The impact of the adoption of hedge accounting rules on enterprise risk management adoption practices by multinationals

Abstract

We predict that adoption of Enterprise Risk Management (ERM) by multinational non-financial firms is inter-related with both firm hedge accounting policies and choices about whether to adopt US GAAP or IFRS ('GAAP quality'). We hypothesize that sources of both market risk and idiosyncratic risk mitigate the ability of ERM-adopting firms to produce greater risk reduction. Therefore, we predict that sources of firm specific risk, such as pension risk, and hedge accounting policies, as well as GAAP quality, interact with ERM to affect incentives facing multinational firms to reduce their risk. Consistent with this hypothesis, we find that firms adopting ERM experience a reduction in stock return volatility but only for the period following implementation. Our results also find that income smoothing; GAAP choice and geographical complexity mitigate the effect of ERM adoption on risk and return volatility for ERM-adopting firms.

Keywords: Enterprise Risk Management, Derivative exposure, multinationals

JEL Classification: M40

Keywords: ERM, hedging instruments, risk, volatility

1. INTRODUCTION

In response to the enactment and implementation of the Sarbanes-Oxley Act 2004, as well as the financial crisis in 2007-2008, managing risk from a holistic perspective is becoming an increasingly major consideration for multinational corporations. However the implementation of new financial instruments and pension reporting standards both under US GAAP and international accounting standards means that firms are also conscious of the ameliorating influence of such risks on the ability of the firm to undertake ERM analysis.[1]

Prior US-based studies of the financial sector (e.g. Hoyt et al., 2009, Eckles et al., 2010) hypothesise that US insurance firms adopting ERM are likely to lower the marginal cost of adopting risk, which creates incentives for profit maximising firms to reduce total risk while increasing firm value. By combining the firm's risks into a risk portfolio, an ERM –adopting firm is better able to recognise the benefits of natural hedging prioritise hedging activities towards the risk that most contribute to the total risk of the firm and optimise the evaluation and selection of available hedging instruments. Thus by so doing, ERM –adopting firms will realise a greater potential reduction in risk per dollar spent. This reduction in the marginal cost of managing risk

[1] The Financial Accounting Standards Board (FASB) and the International Accounting Standards Board (IASB) both recognize the importance of risk management through requiring, since 2001, recognition of notional values, and since 2005, the recognition of hedged and trading-based financial instruments at fair value gains in the profit and loss, although 'cash flow hedge' gains or losses can still be charged direct to equity. Recently the IASB proposed enhancing existing standards IAS 39 with IFRS 9. However other sources of risk are not specifically regulated. The chairman of the IASB, Sir David Tweedie, recently proposed further amendments to enable firms to more easily class derivatives as hedges (Financial Times, 12/12/10).

is argued to incentivise firms to profit maximise and further reduce risk until the marginal cost of risk management equals the marginal benefits (Beasley et al., 2005).

However other research questions the value-added benefits of ERM adoption. For instance, public financial resource allocations to capital constrained health care and social services. A number of papers have discussed the importance of risk management issues for organisational forms (e.g. Miller et al., 2008) or for business continuity management (Power, 2009). However, the impact of specific forms of risk, e.g. market and/or idiosyncratic risk on the financing, accountability and effective management control of organisations affected, has not attracted any attention from researchers studying ERM adoption. Further, to the extent that recent global moves towards global accredition of (non-accounting) ERM professionals highlights the deficiency of accounting professionals in managing overall enterprise risk, the role of accounting versus ERM professionals in managing the transition to ERM adoption where multinationals can choose to adopt either strict US GAAP versus relatively non-enforceable IFRS reporting environments becomes a crucial issue.

Contrary to the results of prior research, we find that firms which adopt ERM experience a reduction in stock return volatility but only temporarily. Due to the costs and complexity of ERM option, we also find that, contrary to the results of prior research, that the reduction in return volatility of ERM adopting firms does not become stronger over time. Finally, we find that operating profits per unit of risk (RO/return volatility) increases post ERM adoption, but these effects do not persist.

This paper makes a number of contributions to the literature. First, it adds to the findings of existing literature on ERM adoption, which has been to date entirely restricted to studying only financial firms. Of the limited evidence available, Hoyt and Liebenberg (2009) find a large valuation premium (as measured by Tobin's Q) for ERM adopters, whereas Beasley et al. (2008) find insignificant negative announcement returns for ERM adoption. Eckles et al. (2010) find that, after adopting ERM, firm risk decreases and accounting performance increases for a given unit of risk. Therefore, their results complement the findings of Hoyt and Liebenberg (2009) which are based on market valuation of firm performance.[2] This study adds to the literature exploring the role and impact of para-professionalism in organisations, by examining ERM adoption for a sample of large European and US multinational non-financial firms.[3] We also incorporate the effects of firms' choice over GAAP quality, by controlling for their choice whether to adopt IFRS versus US GAAP in implementing relevant financial instruments reporting and measurement standards. We also identify and control for other sources of firm-wide risk, such as pension funding risk, and also specifically control for efforts by firms to explicitly manage operational risks by the usage of both hedged and unhedged sources of interest rate, commodity and foreign exchange risks.

[2] Other studies examine ERM adoption by reference to the appointment of a chief risk officer (e.g. Kleffner et al., 2003) or in terms of 'goodness of fit' with other firm characteristics (Gordon et al., 2009). However these measures are problematic and therefore are not examined in this paper. We instead use the standard approach of prior studies in identifying ERM adoption through evidential analysis of keywords in annual reports.

[3] Limiting our analysis to the largest US and European multinational firms also allows us to avoid the size and institutional ownership issues which dominate the findings of prior studies on ERM adoption (e.g. Beasley et al., 2005; Hoyt et al., 2009; Eckles et al., 2010).

Our results are generally supportive of our predictions and thereby significantly extend the findings of prior research. Specifically, we find that the choice of ERM adoption is related to firm risk, GAAP quality, hedging policy, derivatives usage and pension funding risk. Our results have a number of broader policy implications that support recent pressure from regulators, rating agencies and institutional investors on firms to adopt ERM.[4]

The remainder of this paper is organised as follows. Section 2 provides the institutional background and literature review. Section 3 develops the hypotheses. Section 4 outlines the research design. Section 5 discusses the data and sample. Section 6 reports the results of empirical tests. Section 7 provides a conclusion.

