEV* and *LONGDEV*, respectively. The variable *SHORTDEV* is coded as one if the firm during the last year used short-term currency derivatives to manage foreign exchange risk and zero otherwise (responses to Question 13). The variable *LONGDEV* is coded as one if the firm during the last year used long-term currency derivatives to manage foreign exchange risk and zero otherwise (responses to Question 13). The independent variables are defined in Table 2. The superscripts *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>	<u>Model 5</u>
Dependent variable	FDEBT	FDEBT	FDEBT	SHORTDEV	LONGDEV
	(binary)	(binary)	(binary)	(binary)	(binary)
C	-0.1712	0.5847	1.0020	-2.9145***	-2.6006***
	(0.8467)	(0.5793)	(0.5946)	(0.0013)	(0.0063)
TOTALASSETS	-0.0877	-0.2595	-0.4275	0.4865***	0.2512
	(0.6208)	(0.2106)	(0.2206)	(0.0066)	(0.1873)
RETURNEQUITY	0.1853	0.2029	0.6510*	0.1185	0.0402
	(0.2122)	(0.2025)	(0.0812)	(0.4036)	(0.7891)
EQUITYRATIO	-1.0770**	-1.0992*	-1.0432	-0.2883	-0.4531
	(0.0355)	(0.0794)	(0.2486)	(0.5678)	(0.4096)
FREVENUES	0.4983	0.5106	1.4555**	0.7550*	0.6109
	(0.2115)	(0.2676)	(0.0468)	(0.0595)	(0.1625)
FCOSTS	0.3831	0.1188	0.3095	0.4406	0.6489
	(0.4257)	(0.8428)	(0.7359)	(0.3677)	(0.1934)
FASSETS	1.0944**	1.2180**	0.5975	-0.8242*	0.6863
	(0.0217)	(0.0338)	(0.4329)	(0.0994)	(0.1676)
FCOUNTRIES	0.3055**	0.3694**	0.0971	0.2663**	0.0081
	(0.0184)	(0.0155)	(0.6745)	(0.0373)	(0.9525)
Sector dummies	Yes	Yes	Yes	Yes	Yes
N=0	94	81	45	84	139
N=1	92	58	27	102	47
N	186	139	72	186	186
McFadden R ²	0.1492	0.1445	0.1655	0.1229	0.1052
LR statistic	38.4589	27.2856	15.7632	31.4741	22.1212
Prob(LR stat.)	0.0000	0.0023	0.1066	0.0005	0.0145