Empirical evidence on the incentives to hedge transaction and translation exposure[♣]

Niclas Hagelin

The Swedish National Debt Office and Stockholm University School of Business

Bengt Pramborg[*]

Stockholm University School of Business

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Abstract

We investigate Swedish firms' use of financial hedges to reduce their foreign exchange exposure for 1997–2001. The study uses survey data, which enables us to differentiate between hedging aimed at translation exposure and transaction exposure, respectively. The survey responses show that more than 50% of the firms employ financial hedges and that transaction exposure is more frequently hedged than translation exposure. We find that the likelihood of using financial hedges is increasing with firm size and exposure and that liquidity constraints are important in explaining transaction exposure hedging. Importantly, we find that the existence of loan covenants explains translation exposure hedging. This suggests that firms hedge translation exposure in order to prevent costly violations of loan covenants.

Key words: Risk management, hedging, foreign exchange exposure, transaction exposure, translation exposure, loan covenants, bond covenants

JEL classification: F23, F31, G39

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[*] Corresponding author: Bengt Pramborg. Postal address: School of Business, Stockholm University, SE-10691 Stockholm, Sweden; E-mail address: bpg@fek.su.se; Tel.: +46 8 6747427.

1. Introduction

Why widely held firms, whose owners have the ability to hold diversified portfolios of securities, elect to employ financial hedges to reduce their foreign exchange (FX) exposures has been under debate. Theoretical research has shown that risk-reducing efforts may be value enhancing if they successfully alleviate costs associated with market imperfections (see Smith and Stulz, 1985; Bessembinder, 1991; Froot et al., 1993).

Empirical studies have investigated whether firms' use of currency derivatives conforms to the predictions from theoretical research.[1] Mian (1996) examines 3,022 COMPUSTAT firms out of which 440 are identified as currency derivatives users from footnotes in their annual reports. The evidence from Mian's (1996) study supports that hedging activities exhibit economies of scale but provides weak, if any, support for the theoretical models that explain hedging activities by the existence of market imperfections. Like Mian (1996), Géczy et al. (1997) use a dichotomous measure of currency derivatives use obtained from footnotes in annual reports for a sample of 372 of the *Fortune 500* non-financial firms in 1990. They find that firms with extensive FX exposure and economies of scale are more likely to use currency derivatives. Importantly, they also find that firms with less liquidity and greater growth opportunities (as measured by the expenses for R&D) are more likely to use currency derivatives. They interpret this as evidence that firms use currency derivatives to reduce cash flow variations that might otherwise preclude firms from investing in valuable growth opportunities.

Graham and Rogers (2000) investigate 161 COMPUSTAT firms that face foreign exchange exposure out of which one third is identified as currency derivatives users. They

[1] To conserve space, the presentation of earlier research is confined to empirical studies that examine why firms use currency derivatives. Studies like Nance et al. (1993), Dolde (1995), Berkman and Bradbury (1996), Gay and Nam (1998), and Guay (1999) analyze why firms use derivatives, but are not confined to any particular type of exposure. Tufano (1996) and Haushalter (2000) examine why firms use derivatives to hedge gold and oil price exposure respectively.

find that firms hedge in response to expected financial distress costs, firm size, and investment opportunities. In addition, their results show that firms hedge in order to increase debt capacity but not in response to convexities in tax schedules. Allayannis and Ofek (2001) analyze firm characteristics associated with adoption of and level of currency derivatives usage for a sample of 378 US non-financial firms. Their evidence concerning the decision to adopt currency derivatives use corroborates the evidence of Géczy et al. (1997) whilst the degree of FX exposure is shown to be the only important factor in explaining the *amount* of currency derivatives used.

Finally, Hagelin (2003) examines 101 Swedish firms use of currency derivatives. The study uses survey data in combination with publicly available data for 1997 and examines the association between firm characteristics and hedging of translation (TL) exposure, committed transaction (CT) exposure, and anticipated transaction (AT) exposure. This is of interest since transaction exposure and TL exposure tend to affect firms differently. Transaction exposure to currency risk refers to potential changes in the value of future cash flows as a result of unexpected changes in exchange rates while TL exposure arises as the financial accounting statements of foreign affiliates are translated into the currency of the parent firm.[2] Since TL gains (losses) tend to be unrealized and have little direct impact on firms' cash flows and market values the general recommendation of the finance literature is to not hedge TL

[2] TL exposure depends on the translation method used. The International Accounting Standard 21 (IAS 21) suggests the use of the current rate method for self-contained foreign affiliates and the use of the temporal method for integrated foreign affiliates and for foreign affiliates in countries with high inflation. The exposure under the current rate method is given by the equity of the foreign affiliate, whereas under the temporal method it is the net amount of assets and liabilities translated at the current exchange rate. Changes in exchange rates on foreign operations thus always cause changes in group equity and under the temporal method, these changes also affect group net income. Swedish firms follow The Swedish Institute of Authorised Public Accountants' proposal to recommendation, which builds on the IAS 21. In practice, the current rate method dominates among Swedish firms.

exposure.[3] Hagelin's (2003) results are consistent with the conjecture that firms hedge transaction exposure with currency derivatives to increase firm value by reducing costs associated with market imperfections. No evidence is found to support the notion that TL exposure hedges are used to increase firm value.[4]

In similarity with Hagelin (2003), we investigate the association between firm characteristics and hedging of TL exposure, CT exposure, and AT exposure for Swedish firms. This study adds to Hagelin (2003) in several ways. First, we examine the relationship between the existence of loan covenants and hedging. The motive for this is that one possible explanation for firms hedging TL exposure would be the existence of loan covenants requiring firms to maintain certain levels of accounting performance to retain access to funds and that this performance measure is affected by TL gains and losses (see e.g. Butler, 2000; Eiteman et al., 2001). That firms use covenants that are affected by TL gains and losses is suggested by Smith and Warner (1979). They show that covenants based, implicitly or

[3] Oxelheim and Wihlborg (1997) offer one potentially interesting observation on the relationship between TL exposure hedging and hedging of cash flows. They note that if the translation FX rate is a close proxy for a weighted average of future FX rates at the time cash flows occur then the economic exposure and the TL exposure are nearly identical. If so, by hedging TL exposure, firms may successfully reduce economic exposure. It could be that through experience firms develop proxies for economic exposure, which is being hedged, while being confined conceptually to TL and transaction exposure. We note however that the results of Hagelin (2003), suggesting that firms hedge transaction exposure to increase firm value by reducing costs associated with market imperfections, but that no evidence is found to support the notion that TL exposure hedges are used to increase firm value, do not support this explanation for TL exposure hedging.