[4] S&P introduced ERM analysis into its global corporate credit rating process for non-financial companies starting 2008.

2. LITERATURE REVIEW

This section comprises a brief overview of the major features of financial instruments and the relevant applicable accounting standards. A financial instrument is any contract that gives rise to a financial asset of one entity and a financial liability or equity instrument of another entity.[5] The need for a specific standard on financial instruments such as derivatives arose from the apparent inadequacy of traditional accounting practices, which are founded on principles developed when the primary focus in accounting was on manufacturing, e.g. accruing costs to be matched with revenues. Financial instruments arise at the point of revenue realisation, i.e. the need to transform these inputs into cash or claims to cash. Enterprises can use derivatives either to monitor changes in market risk or for speculative or trading purposes. Presumably firms that adopt ERM will be more likely to do the latter. The demand for hedge accounting is also related to the recognition that the traditional realisation and cost-based measurement concepts are generally inadequate for the recognition and measurement of financial instruments.[6]

Under International Financial Reporting Standards (hereinafter 'IFRS'), the recognition and derecognising of financial assets and financial liabilities is addressed in IAS 39 – Financial Instruments: Recognition and Measurement (IASB 2004), while the offset of financial assets and financial liabilities and presentational disclosures is addressed in IAS 32 – Financial Instruments: Disclosure and Presentation (IASB

[5] IAS 32, Paragraph 11

[6] 'Recognition' is the inclusion of financial instruments in financial statements.

2005).[7] Further, IAS 32, IAS 39, and when applied, IFRS 7 (IASB 2006), apply to the financial instruments of all entities that are prepared in accord with IFRS. There are no exclusions from the presentation, recognition, measurement or even the disclosure requirements of these standards. However, insurance contracts are excluded. The standards identify a number of criteria for financial instruments to qualify as hedging instruments. The standards also set out a number of restrictive conditions and documentation requirements in order to justify the procedure. Finally, the standards discriminate between fair value and cash flow hedges and require separate classification of interest rate, currency and commodity and other hedging derivatives.

Another major issue arises over the implementation of these standards and ERM adoption propensity by multinational corporations and their decision to list on various global stock exchanges. First, US-based corporations and those whose cross-list in US stock markets are required to reconcile their accounts with those prepared in accordance with US GAAP (i.e. by submitting either a Form 10K (US domestic firms), or Form 20F (foreign firms) to the Securities and Exchange Commission). Thus these corporations are required to provide detailed disclosures in accordance with SFAS 133 and these are enforceable by registration and via the Sarbanes–Oxley

[7] IAS 32 has both presentation and disclosure issues. IFRS 7– Financial Instruments, issued in August 2006, replaced the disclosure requirements of IAS 32, and requires entities to provide more comprehensive disclosures in their financial statements that enable users to evaluate both the significance of financial instruments for the entity's financial position and performance, and the nature and extent of risks arising from financial instruments to which the entity is exposed during the accounting period and at the reporting date, and how the entity manages those risks. However, IFRS 7 was not fully effective for annual periods commencing before 1 January 2007; therefore there is only limited scope within this project to study the impact of this standard on disclosure and derivative usage practices. A new standard intended to simply the requirements, IFRS 9, is not effective until 2013.

Act (s. 404) internal control enforcements. In contrast, multinational firms that cross-list in non-US exchanges face considerably less stringent requirements. Multinationals based in the European Union (EU) are required to adopt IFRS as required by the European Commission (but with explicit carve-outs for hedge accounting); however, there is no uniform enforcement of these disclosures as they are subject to the disclosure-based regulatory monitoring by national securities regulators.[8] Therefore an interesting issue addressed by this study is to examine to what extent ERM adoption practices by multinationals is conditioned by market or firm-specific risk factors, after controlling for likely variations in the strength of regulation and enforcement between the US and EU.

2.2. Literature Survey - derivative usage

The existing literature suggests that risk management is the main motivation for the use of derivatives. Previous US survey-based research suggests that firms that face challenges to manage their firms' exposure to various sources of market risk are more likely to use derivatives (e.g. Geczy et al. 1997, Haushalter 2000), while Guay (1999) suggests that firms experience significant volatility reduction after using derivatives. By contrast, Petersen and Thiagarajan (2000) and Hentschel and Kothari (2001) find little evidence of any relationship between derivative use and firm risk. Huang et al. (2007) find that price exposure for a sample of UK firms for the period 2003–2005 is

[8] Multinationals based in non-US or non-EU environments are subject to even looser requirements.

lower for a sample of UK firms with derivatives. However, they also find that derivative usage does not increase firm risk.[9]

Most recently, Zhang (2008) examines the effect of SFAS 133 on corporate risk management behaviour of US firms by hypothesising that the standard's effect varies depending on the hedge effectiveness of the derivative instruments. New derivative users are identified and then are classed as either 'effective hedgers' (EH) or 'ineffective hedgers/speculators' (IS) depending on whether their risk exposures increased or decreased relative to the 'expected level' after the initiation of the derivatives programme. He finds that risk exposures relating to interest rate, foreign currency rate and commodity price decrease significantly for IS firms but not for EH firms following the adoption of SFAS 133.

However Zhang (2008) only studies new users of the standard and thus risk exposures may vary considerably cross-sectionally, depending on when the firm initiated the programme. Further, the study is based on a large sample, where most firms hold no more than one of the three types of risk exposure. By contrast, most multinational firms in our study have exposure to both interest rates and foreign currency derivatives. Further, in common with other studies, Zhang (2008) focuses only on hedged derivative usage, and ignores the broader corporate use of derivatives for speculative trading. Finally, in common with other studies reviewed above, Zhang

[9] Hentschel and Kothari (2001) attempt to control for industry effects by deflating all variables by an average of two SIC code industry averages. This procedure, however, assumes that firms with higher equity volatility have a higher incentive to hedge. As we find no evidence of any such relationship, and since our sample comprises firms that raise their equity in various capital markets which suffer from different implied volatilities, equity volatilities are not comparable and we do not adopt this procedure in this study.