[4] This finding is interesting given that firms spend real resources on hedging their TL exposure. Aggarwal's (1991) finding, that managers pay attention to TL exposure, is also interesting in this context. He compares firms that voluntary adopted FAS 52 with firms that did not. Specifically, differences between the early and late adopters among the largest 100 US industrial firms are analyzed. The result lends support to the contention that managerial preferences for *reporting* higher income is a major reason for the early adoption of FAS 52. For this reason Aggarwal (1991) contends that managers pay attention to the choice of translation method and thus, contrary to the conventional wisdom, to the impact from TL exposure per se.

explicitly, on *net worth* are commonly observed. To our knowledge, the present study is the first attempt to empirically document the relationship between hedging and TL exposure.[5]

Second, we use questionnaire data covering a five-year period (1997–2001) while Hagelin (2003) uses data for only one year. The use of data covering five years enables us to study whether recorded relationships hold over time and if these relationships also are able to explain changes in hedging policies. Finally, in contrast to Hagelin (2003) and most of the previous studies, hedging activity is not only approximated by hedging with currency derivatives but also by hedging with foreign denominated debt. This, like the use of data covering five years, should improve the reliability of the results.

We find that use of financial hedges to reduce FX exposure is widespread. More than 50 percent of the observations are for firms that hedge FX exposure. We find that transaction exposure is more frequently hedged than TL exposure although as much as 20 percent of the firms hedge their TL exposure. From the survey responses it is shown that about one tenth of the sample firms changed their hedging policy concerning TL, CT, and AT exposure each year in favor of adoption of hedging while changes seldom meant that firms quit hedging.

We estimate logit regressions to analyze firm characteristics associated with the likelihood of using financial hedges. In accordance with the evidence from studies of US firms, we find that larger firms are more likely to employ financial hedges. We also find that firms with greater FX exposures are more likely to use financial hedges. The results for size and FX exposure are consistent with the conjecture that fixed costs act as a barrier to small firms and firms with low degrees of FX exposure. The logit results also show that the

[5] Studies that examine the effect of loan covenants exist. For instance, Core and Schrand (1999) use an option pricing framework to model equity valuation when firms face costs associated with violating accounting based debt covenants. Their model shows that the value of equity depends on two factors: the economic value of the firm and the probability that the firm violates the covenant. Other examples are Roberts and Viscione (1984) that examine the effect of covenants on bond yields and Leland (1994) who investigates the effect of covenants on optimal capital structure.

likelihood of using financial hedges for CT exposure increases with decreases in liquidity, which corroborates the view that firms with low levels of liquidity hedge to reduce the probability of encountering financial distress, as suggested by Nance et al. (1993). In parallel with earlier studies that use the market-to-book ratio to approximate for growth opportunities (see Mian, 1996; Géczy et al., 1997; Graham and Rogers, 2000; Allayannis and Ofek, 2001; Hagelin, 2003) we fail to document the expected positive association between hedging and growth opportunities. Interestingly, we are able to document a significant positive association between TL exposure hedging and the existence of loan covenants. This finding suggests that firms hedge TL exposure to avoid that loan covenants are violated.

The relationship between firm characteristics and the level of exposure hedged of a particular exposure is also investigated. Like Allayannis and Ofek (2001) we find that the level of exposure hedged is largely unrelated to differences in firm characteristics.

The study is organized as follows: The next section contains a description of the sample selection procedure and presents our findings on firms' FX exposure and hedging practices. Section 3 describes the research design and how the variables are defined. The cross-sectional results are presented in section 4, which is followed by a conclusion.

2. Sample selection, FX exposure, and hedging practices

2.1. Sample selection

Because detailed public data are not available on firms' FX exposures and hedging practices, we employ three questionnaires to determine exposures and firms' use of financial hedges.[6]

6 The accounting practices regarding exposures and hedging for Swedish firms did not follow strict rules over the course of the sample period. New rules and regulations based on IAS 39 will be introduced, but were not in effect during the sample period. Recommendations from Bokföringsnämnden (BFN R9) stipulated that firms should report net revenues, investments, and employees for geographical markets, with considerable freedom in deciding what the "geographical market" was. Of two accounting methods allowed for hedging, deferral accounting and mark-to-market, almost all firms used deferral accounting. Firms were required to disclose

The first questionnaire was sent to 160 firms in October 1997, and contained questions concerning the respondents' inherent exposures and hedging policies for 1997. The second questionnaire was sent to 275 firms in March 2000, followed by the third questionnaire, sent to 261 firms in September 2001. The three questionnaires are nearly identical; however, the latter two each included one question regarding the types of exposure hedged with foreign denominated debt while the last questionnaire asked firms whether they were subject to loan covenants or not. The questionnaires of 2000 and 2001 asked questions concerning 1998–1999 and 2000–2001, respectively. The questionnaires are presented in Hagelin and Pramborg (2004).

The questionnaires were sent to firms that met the following three criteria: (i) the firm was listed at the Stockholm Stock Exchange; (ii) the firm was a non-financial firm; and (iii) the firm's headquarter was located in Sweden. Financial firms were excluded because the focus of the study is on end-users rather than producers of financial services. Foreign firms were also excluded (firms with headquarters located outside Sweden) to eliminate differences between firms arising from differences in accounting standards between countries.

One hundred and one, 130, and 128 usable responses were obtained from the first, second, and third questionnaire, representing response rates of 63, 47, and 49 percent, respectively. This can be compared with Bodnar et al.'s (1996) 26 percent response rate. The three surveys rendered a total of 617 firm-year observations. To check for potential non-response bias, the sample firms were compared with firms that did not return the questionnaires; this comparison indicated no response bias.[7]

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derivatives positions in footnotes, and most firms reported a net position rather than per currency, type of exposures hedged, or exposures partitioned over time. It is also noteworthy that practices varied widely among firms. Overall accounting practices for international operations and hedging seem to some extent to lag those in the US, at least for the sample period.

[7] Results are available by request from the authors.

2.2. FX exposure and hedging practices

Firms were asked in the questionnaires what proportion of revenues (FR), proportion of costs (FC), and proportion of equity (FE) that were denominated in foreign currencies each year. Respondents were also asked whether or not they hedged FX exposure with currency derivatives, and, if so, whether their hedging concerned TL, CT, and/or AT exposure. Specifically, they were asked how much of each exposure they hedged. In addition, they were asked whether they used foreign denominated debt for hedging purposes, and, in the second and third questionnaire, which type of FX exposure that was hedged with foreign denominated debt.

Table 1, Panel A, presents FR, FC, FE, and the *absolute net exposure* (ANE), defined as the absolute value of the difference between FR and FC. This measure, our proxy for transaction exposure, draws on that suggested by Marston (2001) and captures the potential effect of a net position (long or short) in foreign currency. In Table 1, statistics for the pooled sample of firm-year observations are presented, where the sample firms are divided into different groups based on size. A book value of total assets of less than SEK 500 million is considered small, more than SEK 500 million but less than SEK 5000 million is considered medium, and more than SEK 5000 million is considered large.

From Panel A in Table 1 it can be seen that the average FR is 39.5 percent while the average FC is 30.6 percent, which suggests that our sample of firms is more involved in exporting than importing businesses. From the table it is evident that larger firms, on average, are characterized by higher FR and FC than small firms are. Even though larger firms have higher levels of FR and FC than small firms have, there is a tendency for firms being categorized as small to have higher levels of ANE than for firms being categorized as large. For the pooled sample of small firms the average ANE is 22 percent, suggesting that small firms are subject to considerable levels of FX exposure. Panel A also shows that the average

FE is 17.8 percent for the pooled sample and that FE is increasing with firm size. This suggests that larger firms are more likely to be multinationals than small firms are which in turn suggests that larger firms have more opportunities to employ operational hedges than small firms.

Panel B in Table 1 shows the percentage of firms that hedged FX, TL, CT, and AT exposure for the pooled sample of firm-year observations. Like Panel A Panel B presents the results broken down by size group. From Panel B it can be seen that 57.2 percent of the observations for the pooled sample are for firms that used currency derivatives or foreign denominated debt to hedge FX exposure. It can also be seen that 23.1 percent of the observations are for firms that hedged TL exposure, whereas 42.6 and 31.8 percent of the observations are for firms that hedged CT and AT exposure, respectively. We do not report numbers for each sample year but note that the pooled sample is representative for each year and size group with the exception that the percentage of hedgers is higher for all size groups for 1997 than for the other sample years. This is likely a result from the sample construction rather than from any economy wide changes is hedging policies.

In addition, we investigated if specific firms changed their hedging policy concerning FX, TL, CT, and AT exposure, respectively. It is evident from Figure 1 that most firms did not change their policy as to whether a particular exposure category should be hedged or not. However, out of firms that changed policy more observations are for firms that began to hedge than for firms that quit hedging.

3. Research design and variable definition

In this section, we present the variables used in our logit regressions to investigate among the potential explanations for using financial hedges for FX, TL, CT, and AT exposure respectively. The explanatory variables for these regressions include proxies for economies of

scale, expected costs of financial distress, the underinvestment problem associated with costly external financing, and firms' FX exposure.[8] How proxies are defined and reasons as to why these variables are included are as follows:

a) *Firm size*. Empirical research supports the perception that starting and managing a hedging program is associated with significant economies of scale (see e.g. Géczy et al., 1997). These economies arise from fixed costs associated with, among other things, training employees and developing hedging strategies. We use the log of the book value of total assets as a proxy for size.

b) *Liquidity*. Hedging can increase the value of the firm by lowering the expected costs of financial distress (see Smith and Stulz, 1985). Nance et al. (1993) argue that the probability of encountering financial distress can be reduced by maintaining more liquid assets, and thereby reducing the need for hedging. We use the ratio of current assets to current liabilities as a proxy for liquidity.

c) *Leverage*. Hedging can reduce the variance of the value of the firm and thereby the expected cost of financial distress (see Smith and Stulz, 1985). Leverage can therefore

[8] In addition to the rationales for hedging investigated in this study theorists have provided another two. One rationale focuses on hedging as a means to reduce tax costs due convexity of the tax schedule and the second focuses on hedging as a means to maximize managers' private utility. The motive for not examining tax based explanations related to the convexity in the tax schedule is the failure of earlier studies to document a relationship between use of currency derivatives and tax convexity (see Mian, 1996; Géczy et al., 1997; Graham and Rogers, 2000; Allayannis and Ofek, 2001). Graham and Rogers (2000) conclude that firms do not hedge in response to convexity because the incentive is small relative to other hedging incentives. In a later study, Graham and Rogers (2002) show that although hedging cannot be explained by tax convexity, hedging may reduce costs associated with taxes since it allows for more debt in the capital structure. Similarly, the rationale for not examining motives related to managers' private utility is the relatively weak support for this class of explanations in earlier empirical studies on currency derivatives usage (see Géczy et al., 1997; Graham and Rogers, 2000; Hagelin, 2003). A notable exception is a recent study by Knopf et al. (2002) who show that as the sensitivity of managers' stock and stock option portfolios to stock price (return volatility) increases, firms tend to hedge more (less).

be hypothesized to be positively related to hedging. We use the book value of debt divided by the book value of equity as a proxy for leverage.