(2008) does not examine the likely effect of idiosyncratic risk, pension risk and other industry and cultural effects on cross-sectional variation in derivative usage and firm choice of ERM strategy.

In summary, the existing literature provides little insight into how the adoption of fair value oriented reporting of derivative exposure is related to non-financial firms' strategic decisions to use derivative securities for risk management purposes and its consequences for cost of capital and shareholders' wealth. While risk management is now a feature of many developed economies, perfect markets finance theory, upon which accounting standards are premised, provides little rationale for why multinational firms would seek to expend scarce resources to hedge unsystematic risk. However, the development of financial innovations in risk transfer means that various market imperfections can create opportunities for such firms to maximise market value through hedging. In fact, there is a range of value, cash flow and accounting rationales for risk management.

The above discussion highlights the importance of the hedging versus non-hedging distinction in the context of the use of derivatives. However, the existence of hedge accounting highlights the limitations of the accounting framework in representing a firm's underlying economic exposure. This is because the reported accounting exposure – based on exposure of fixed obligations to floating interest rates or foreign currency rates – may, for reasons associated with the application of fair value measurement principles, either understate or overstate the firm's true underlying economic exposure.

Cornell and Landsman (2005) analyse various aspects of SFAS 133. They criticise SFAS 133 for classifying fair value hedges, changes of which are charged to income, separately from cash flow hedges, which are charged against comprehensive income. Shrand (1997) further identifies interest rate sensitivity as an important issue in analysing the impact of new accounting rules on financial instruments. The broader literature, which draws on accounting disclosure and measurement to explain firms' risk management policies, has mainly sought to examine firms' risk management policies through the analysis of 'accounting quality'. Viewed from this perspective, firms attempt to manage earnings and their financial leverage by exercising managerial discretion over variations in GAAP application. The extent to which firms can exploit these factors is limited by the choices available under GAAP, audit quality, tax and enforcement, litigation by shareholders and enforcement of covenants by lenders. Since a firm's decision to use derivatives that qualify for hedge accounting treatment involves discretion over the application of GAAP, one would need to control for other firm-specific factors, such as pensions and other idiosyncratic risks.

In addition, it is likely that firms' operating and financial activities are exposed to market-wide financial risk. The increasing globalisation and integration of product, insurance and financial markets highlights the increasing importance of the ability or inability of the firm to manage market or non-diversifiable risk, and their inability to do so is increasingly being exploited by powerful hedge funds and other speculative investors. However, until relatively recently, efforts by corporations to hedge against

the negative impact of these exposures on cash flows, earnings and capital structure by using derivatives were not even recognised in their balance sheets or performance. Further, previous empirical research has not examined whether the ability of firms to manage financial risks is systematically associated with their discretionary choices in managing accruals, reporting accounting exposures, and other firm, industry or cultural factors. Alternatively, it simply reflects the underlying economic exposures.

To our knowledge, current literature on the impact of derivative usages is based on survey data, which may not be representative owing to the low response rates that are typical of such an approach. An important exception is the new study by Zhang (2008). In addition, existing literature normally examines the impact of financial instrument usage by comparing that for an individual country to usage in the US. In contrast, we use data for a broader sample of both US and European FTSE Global 500 firms.

Under the restrictive assumptions of a perfect capital market, Modigliani and Miller (1959) show that capital structure is irrelevant to a firm's intrinsic value and the cost of capital. There is therefore little rationale for the firm to hedge these risks by using any derivative securities for fund raising or asset exposure.

However, with market frictions, such as taxes and the cost of financial distress, there may be an optimal combination of different financial securities to finance the needed assets (Stulz 1985). While there is a trade-off between the benefit of a tax shield and the cost of bankruptcy when firms issue debt financing, interest rate risk still exists. For example, when the interest rate goes down, a firm can issue cheap debt.

The old debt represents an opportunity cost. Change in financial leverage implies change in the cost of capital. However, there is little empirical evidence for the cost of capital and firm risk effects associated with the usage of derivatives. Moreover, there is little or no evidence for an association between the propensity to adopt ERM and the incidence of derivative usage by firms and their exposure to other sources of idiosyncratic risk, such as pensions.

Eckles et al. (2010) contrast the number of studies examining the determinants of corporate risk management policy, with the much fewer studies analyzing the valuation impact of risk management. Allayannis and Weston (2001) study the use of foreign currency derivatives for 720 non-financial US firms between 1990 and 1995. Using Tobin's Q as a proxy for firm value, they find a positive relation between firm value and the use of foreign currency derivatives, with an average hedging premium of 4.87%. Carter et al. (2006) study the jet fuel hedging behaviour for US airline industry between 1992 and 2003. Using Tobin's Q as a proxy for firm value, they find that the hedging premium could be as large as 10%. Further they find that the positive relation between hedging and firm value increases in capital investment, and most of the hedging premium is attributable to the interaction of hedging with investment, suggesting that the hedging benefit comes from a reduction of underinvestment costs.

To summarise, the overall weight of empirical evidence supports the theory of corporate risk management. Firms' optimise their risk management policy based on the cost benefit tradeoffs and consequently managing risk has a positive impact on

firm value. However there is little known inter-relation between firm ERM choice, derivative usage trends, and firm risk sources.