d) *Market-to-book*. Bessembinder (1991) demonstrates that hedging reduces the incentive to underinvest since hedging shifts individual future states from default to non-default outcomes. Because firms with more valuable growth opportunities are more likely to be affected by the underinvestment problem, these firms may be more likely to hedge. As a measure of future growth opportunities, we use the ratio of the market to the book value of total assets.

e) *Industry dummies*. We divide the sample into different industry sectors since we expect the typical levels of exposure to vary across industry sectors. We use the same industry sector categories as Bodnar et al. (1996) do, namely, primary products, manufacturing, and services.

f) *Foreign exchange exposure.* Given the fixed costs associated with a derivatives program the decision to initiate one is not only determined by whether FX exposure exists or not, but also by its level. We use one proxy for transaction exposure and one for translation exposure. As a proxy for transaction exposure, the absolute value of the difference between FR and FC (i.e. ANE) is used. As a measure for translation exposure, we use the percentage of the firm's equity that is denominated in foreign equity (FE).

g) *Loan covenants.* Butler (2000), Eitman et al. (2001) among others argues that the existence of loan covenants can explain why firms engage in hedging activities. The rationale for this is that loan covenants require that a firm maintain certain levels of performance and that a violation of a loan covenant can lead to a reduction in borrowing capacity. In these circumstances, a hedge can ensure that the firm retains its access to funds. We use a dummy variable that is assigned a value of 1 if loan

covenants exist, and 0 otherwise (Note that data is only available for year 2000 and 2001). This variable is of special interest since, to our knowledge, this study is the first attempt to empirically analyze the relationship between hedging and loan covenants.

Data for creating the explanatory variables f) and g) are taken from the questionnaires. The accounting data required to calculate the explanatory variables a) – d) are collected from the stock market guide *Nordbanken Aktieguide Sommar 2001* and annual reports. For variable e) we use the industry classification from SCB (Statistics Sweden) standard SNI 92.

Table 2 presents median values for variable a) – d) and mean values for e) and g) for each year and for the pooled sample of firm-year observations. It can be seen from the table that no apparent trends exist even though the values fluctuate between the years. Table 2 also shows that about 60 percent of the firms are categorized as belonging to the service industry while less than 10 percent are categorized as primary producers. Interestingly, as much as one quarter of the firms is subject to loan covenants. This widespread use of covenants is in accordance with Smith and Warner (1979).

4. Cross-sectional results

4.1. Logit regression estimates on usage of financial hedges

We estimate logit regressions to distinguish among the potential explanations for use of financial hedges. Table 3 presents the results of logit regressions of binary variables representing usage of financial hedges. For each observation, the binary variables are assigned a value of one if the firm use financial instruments, i.e. currency derivatives or foreign denominated debt, to hedge a particular exposure, and zero otherwise. For all regressions, coefficient estimates, *p*-values, and McFadden R^2 values are presented. In Panel A, the dependent variable is set to one for firms that use financial hedges to hedge FX exposure and zero for nonusers. Panel B, C, and D present results broken down by type of FX exposure that

is hedged. More specifically, Panel B uses TL exposure hedging as the dependent variable; Panel C uses CT exposure hedging as the dependent variable; and Panel D uses AT exposure hedging as the dependent variable in the logit regression estimation.

The data include observations on an unbalanced panel of 89 to 116 firms per year for five years. In addition to the results for each respective year we also present regression results for the pooled sample. Pooling firm-year observations treats each observation as independent, which tends to underestimate standard errors and overstate reported *p*-values to the extent that firm values are correlated from year to year. Therefore, as a robustness test, we also performed panel data regressions using population average models. The results are similar to those for the pooled sample in Table 3 and are therefore not presented.

All regressions, except two with TL exposure as the dependent variable, show that greater firm size is significantly associated with greater probability of financial hedging at the 10 percent level. This result strongly supports the hypothesis that a firm's choice of whether to use financial hedges or not is influenced by the existence of economies of scale and is in parallel with earlier studies investigating currency derivatives usage (see Mian, 1996; Géczy et al., 1997; Graham and Rogers, 2000; Allayannis and Ofek, 2001; Hagelin, 2003).

The coefficient for liquidity is negative, as predicted, for 26 out of 29 regressions and significant at the 10 percent level for 11 out of these 26 regressions. From the table it is evident that the results vary across time period and exposure category being investigated. Significance is indicated for the pooled regression models with FX, TL, and CT exposure as dependent variables as well as for individual years for these exposure categories. The result for CT exposure is in accordance with our expectations and we interpret this evidence as being indicative of that firms hedge CT exposure in response to their liquidity and to reduce the likelihood of financial distress. The result for TL exposure on the other hand is unexpected. This is because TL gains (losses) tend to be unrealized and have little direct

impact on firms' cash flows. Perhaps the result is due to the fact that more than 95 percent of the firms that hedged TL exposure also hedged transaction exposure. To investigate this we made two robustness tests. First, we re-ran the regression presented in Table 3 for the pooled sample of firms treating those observations that hedged TL exposure only as TL hedgers and all other observations as non-hedgers.[9] This treatment results in that only 12 out of 419 observations are classified as TL hedgers and calls for a cautious interpretation of the results. The results from the regression are not presented in any detail but indicate that liquidity is unrelated to TL hedging. Second, we re-ran the regressions on TL exposure, allowing only firms that did not hedge any other type of FX exposure to remain in the sample as non-hedgers. For this specification the significance of liquidity is indicated less frequently than as reported in Table 3. These robustness tests suggest that the indicated relationship between liquidity and TL exposure in Table 3 is uncertain.

For leverage, only one coefficient is found to be significant at the 10 percent level. In addition, contrary to the prediction, this coefficient is found to be negative. The finding that no significant positive association between leverage and use of financial hedges exists is in accordance with Géczy et al. (1997), Allayannis and Ofek (2001), and Hagelin (2003), but in contrast to Graham and Rogers (2000).

In contrast to our prediction, for the pooled regressions the coefficients for the market-to book ratio is negative and significant at the 10 percent level. We note that the results from running regressions on separate years indicate that the sign of the coefficient changed during the sample period from negative to positive for year 2001. One possible explanation for the negative coefficients is the high valuation of firms belonging to the so-called "new economy" until early 2000. This is because many firms that constitute this group typically had no reasons to employ hedges as their existing cash flows were small. In general, the risks these

[9] The sample size did not allow for inclusion of any industry dummies in this specification.

firms faced were not related to changes in exchange rates but rather to project risk and access to external financing. The failure to document a positive relationship between the market-to-book ratio and hedging is in parallel with that of earlier studies (see Mian, 1996; Géczy et al., 1997; Graham and Rogers, 2000; Allayannis and Ofek, 2001; Hagelin, 2003) on usage of currency derivatives.

The coefficients for the industry dummies provide evidence suggesting that the likelihood of hedging is related to industry belonging. In short, firms belonging to the categories primary products and manufacturing are more likely to hedge FX, TL, and CT exposure than firms in the service category. This evidence is in accordance with the survey evidence of Alkebäck and Hagelin (1999) for Sweden and Bodnar et al. (1996) for the US.

In accordance with our prediction, firms with larger absolute differences in revenues and costs denominated in foreign currency (ANE) are more likely to use financial hedges to hedge FX, CT, and AT exposure. In detail, the coefficients for ANE are positive for all regressions and significance is indicated for the four pooled sample regressions and for 16 out of the 19 regressions on individual years. The results for foreign equity (FE) are also in accordance with the prediction, i.e. the likelihood of TL exposure hedging increases with FE. This finding is contrary to Hagelin (2003), who argues that the failure to document the predicted relationship in his study may be due to that many firms being classified as non-hedgers do hedge TL exposure with foreign denominated debt. The fact that we classify both currency derivatives hedging and foreign denominated debt hedging as hedging activity and are able to document the predicted relationship corroborates his view.

The logit regression results show that hedging is significantly associated with the existence of loan covenants, at least for TL exposure hedging. We interpret this finding as evidence that firms hedge TL exposure in order to avoid that loan covenants are violated and thereby maintain their access to funds, as Butler (2000) among others suggests. This finding is

important given that the theoretical models of Smith and Stulz (1985), Bessembinder (1991), and Froot et al. (1993) do not attempt to explain TL exposure hedging.

McFadden R^2 values for the regressions in Table 3 range from 14.1 to 50.8 percent and are typically higher for the category FX exposure than for the others. This is likely to be a result of that firms recorded as non-hedgers of a particular FX exposure may hedge another type of FX exposure. For example, if firms that hedge CT and AT exposure do so to alleviate the underinvestment problem, they are expected to be characterized by similar firm-specific traits. However, if a substantial number of the firms only hedge CT exposure (perhaps because their expected cash flows are troublesome to predict) and consequently are classified as non-hedgers of AT exposure, the results in Panel D are blurred since firms classified as hedgers and non-hedgers are partly characterized by similar traits. Therefore, similar to our robustness test for TL exposure, we re-ran the regressions on CT and AT exposure, allowing only firms that did not hedge any other type of FX exposure to remain in the sample as non-hedgers. As expected, this lead to substantial increases in the McFadden R^2 values. For instance, the R^2 for the regressions using AT exposure hedging as the dependent variable increased with a factor of two. For the regression results on CT and AT exposure the *p*-values for liquidity and the industry dummies are found to indicate significance at a 10 percent level more frequently than for the regressions presented in Table 3. We interpret this as evidence that a relationship between transaction exposure hedging and liquidity exists, as predicted by theory. As for FX exposure in Table 3, the coefficients for the market-to-book ratio are found to be positive and significant for CT and AT exposure for year 2000. Finally, the negative coefficients for the market-to book ratio in Panel B, C, and D of Table 3 are not significant for the reduced sample.[10]

[10] Detailed results are available by request from the authors.

4.2. Regression estimates on the degree of exposure hedged

In the questionnaires respondents are asked how much of their TL, CT, and AT exposure they hedged with currency derivatives. Firms that hedged TL exposure hedged on average 58.4 percent of their exposure, whereas the equivalent figures for CT and AT exposure were 79.0 and 53.4 percent, respectively. That firms that hedged a particular type of exposure with currency derivatives did so to hedge a substantial part of it is in accordance with survey results of Hakkarainen et al. (1998). This finding is also consistent with the view that hedging only a minor part of the exposure is uneconomical due to large fixed costs.

To investigate the level of exposure hedged, we use Tobit regressions and a model proposed by Cragg (1971), which is a combination of a probit analysis (i.e., the decision to hedge) and a truncated regression (i.e., the regression equation for nonzero outcomes). The results from the Tobit model and the first step of the Cragg model, the probit analysis, are broadly similar to the results presented in Table 3. For the second step of the Cragg model almost all coefficients are non-significant for all regressions which is in parallel with the results of Allayannis and Ofek (2001). The results from the Tobit regressions and the Cragg model, together with the fact that the firms that hedged a particular type of exposure did so extensively, suggest that the decision as to whether hedges should be employed or not is of more interest for this type of study than the decision regarding how much of the exposure should be hedged.

4.3. Logit regression estimates on the likelihood of beginning to use financial hedges

To further examine the robustness of the results presented in Table 3, we use logit regressions to compare those firms that began to hedge TL, CT, and AT exposure with those firms that did not. The reason for not investigating firms that began to hedge FX exposure or firms that

quit hedging is that these groups contain too few observations to allow for a meaningful analysis (see Figure 1).

Table 4 presents the results on the likelihood that a firm began to hedge TL, CT, and AT exposure using financial hedges. The use of explanatory variables between Table 3 and 4 differs in two respects. First, the regressions in Table 4 use both the levels of the explanatory variables as well as the change, in percent, from the previous year. Second, the industry dummies and the dummy indicating existence of loan covenants, that are used in Table 3, are not used in the regressions presented in Table 4. The rationale for not including industry dummies is that industry belonging typically do not change between years, while the reason for omitting the dummy concerning loan covenants is that this information is only available for two years.