3. Hypothesis development

In this section, we briefly discuss the costs and benefits of hedging for a multinational firm. We then develop specific hypotheses concerning specific types of derivatives used to hedge foreign currency and interest rate risk, and their association with various sources of market, firm and institutional risk respectively. In order to explore these interactions, we distinguish between systematic risk and specific or idiosyncratic sources, for example, focusing in particular on leverage (for interest rate risk) and earnings from foreign operations (affecting the management of foreign currency risk). We focus specifically on relating these factors to the firm's overall reported accounting exposure.[10]

3.1. Costs and Benefits of ERM

Derivatives have generally lowered the cost and increased the precision with which financial markets are able to unbundle and distribute both interest rate and foreign currency risk. There are various arguments for the use of hedging by firms. In particular various 'market imperfections' may create a solid case for corporate

[10] For the remainder of this report we focus only on the use of derivatives solely for hedging purposes. Therefore we do not seek to analyse the use of derivatives that do not qualify for hedge accounting treatment.

hedging. We consider a number of different arguments for risk management using ERM, each of which justifies our predictions in the following sections. Most of the existing theoretical literature (e.g. Stulz 1985; Froot et al. 1993) does not directly discuss ERM, but instead has shown a number of ways in which hedging on corporate account can increase shareholder value. The substantial gains produced by hedging result from the fact that risk affects the expected cash flows that corporations can deliver to their shareholders because of taxes, transaction costs, bankruptcy and other sources of market imperfections. For most of these, a shareholder's hedging on their own account cannot reduce the firm's financial distress or change its expected liability. The major reasons for using derivative securities are to manage first the exposure of assets and liabilities, and secondly of internal operating cash flows and operating income. Myers and Majluf (1984) develop a pecking order theory which suggests that firms find that raising external capital is relatively costly in the presence of transaction and incentive problems. Froot et al. (1993) extends this theory by arguing that the major reasons for using derivative securities are primarily related to incentive problems and information asymmetries between a firm's managers and their external capital providers. Informational asymmetries arise because incentive problems within multinationals generate frictional costs that also make externally raised funds relatively costly. Froot et al. (1993) argues that corporate risk management programmes allow a multinational firm to use its cash flow more effectively by permitting it to shift the internal funds.

While the costs of implementing ERM and specific hedging instruments can be high for any firm, we believe that for multinational firms these costs are low relative to the benefits of reducing information asymmetries and for ameliorating incentive problems. An important attribute of high-reputation firms is their ability to maintain high levels of sustainable or high-quality earnings over time. Another important attribute is their ability or willingness to engage in hedging activities to mitigate risk. However, empirical research has not so far examined whether the ability of firms to manage financial risks through reducing their cost of equity or enhancing their performance is systematically associated with their discretionary choices over ERM adoption, or their relationship with reporting accounting exposures, other firm, industry or culture-specific factors, or whether it is simply reflecting the underlying economic exposures.

3.2. Hypotheses

We now discuss hypotheses concerning the various testable empirical implications of incentive problems related to the association between risk taking, risk to reward ratios and ERM adoption incentives facing multinationals. It is likely that firms' operating and financial activities are exposed to market-wide financial risk. The propensity to adopt ERM is therefore related to the ability or inability of the firm to manage market or non-diversifiable risk, and their inability to do so is increasingly being exploited by powerful hedge funds and other speculative investors. However, until relatively recently, efforts by multinational corporations to hedge against the deleterious impact of these risks on cash flows, earnings and capital structure by using derivatives that were previously not even recognised in their balance sheets or performance. In

developing our hypotheses below, we specifically control for cross-sectional variation in both market-related factors (book-to-market) as well as a number of firm-specific risk factors (e.g. firm complexity, financial leverage, pension risk). We also control for accounting quality and earnings volatility, since the concurrent implementation of IFRS and US GAAP over the period of the study required firms to be more transparent about the sources of pension funding and risk on their balance sheets. All these hypotheses include the assumption that all other factors are held constant.

Propensity to adopt ERM

Following Froot et al.'s (1993) arguments concerning the need to reduce incentive problems, we initially predict that the propensity of firms to adopt ERM is primarily related to the desire of multinational firm managers to better manage the exposure of their existing assets, liabilities and internal cash flows. To reduce incentive problems, increased usage of foreign currency derivatives can be beneficial for firms subject to idiosyncratic risk affecting their global operations. We posit a positive association between usage of derivatives and specific sources of firm risk.

H1: The propensity of firms to adopt ERM is positively associated with firm risk.

Changes in Firms' Market Risk Exposure over time

We also examine, for a given level of disclosure and usage, the propensity of firms to increase or decrease their ERM adoption over time. Zhang (2008) argues that changes in derivative usage following the implementation of new GAAP can help us to discriminate between cosmetic and cash flow rationales for hedging.

Following Zhang (2008), we first separate effective hedgers from ineffective hedgers by identifying the propensity of firms to either increase or reduce their use of risk management programmes over time. We further specify the relationship between the propensity to adopt ERM and firms' total risk and their risk to reward ratio, respectively, is generally consistent with the prior arguments developed by Eckles et al. (2010), after controlling for regulatory and firm specific factors discussed above.

H2. The propensity to adopt ERM is positively associated with a reduction in total risk.

H3. The propensity to adopt ERM is positively associated with an increase in the risk to reward ratio.

4. Research design

Our research design follows the 2-stage Heckman procedure for evaluating ERM adoption, as developed in Eckles et al. (2010). Specifically, in order to test our first hypothesis (H1), we need to specify a model with firm's risks as the dependent variable and ERM adoption and other controls that potentially influence firm's risk as the independent variables:

$$firm\_risk = \text{intercept} + \gamma * ERM\_adoption + \beta * controls \quad (1)$$

A finding of $\gamma < 0$ will be in support of H1. One potential concern in estimating (1) is the self-selection problem. To mitigate this form of omitted variable bias, we employ

the Heckman two-step procedure to estimate the impact of ERM adoption on firm risk.[11]

To predict the probability of ERM adoption, we control for firm size and operation complexity by using the log of total assets (size), the log of the number of overseas business operations (BUSSEG), and the percentage of foreign sales (FORS).[12] We include a lagged measure of firm risk, the log of annualized standard deviation of monthly stock returns over the previous three years (volt), to control for the potential relation that riskier firms have greater incentive to hedge (see e.g. Smith and Stulz (1985)). Since firm earnings is related to the demand for hedging, we also include a measure of covariation in firm earnings (COEARN).[13] Finally, we also use a dummy for GAAP quality, for the sample of firms which are non-US and use IFRS (GAAP).[14]

[11] Following the procedure outlined in Eckles et al. (2010), we first use a probit model to estimate the probability of a firm adopting ERM to get the predicted probability for each firm (prob(ERM)). We then use this predicted probability (prob(ERM)) to compute the inverse Mills ratio (IMR), which is the probability density function of prob(ERM) over the cumulative probability density function of prob(ERM). In other words, the inverse Mills ratio captures the selection hazard. We then estimate (1) including the inverse Mills ratio in addition to other control variables.