Like Table 3, Table 4 shows that firm size is significantly associated with hedging of TL, CT, and AT exposure. It can be seen that the likelihood of a firm begins to hedge CT and AT exposure is positively associated with its ANE. The association between liquidity and CT exposure hedging is also in parallel with the results in Table 3. Overall, the results presented in Table 4 corroborate the results presented in Table 3.

5. Conclusions

In this study, we examine Swedish firms' use of financial hedges to reduce foreign exchange exposure for 1997–2001. We use survey data which makes it possible to differentiate between hedging aimed at translation exposure and transaction exposure respectively.

The survey responses show that use of financial hedges is widespread. We find that more than 50% of the firms employ financial hedges and that transaction exposure is more frequently hedged than translation exposure. About 20 percent of the firms hedge their translation exposure which is interesting given that the finance literature generally

recommends that translation exposure should not be hedged. Butler (2000) among others, however, argues that translation exposure hedging may be rational in the presence of loan covenants that require firm performance to be maintained within certain levels and that a violation of a loan covenant can lead to a reduction in borrowing capacity. We document a positive relationship between existence of loan covenants and translation exposure hedging which provides support for the conjecture that firms hedge translation exposure in order to secure their access to funds.

As predicted by theory, liquidity is negatively related to transaction exposure hedging supporting that firms hedge in response to expected financial distress costs. We also find that the likelihood of hedging foreign exchange exposure increases with firm size and exposure suggesting that economies of scale affects firms hedging decisions. Based on this evidence we conclude that Swedish firms hedge in way that is consistent with shareholder value maximization.

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Table 1
Data on foreign exchange exposure and frequency of hedging

Panel A, presents foreign revenues (FR), foreign costs (FC), foreign equity (FE), and the absolute value of the difference between *FR* and *FC* (ANE) for the pooled sample of firm-year observations. In Panel B the percentage of firms that hedged foreign exchange (FX) exposure, translation (TL) exposure, committed transactions (CT), and anticipated transactions (AT) for the pooled sample of firm-year observations are presented. The sample consists of firms listed on the Stockholm stock exchange and are divided into different groups based on size. A book value of total assets of less than SEK 500 million was considered small, more than SEK 500 million but less than SEK 5000 million was considered medium, and more than SEK 5000 million was considered large.

Panel A: FX exposure in percent

	All	Small	Medium	Large
FR	39.5%	32.2%	36.0%	57.8%
FC	30.6%	23.5%	28.3%	45.9%
FE	17.8%	8.0%	16.8%	33.2%
ANE	16.7%	22.0%	14.1%	16.6%

Panel B: Frequency of hedging in percent

	All	Small	Medium	Large
FX	57.2%	35.4%	56.8%	88.9%
TL	23.1%	9.5%	22.5%	43.1%
CT	42.6%	25.5%	38.9%	76.6%
AT	31.8%	17.6%	30.5%	56.0%

Figure 1
Comparison of variability in hedging policy

This figure reports the percentage of firms that began, quite, or did not change its policy as to whether foreign exchange (FX), translation (TL), committed transaction (CT), and/or anticipated transaction (AT) exposure should be hedged or not. The total number of observations is 319.

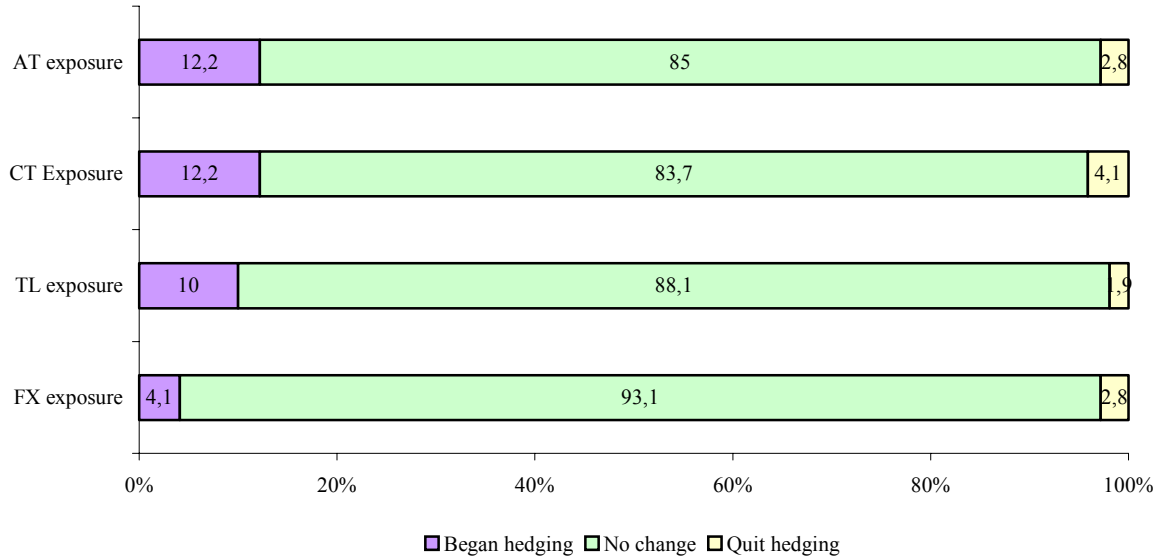

Table 2
Summary statistics on explanatory variables

Summary statistics of explanatory variables for each year and for the pooled sample of firm-year observations. The sample consists of firms listed on the Stockholm stock exchange that responded on the questionnaire. All variables are as defined in section 3. The table reports the median value for Firm size, Liquidity, and Market-to-book. For the dummy variables, Manufacturing, Services, Primary products and Loan covenants are the mean values reported.