[12] Eckles et al. (2010) argue that the rationale for these control variables is that (a) the more complex and more myriad risks that a firm faces, the greater benefit a firm can realize by taking a portfolio approach to manage risk; (b) existing literature (see, e.g. Mian (1997)) finds that corporate demand for hedging activities are function of economic scale and operation complexity.

[13] The relation of firm earnings and propensity to use derivatives is a controversial and unresolved issue. Allayannis and Weston (2001) argues that derivatives use can reduce the volatility earnings, although these findings are contradicted by Rowntree et al. (2009). Understanding this relation requires further specification of the earnings measure used and whether and in deriving a robust measure and scope of derivative usage is adopted. The relation of earnings to derivative usage and ERM adoption is therefore problematic and we make no specific prediction on this relation.

[14] Our model is robust to alternative specifications. In unreported tests we also use the median OLS regression to address issues of extreme outliers. There are no significant differences in results.

The dependent variable in this Probit model is a dummy variable (ERM) that takes the value of one if a firm practices ERM in that year. Therefore, we have the following equation for the first-stage regression of the two-step Heckman procedure:

$$\text{Probit}(ERM_{i,t}=1) = \text{intercept} + \beta_1 size_{i,t} + \beta_2 BUSSEG_{i,t} + \beta_3 GAAPDUMMY_{i,t} + \beta_4 PENFUND_{i,t} + \beta_5 VOLT_{i,t} + \beta_6 DERIVDUMMY + \varepsilon_{i,t} \quad (2.1)$$

For the second stage, we estimate an OLS model of the following specification to investigate the impact of ERM adoption on firm risk:

$$volt_{i,t} = \text{intercept} + \beta_1 size_{i,t} + \beta_2 ERM\_firm_{i,t} + IMR_{i,t} + \beta_3 GAAPdummy_{i,t} + \beta_4 DERIVVAL_{i,t} + \beta_5 BUSSEG_{i,t} + \beta_6 MTB_{i,t} + \beta_7 LEV_{i,t} + \beta_8 COEARN_{i,t} + \beta_9 PFUND_{i,t} + \varepsilon_{i,t} \quad (2.2)$$

The dependent variable (volt) is the log of the annualized standard deviation of monthly stock returns. We choose stock return volatility as our proxy for firm risk, because it is a well established measure for a firm's total risk. Mayers and Smith (1982) and Smith and Stulz (1985) show that, when capital markets are imperfect, firms care about total risk (as opposed to systematic or idiosyncratic risk).

Stock return volatility is also preferred to other alternative measures of firm risk such as earnings or cash flow volatility, because stock price data are available on a daily basis whereas earnings and cash flow data are only reported quarterly.

Following the approach suggested by Eckles et al. (2010), our primary variable of interest is the interaction term between a dummy that takes the value of one if a firm has ever adopted ERM during our sample period (ERM_firm) and a dummy variable that takes the value of one if a firm practices ERM that year (ERM-

implem_dummy). Based on our H1, we expect $\beta_2 < 0$. The dummy ERM_firm controls for any potential group fixed effects between firms that ever adopted ERM and firms that never adopted ERM during our sample period. For example, ERM firms may have a more flexible corporate culture than non-ERM firms, which allows them to more quickly learn and implement new technology. Supporting this argument, Kleffner et al. (2003) find that organizational inertia is a major deterrence preventing firms from adopting ERM. By including both ERM_firm and ERM_firm*ERM_implemen_dummy in the regression, we can then isolate the incremental impact of ERM adoption on firm risk. Adopting ERM is an endogenous decision made by a firm. Our estimation could be biased if ERM adoption coincides with the change in underlying firm characteristics that drive firm risk. We explicitly control for this potential omitted-variable bias by including the inverse Mills ratio (IMR) that we compute from (2.1).

We also follow Eckles et al. (2010) by including in Eq (2.2) other variables that the existing literature predicts influence firm risk, such as firm size (the log of total assets, size), growth opportunities (the log of the market-to-book ratio of assets, MTB), firm leverage (long-term debt over total assets, debt). Larger firms and firms with a long trading history provide the market more information (Barry and Brown, 1985). Thus we expect those firms to be less volatile. We also measure leverage (LEV) based on the standard argument that debt acts as a lever, magnifying profits and losses, and thus, contributes to higher firm risk (Lev, 1974).

We also include two additional control variables which we consider to be pertinent to our analysis but which are not studied by prior research. First, we model firms' notional or fair value exposure to interest rate and /or currency risk. This measure of firm risk is relevant in particular to the argument of Froot et al. (1993) that derivative usage by firms should be viewed from a broader functional perspective. These arguments imply that derivative usage is connected with sources of idiosyncratic or firm specific risk, rather from an institutional perspective, as codified by existing rules to narrowly focus on mitigating specific market risks.

Second, we include specific potential sources of systematic and idiosyncratic risk that may affect the propensity to adopt ERM. Specifically, we include a measure of both the propensity to use derivatives (DERIVDUMMY), the notional or fair value of derivative usage (DERIVAL) and total pension fund risk, defined as the relation of market value of pension assets to accrued benefit obligation (PFUND). The corporate finance and accounting literature has previously treated pension funds as off-balance sheet debt, notwithstanding the recent requirement in FRS 17, SFAS 158 (US) and IAS 19 (IFRS) to require recognition of deficits or surpluses. However the differential treatment accorded to changes in value over time whereby firms can elect to use a corridor approach to amortise any shortfall under IAS 19 and US GAAP means that the full funding implications are only observed via footnotes. Coronado et al. (2008) argue that these are insufficient and that analysts regularly underprice pension

shortfalls. This is measured as the disclosed ratio of assets to liabilities, even though it is not reported in the financial statements.[15]

Finally, an important explanation of ERM adoption is firm complexity (BUSSEG), which which is used by prior studies such as Eckles et al. (2010) in the second-stage regression to controls for the possibility that firms decide to change business mix or other activities in response to a change in firm risk due to ERM adoption. However BUSSEG is likely to be highly correlated with size. Further, our study sample is restricted to the largest global multinationals, whose business complexity may be complicated by international diversification of business operations. Therefore, we replace the standard proxy (number of operating segments) with the number of geographic segments, to reflect the agency related costs of complexity arising from the demand for decentralisation of decision making control facing multinational firms.

To test our second hypothesis (H2), following Eckles et al. (2010) we also modify equation (2) by adding time lags of ERM implementation (X denotes the vector of the control variables):

$$volt_{t-1} = \text{intercept} + \kappa ERM\_firm_{1,0} * \sum_{t=1}^{n} ERM\_implemen\_lag_{i,t} + \lambda X + \varepsilon_{i,t} \quad (3)$$

[15] Prior to the issue of SFAS 158, US firms (under SFAS 87) were only required to recognize the underfunded net pension obligation. A corridor approach was used to minimize the impact of unexpected variations in pension risk. A similar approach is used under IAS 19 unde which firms could elect to spread pension costs based on the corridor approach. IAS 19 was amended in 2009 to restrict the corridor option. Neither SFAS 158 nor amended IAS 19, which removes this discretion, was effective during the study period.

To test our third hypothesis (H3), we also follow Eckles et al. (2010) by using equation (2), replacing volt with ROA/volt in the second stage of the equation.

$$\frac{ROA_{i,t}}{volt_{i,t}} = \text{intercept} + \beta_1 size_{i,t} + \beta_2 ERM\_firm_{i,t} + IMR_{i,t} + \beta_3 GAAPdummy_{i,t} + \beta_4 DERIVVAL_{i,t} + \beta_5 BUSSEG_{i,t} + \beta_6 MTB_{i,t} + \beta_7 LEV_{i,t} + \beta_8 COEARN_{i,t} + \beta_9 PFUND_{i,t} + \varepsilon_{i,t} \quad (4)$$

For all our regressions, we control for firm-level clustering following Petersen (2009).

5. Sample Selection, data sources and sample description

5.1. Sample selection and ERM identification

We start our sample selection process with all publicly-traded companies in the S&P 500 and Euro top 300. We focus on non-financial companies, which are publicly traded so we can utilise stock return data and more easily identify ERM implementation through public filings. After controlling for financial firms, non-surviving firms and entries and withdrawals over the period 2005-2009, we identify 60 European and 121 US-listed firms. We chose both European and US-listed firms to identify the impact of differences in GAAP treatment between IFRS and US GAAP, and regime enforcement.

Firms are not required to disclose information about ERM implementation. Therefore we follow the procedure suggested by Hoyt and Liebenberg (2009) and Eckles et al. (2010) to identify ERM adoption for the above mentioned 181 firms. Specifically, we searched the annual report using key words such as 'Chief Risk Officer', 'Enterprise Risk Management', 'Enterprise Risk Officer', 'Strategic Risk Management, 'Integrated Risk Management', 'Holistic Risk Management' and 'Consolidated Risk Management'. Once we find a reference using any of those key words, we read the item to determine whether it documents an ERM adoption event. We record the year of publication of the annual report to first provide evidence of ERM adoption. Our search yields 59 unique firms that adopted ERM between 2005 and 2009.

5.2. Data sources and variable description

We collect financial data from COMPUSTAT, stock price data from CRSP and derivative reporting data from the annual report.

5.3. Sample description

Table 1 reports the number of total sample firms and the number of firms that adopt ERM year by year for the period 2005-2009. We chose 2005 as the start of our sample period (i.e. three years prior to the first ERM adoption event) to examine the impact of ERM adoption on firm risk over time. Although firms started to adopt ERM in the mid-2000s, this practice does not become widespread until 2009. By 2009, 35% of publicly traded non-financial firms had implemented ERM.

Table 2 reports key operating characteristics for the sample firms. For more in-depth illustration, Table 3 partitions the sample by whether a firm implemented ERM between 2005 and 2009 (hereinafter ERM firms) or never adopted ERM within the same period (hereinafter non-ERM firms). Panel A reports the descriptive statistics partitioned by ERM practice (two-tailed t test compares the mean differences in the variables). We also partition the sample by whether a firm exhibits stock return volatility greater than the sample median. Panel B reports the descriptive statistics partitioned by firm risk. As panel A shows, ERM firms are generally less volatile, significantly larger, more diversified and levered. Thus, descriptive statistics confirm findings in prior studies that ERM firms could be systematically different from non-

ERM firms, highlighting the importance of controlling for the group fixed effect in our empirical tests. As Panel B shows, less volatile firms are larger and more diversified. These relations between firm risk and other firm characteristics are consistent with the findings from the existing literature.

Table 4 reports the correlations among variables. There are no significant positive or negative correlations, indicating serial correlation and covariation is not an issue.

6. Empirical results

This section reports the results of multivariate logistic and OLS models that are used to test hypotheses 1 to 3. Because there is controversy over whether notional or fair values are most appropriate basis to quantify the effects of firm exposure to derivatives, all results are reported separately for derivative exposure measured at fair value (Panel A) or at notional value (Panel B).[16]

6.1. Impact of the propensity to adopt ERM

Table 5 reports the logistic regression results of our first hypothesis that firms' propensity to use ERM is related to size and various risk characteristics (i.e. equation 2.1). Our results are generally consistent with these predictions. In particular, for both Panel A (fair value hedge) and Panel B (notional value hedge), we find that larger firms are more likely to adopt ERM. The dummy for number of international operations is positive and statistically significant. There is also a positive and statistically relation between ERM adoption and pension funding, suggesting that firms with less onerous net pension obligations are more likely to adopt ERM. The relation between ERM adoption and market risk (measured by fair value) are more equivocal, but are generally consistent with the prediction that ERM adoption is positively related to market risk but negatively related to idiosyncratic or non-diversifiable sources of risk.

[16] Most statistics available on derivative usage by firms is stated in terms of notional values. The notional value does not represent necessarily the full exposure of the firm. While the FASB originally required firms to disclose the notional value of derivatives (SFAS 115) this was later dropped and replaced with a fair value disclosure (SFAS 133; IAS 39).