	Firm size	Liquidity	Leverage	Market-to-B.	Manufact.	Services	Primary prod.	Loan coven.
1997	1520	1.65	1.47	1.34	0.37	0.55	0.08	-
1998	885	1.72	1.24	1.25	0.32	0.63	0.05	-
1999	1245	1.78	1.24	1.65	0.32	0.63	0.05	-
2000	1202	2.12	0.99	1.50	0.32	0.63	0.05	0.24
2001	853	1.91	1.11	1.24	0.32	0.63	0.05	0.28
Pooled	1121	1.85	1.17	1.36	0.33	0.62	0.05	-

Table 3
Logit regression estimates of the likelihood of using financial hedges

Logit regression estimates of the relation between the likelihood that a firm uses financial hedges to hedge and proxies for incentives to hedge and proxies for foreign exchange exposure. The sample consists of firms listed on the Stockholm stock exchange. In Panel A the dependent variable is set to one if the firm uses financial hedges to hedge foreign exchange (FX) exposure. Panel B uses translation (TL) exposure hedging with financial hedges as the dependent variable, Panel C uses committed transaction (CT) exposure hedging with financial hedges as the dependent variable, and Panel D uses anticipated transaction (AT) exposure hedging with financial hedges as the dependent variable. The explanatory variables are: *Firm size*, the logaritmn of total assets: *Liquidity*, the current ratio: *Leverage*, the debt-to-equity ratio: *Market-to-book*, market value divided by book value of assets: *Manufacturing* and *Primary products*, dummy variables classifying firms into industries: *Foreign equity* (FE), the proportion of equity denominated in foreign currency: and *Absolute net exposure* (ANE), the absolute value of the difference between the proportion of revenues and the proportion of costs denominated in foreign currency. *P*-values are presented in parentheses and based on a two-sided test. Values less than 0.10 are shown in boldface type. The significance tests are based on QML (Huber/White) standard errors & covariance.

Panel A: Hedging FX exposure

	1997	1998	1999	2000	2000	2001	2001	Pooled
Firm size	0.680	0.772	0.889	0.701	0.658	0.444	0.368	0.646
	(0.031)	**(0.001)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.036)**	**(0.098)**	**(0.000)**
Liquidity	-0.049	-0.182	0.075	-0.154	-0.143	-0.276	-0.282	-0.105
	(0.633)	(0.171)	(0.465)	**(0.018)**	**(0.036)**	(0.144)	(0.157)	**(0.009)**
Leverage	-0.343	-0.304	-0.096	0.280	0.255	0.137	0.108	-0.010
	(0.139)	(0.203)	(0.439)	(0.352)	(0.382)	(0.416)	(0.507)	(0.840)
Market-to-book	-0.984	-0.671	-0.142	-0.052	-0.046	0.621	0.728	-0.126
	(0.002)	**(0.000)**	(0.195)	(0.505)	(0.565)	**(0.047)**	**(0.035)**	**(0.030)**
Manufacturing	-0.930	1.107	0.908	0.457	0.465	1.350	1.370	0.491
	(0.337)	(0.182)	(0.124)	(0.509)	(0.499)	**(0.046)**	**(0.049)**	**(0.062)**
Primary products	34.651	2.615	3.234	35.229	41.196	36.114	36.119	2.845
	(0.000)	**(0.098)**	**(0.046)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.003)**
ANE	0.034	0.029	0.017	0.034	0.034	0.031	0.031	0.029
	(0.056)	**(0.096)**	(0.138)	**(0.003)**	**(0.003)**	**(0.031)**	**(0.036)**	**(0.000)**
FE	0.074	0.088	0.066	0.032	0.029	0.029	0.026	0.045
	(0.070)	**(0.000)**	**(0.003)**	(0.114)	(0.155)	(0.197)	(0.230)	**(0.000)**
Loan covenants	-	-	-	-	0.464	-	0.688	-
	-	-	-	-	(0.533)	-	(0.351)	-
Log likelihood	-33.653	-36.785	-45.904	-48.890	-48.671	-36.764	-36.281	-229.688
McFadden R2	39.2%	50.8%	31.3%	35.5%	38.4%	35.3%	38.7%	33.8%
Observations	91	108	109	110	109	90	89	508

Panel B: Hedging TL exposure

	1998	1999	2000	2000	2001	2001	Pooled
Firm size	0.320	0.039	0.447	0.437	0.318	0.260	0.339
	(0.080)	(0.848)	**(0.028)**	**(0.028)**	**(0.066)**	(0.121)	**(0.000)**
Liquidity	-0.499	-0.232	-0.213	-0.197	-0.494	-0.690	-0.221
	(0.051)	(0.407)	**(0.043)**	**(0.069)**	(0.122)	**(0.067)**	**(0.034)**
Leverage	-0.330	-0.320	0.209	0.129	0.007	-0.037	-0.062
	(0.213)	(0.172)	(0.457)	(0.696)	(0.953)	(0.765)	(0.412)
Market-to-book	-1.491	-0.411	-0.463	-0.501	0.049	0.212	-0.387
	(0.060)	(0.355)	**(0.028)**	**(0.023)**	(0.884)	(0.559)	**(0.036)**
Manufacturing	-0.184	-0.460	0.940	0.981	1.446	1.574	0.373
	(0.812)	(0.521)	(0.181)	(0.184)	**(0.032)**	**(0.035)**	(0.237)
Primary products	0.247	0.243	3.027	3.049	3.572	4.045	1.451
	(0.772)	(0.781)	**(0.001)**	**(0.000)**	**(0.001)**	**(0.001)**	**(0.000)**

FE	0.024	0.030	0.027	0.030	0.017	0.022	0.020
	(0.027)	**(0.010)**	**(0.026)**	**(0.011)**	(0.183)	**(0.096)**	**(0.000)**
Loan covenants	-	-	-	1.451	-	1.513	-
	-	-	-	**(0.022)**	-	**(0.025)**	-
Log likelihood	-39.780	-42.278	-36.749	-31.931	-38.139	-33.830	-170.443
McFadden R2	28.9%	20.9%	40.3%	48.0%	28.7%	36.4%	24.4%
Observations	108	109	111	110	91	90	419