6.2. Factors influencing ERM adoption propensity

Our second hypothesis posits that there is a positive and significant relation between firm risk (measured by the standard deviation of returns) and ERM adoption. Table 6 reports regression results for this prediction, as modelled by equation 3. Contrary to the predictions of H2, we find that ERM firm is positively, but insignificantly, related to firm risk, indicating that ERM firms increase risk post ERM adoption. Since our dependent variable is the log form of firm risk, the positive coefficient of 0.145 (for fair value hedge) and 0.130 (notional value hedge) implies that on average ERM adopting firms increase risk by 13.5 and 12.2 percent, respectively. These results suggest that ERM adopters are systematically riskier than non-ERM firms, which is consistent with the results of our logistic regression results. The inverse Mills ratio also enters the regression with significance, suggesting that it is important to control for self-selection bias. Results on our other control variables, such as negative relation with covariation of earnings and with the number of foreign operations, are consistent with the existing literature. Firm risk is positively related to the notional value of derivatives (panel B), but there is no statistically positive relation between pension risk and firm total risk.

6.2. The impact of ERM on firm risk over time

Table 7 reports the regression results from estimating (3). To test our third hypothesis H3, we estimate three model specifications using different time lags post ERM adoption. Consistent with H3, we find that the risk to reward ratio post ERM adoption increases over time. Specifically, based on Table 7, column 3, firms realise a 47.9 percent (42.6 percent for Panel B, notional value derivatives) percent risk to reward ratio during the year ERM is implemented. (Year = 0). However, the risk to reward ratio increases significantly by 50.9% (48.5 percent for panel B, notional value derivatives), two years after the firm adopts ERM. Therefore, our results are not supportive of the prediction that benefits from ERM adoption increase over time. Moreover, there is a significantly negative relation between GAAP quality and firm volatility, suggesting that the experience effects of ERM adoption differ as between EU and US firms.

This argument could also apply to the effect of ERM adoption on profits scaled by risk. To investigate this lagged effect, we estimate a similar set of regressions as in Table 7 (results not reported). In this case, we use profit per unit of risk as the dependent variable and examine the impact of ERM adoption over various time lags.We find some evidence in support of a lagged effect.

7. Conclusion

In this paper, we exploit new reporting rules concerning the disclosure by multinationals of their hedged derivatives value and pension funding data to further extend and clarify the findings by prior studies concerning ERM adoption by firms.

Specifically we extend the scope of analysis of prior studies concerning the relation of ERM adoption propensity and firm total risk and risk-reward ratios to multinational non-financial firms, by incorporating new measures of sources of both idiosyncratic risk (pension risk), variations in GAAP quality, derivative usage and firm complexity. This enables us to test hypotheses developed by prior researchers in the insurance field that the propensity to adopt ERM and the risk volatility (and risk to reward relationship) is generally negative (positive) for ERM adopters. We do not find evidence to support the premise that multinational firms adopting ERM are better able to recognise the benefits of natural hedging, prioritize hedging activities towards the risks that contribute most to the total risk of the firm, and optimize the evaluation and selection of available hedging instruments. Instead, we find that the risk reduction benefits disappear over time and that the risk to reward benefits reduce over time. Therefore, our results to do not support the premise in financial firms that ERM adopting firms are able to produce a greater reduction of risk per dollar spent. Consequently, our results imply that multinational firms implementing ERM, firms are unable to sustain experience lower risk and higher profits, simultaneously. Instead, consistent with our hypothesis, we find that firms adopting ERM do not experience a reduction in stock return volatility. Return volatility for ERM-adopting firms increase over time. We also find that returns per unit of risk (ROA/return volatility) do not increase over time for firms adopting ERM. These results should be treated with caution at this point. In particular our results are conditioned on voluntary disclosure of notional values, while firms in different industries may experience different

earnings-age profiles of employees that may influence the reported pension funding ration. Subject to these limitations, we believe that our results support the premise that ERM adoption is no universal panacea to reduce risk and increase risk-return reward for non-financial firms.

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Table 1

Sample Selection

	Filtered Firms	No. of Firms in the Sample
Starting Point		450
Financial firms	(123)	
Non-financial firms		327
Firms with no required data	(105)	
Firms with insufficient criteria	40	
Final sample size		182
Regional breakdown of the final sample:		
US	121	
EU	61	
Total		182

Note: The sample consists of non-financial constituents of the FTSE Global 500 firms as of 31 December 2006. Constituent firms had to have been included in the FTSE Global 500 index for at least five years. In addition, sample firms need to have all available financial, stock market and credit ratings data on Compustat Global Insight, DataStream and Ratings Direct, respectively, to qualify for inclusion in the analysis. Firms were also excluded from the sample if they did not meet the liquidity or positive earnings criteria required to exclude alternative tax or financial distress incentives for derivative usage.

Table 2
Descriptive Statistics

This table reports summary statistics of key operating variables for the sample firms. Panel A reports the descriptive statistics partitioned by whether a firm has ever implemented ERM between 2005 and 2009 (ERM firms) or otherwise non-ERM firms. Panel B reports the descriptive statistics partitioned by whether the sample firm exhibits stock return volatility greater than the sample median which is 17.45%

Panel A: Whether firm has ever implemented ERM

ERM firms	N	Mean	Median	Min	Max	Stdev
Stock return volatility (%)	219	1.598	0.182	0.001	14.134	3.285
Total assets (millions)	219	44723	34304	1000	292181	46745
Market value of equity	219	66826	38520	1000	605106	81145
# foreign operations	219	7.708	6	1	42	7.184
% foreign sales	219	0.496	0.490	0	1.814	0.352
LT debt over equity	219	0.352	0.334	0	2.322	0.295
ROA	219	0.067	0.005	0	1.897	0.223
Stock return %	219	0.327	0.015	-0.974	28.936	2.467
Hedged derivatives– notional value	219	6498	710	-12	307000	23093
Hedged derivatives fair value	219	477	0	-3178	41044	3201
Unhedged derivatives – notinoal	219	1213	0	0	50929	5299
Unhedged derivatives – fair value	219	46	0	-10558	10821	1185