Panel C: Hedging CT exposure

	1998	1999	2000	2000	2001	2001	Pooled
Firm size	0.810	0.722	0.473	0.397	0.371	0.319	0.513
	(0.000)	**(0.000)**	**(0.002)**	**(0.009)**	**(0.007)**	**(0.025)**	**(0.000)**
Liquidity	-0.192	0.107	-0.249	-0.244	-0.231	-0.218	-0.161
	(0.165)	(0.234)	**(0.020)**	**(0.030)**	(0.130)	(0.149)	**(0.000)**
Leverage	-0.374	-0.037	0.109	0.074	0.084	0.077	-0.020
	(0.065)	(0.619)	(0.626)	(0.721)	(0.415)	(0.441)	(0.716)
Market-to-book	-0.435	-0.142	-0.012	0.013	0.094	0.146	-0.088
	(0.039)	(0.148)	(0.862)	(0.861)	(0.681)	(0.542)	**(0.065)**
Manufacturing	1.436	1.397	0.458	0.455	0.325	0.395	0.784
	(0.038)	**(0.009)**	(0.434)	(0.424)	(0.546)	(0.470)	**(0.002)**
Primary products	2.802	2.890	0.264	0.233	-0.259	-0.220	1.331
	(0.037)	**(0.037)**	(0.859)	(0.886)	(0.873)	(0.895)	**(0.082)**
ANE	0.015	0.020	0.022	0.024	0.026	0.025	0.020
	(0.204)	**(0.062)**	**(0.023)**	**(0.020)**	**(0.016)**	**(0.017)**	**(0.000)**
Loan covenants	-	-	-	0.924	-	0.331	-
	-	-	-	**(0.098)**	-	(0.537)	-
Log likelihood	-50.640	-57.772	-61.852	-59.915	-55.123	-54.514	-240.397
McFadden R2	35.2%	26.4%	21.0%	22.6%	14.7%	14.6%	19.9%
Observations	113	115	116	115	94	93	438

Panel D: Hedging AT exposure

	1998	1999	2000	2000	2001	2001	Pooled
Firm size	0.527	0.411	0.455	0.387	0.322	0.251	0.427
	(0.001)	**(0.022)**	**(0.000)**	**(0.002)**	**(0.013)**	**(0.076)**	**(0.000)**
Liquidity	-0.086	0.009	-0.047	-0.035	-0.143	-0.128	-0.054
	(0.427)	(0.911)	(0.314)	(0.489)	(0.152)	(0.204)	(0.131)
Leverage	-0.177	-0.097	0.009	-0.053	0.137	0.125	0.003
	(0.390)	(0.611)	(0.970)	(0.845)	(0.205)	(0.241)	(0.950)
Market-to-book	-0.247	-0.218	-0.115	-0.090	0.252	0.330	-0.135
	(0.127)	**(0.044)**	(0.143)	(0.242)	(0.241)	(0.136)	**(0.003)**
Manufacturing	0.609	0.443	0.397	0.402	0.292	0.387	0.345
	(0.319)	(0.415)	(0.522)	(0.527)	(0.603)	(0.512)	(0.166)
Primary products	2.777	1.030	0.335	0.309	0.157	0.186	1.034
	(0.026)	(0.431)	(0.751)	(0.747)	(0.897)	(0.864)	(0.103)
ANE	0.013	0.020	0.021	0.023	0.019	0.019	0.019
	(0.258)	**(0.065)**	**(0.018)**	**(0.010)**	**(0.080)**	**(0.077)**	**(0.000)**
Loan covenants				1.075		0.539	
				(0.039)		(0.305)	
Log likelihood	-57.982	-62.484	-64.854	-62.282	-55.206	-54.082	-248.809
McFadden R2	20.6%	16.7%	15.2%	17.5%	14.3%	14.9%	14.1%
Observations	112	114	116	115	94	93	436

Table 4
Logit regression estimates of the likelihood of beginning to use financial hedges

Logit regression estimates of the relation between the likelihood that a firm began to use financial hedges to hedge and proxies for incentives to hedge and proxies for foreign exchange exposure. The sample consists of firms listed on the Stockholm stock exchange. The dependent variable is set to one if the firm began to use financial hedges to hedge the investigated exposure and zero for firms that did not began to hedge. Only firms that did not hedge in the previous period are included in the analysis. Translation (TL), committed transaction (CT), anticipated transaction (AT) exposure are investigated. The explanatory variables are: *Firm size*, the logaritmn of total assets: *Liquidity*, the current ratio: *Leverage*, the debt-to-equity ratio: *Market-to-book*, market value divided by book value of assets: *Foreign equity* (FE), the proportion of equity denominated in foreign currency: and *Absolute net exposure* (ANE), the absolute value of the difference between the proportion of revenues and the proportion of costs denominated in foreign currency. The symbol Δ denotes the change from beginning-of-year value to end-of-year value. *P*-values are presented in parentheses and based on a two-sided test. Values less than 0.10 are shown in boldface type. The significance tests are based on QML (Huber/White) standard errors & covariance.

	Firm size	ΔFirm size	Liquidity	ΔLiquidity	Leverage	ΔLeverage	Market-to-book	ΔMarket-to-book	ANE	ΔANE	FE	ΔFE	Log likelihood	McFadden R2	Observations
TL exp.	0.333	-0.268	-0.257	0.004	-0.044	-0.021	-0.201	-1.012	-	-	0.002	0.025	-90.954	14.60%	244
	(0.026)	(0.570)	(0.146)	(0.832)	(0.752)	(0.917)	(0.131)	(0.455)			(0.825)	(0.188)			
CT exp.	0.581	0.134	-0.191	-0.428	0.089	0.165	-0.180	-1.571	0.029	0.027	-	-	-76.367	18.66%	191
	(0.000)	(0.723)	**(0.046)**	**(0.001)**	(0.499)	(0.649)	(0.202)	(0.128)	**(0.005)**	**(0.085)**					
AT exp.	0.406	0.305	-0.012	0.006	-0.015	-0.012	-0.242	-0.138	0.025	0.031	-	-	-84.299	13.78%	210
	(0.000)	(0.451)	(0.868)	(0.772)	(0.916)	(0.978)	**(0.018)**	(0.167)	**(0.001)**	**(0.055)**					