Non-ERM firms	N	Mean	Median	Min	Max	Stdev
Stock return volatility (%)	681	1.374	0.169	0.001	19.159	3.217
Total assets (millions)	681	43331	29766	1000	269470	45205
Market value of equity	681	52385	31126	1011	538510	59280
# foreign operations	681	6.539	5	1	49	6.026
% foreign sales	681	0.453	0.461	0	1.730	0.344
LT debt over equity	681	0.394	0.349	0	2.578	0.311
ROA	681	0.023	0	0	1.588	0.080
Stock return %	681	0.133	0.062	-0.960	15.590	0.903
Hedged derivatives– notional value	681	5049	741	-11325	376267	18115
Hedged derivatives fair value	681	197	0	-2983	13027	1023
Unhedged derivatives – notional	681	1676	0	1245	346191	18017
Unhedged derivatives – fair value	681	23	0	-665	2596	201

Panel B: Partitioned by firm stock volatility

Low volatility firms	N	Mean	Median	Min	Max	Stdev
Stock return volatility (%)	450	0.061	0.054	0.001	0.175	0.046
Total assets (millions)	450	56659	36403	1000	292181	56978
Market value of equity	450	60329	34367	1000	605107	72772
# foreign operations	450	0.548	0.575	0	1.814	0.376
% foreign sales	450	0.391	0.355	0	2.322	0.300
LT debt over equity	450	0.042	0.005	0	1.897	0.157
ROA	450	0.145	0	-0.960	28.936	1.758
Stock return %	450	0.548	0.575	0	1.814	0.376
Hedged derivatives– notional value	450	6645	1255	0	124129	14304
Hedged derivatives fair value	450	205	0	-3189	16534	1401
Unhedged derivatives – notional	450	2855	0	-1245	346191	22325
Unhedged derivatives – fair value	450	49	0	-10588	10821	855

High-volatility firms	N	Mean	Median	Min	Max	Stdev
Stock return volatility (%)	450	2.802	0.357	0.176	18.437	4.077

Total assets (millions)	450	30632	25847	2440	253932	23864
Market value of equity	450	51451	31853	1000	504240	57070
# foreign operations	450	6.904	5	1	49	6.647
% foreign sales	450	0.375	0.401	0	1.232	0.286
LT debt over equity	450	0.376	0.341	0	2.578	0.316
ROA	450	0.025	0	0	1.440	0.099
Stock return %	450	0.214	0.086	-0.974	14.690	1.075
Hedged derivatives– notional value	450	4151	500	0	375267	23840
Hedged derivatives fair value	450	324	0	-1559	41055	2154
Unhedged derivatives – notional	450	255	0	-40	18315	1275
Unhedged derivatives – fair value	450	8	0	-347	1599	103

Table 3

Descriptive Statistics: Univariate Analysis

Panel A: ERM choice	ERM firms		Non-ERM firms		Diff
	N	Mean	N	Mean	
Annualised stock return volatility	219	1.598	681	1.374	-0.893
Total assets (in millions)	219	44723	681	43331	-0.393
Market value of equity (millions)	219	66826	681	52385	-2.849
FORS	219	7.71	681	6.54	-2.380[a]
MTB	219	37.03	681	56.83	0.220
LEV	219	0.35	681	0.40	1.754[b]
ROA	219	0.07	681	0.03	-4.346[a]
Stock return	213	0.33	660	0.13	-1.700[c]
COVEARN	176	0.83	568	0.79	-2.310[b]
PFUND	218	0.381	676	0.04	0.483
Total value of Hedging	219	477.13	681	196.70	-1.992[b]

PANEL B: Volatility of stock returns	Low volatility firms		High volatility firms		Diff
	N	Mean	N	Mean	
Annualised stock return volatility	450	0.06	450	2.79	-14.01[a]
Total assets (in millions)	450	56730	450	30609	8.96[a]
Market value of equity (millions)	450	60403	450	51319	2.06[a]
FORS	450	6.74	450	6.90	-0.37
MTB	450	5.17	450	98.85	-1.21
LEV	450	0.39	450	0.38	0.70
ROA	450	0.04	450	0.02	2.03[b]
Stock return	450	0.15	450	0.21	-0.70
COVEARN	450	0.41	450	-0.15	1.38
PFUND	450	0.76	450	0.85	-5.12[a]
Total value of Hedging	450	206.5	450	323.3	-0.96

PANEL C: GAAP quality	IFRS firms		US GAAP firms		Diff
	N	Mean	N	Mean	
Annualised stock return volatility	296	0.147	605	0.381	-8.49[a]
Total assets (in millions)	296	71787	605	29840	14.37[a]
Market value of equity (millions)	296	61796	605	52922	1.91[b]
FORS	296	51.7	605	7.62	-5.53[a]
MTB	296	6.23	605	74.32	-0.83
LEV	296	0.386	605	0.382	0.24
ROA	296	0.02	605	0.04	-2.31b
Stock return	270	0.147	604	0.195	-0.45
COVEARN	295	0.425	600	-0.019	1.02
PFUND	279	0.733	605	0.843	-6.43[a]
Total value of Hedging	296	269.4	605	253.3	0.11

Note: This table provides descriptive statistics on the independent variables for the pooled samples of US firms (Panel A) and EU firms (Panel B), relating to four fiscal years, 2005-2009.
Variable definitions:

SD = Standard deviation of firm stock returns, calculated daily over one year
SIZE = Market value of equity of stock as at 31 December or total assets in millions at 31 December.
MTB = Ratio of book value of common equity to market value of equity
LEV = Leverage ratio, equals long term debt divided by long term debt plus common equity
FORS = number of overseas identified operations
COVEARN = coefficient of variation for EBIT over past 3 years.
PFUND = Ratio of market value of firm's sponsored defined benefit pension fund assets to projected benefit obligation
TVH = fair value of hedged foreign exchange and interest rate derivatives

Table 4
Correlations among Independent Variables

PANEL A: ERM firms (Pooled 2005-2010: n = 218)

Variable	ROA	Lev	LnTA	LnMTB	lnBus	LnSdy	Pfund	HedgeNL	HedgeFV	Coefop
ROA	1									
Lev	0.289	1								
LnTA	-0.038	0.259	1							
LnMTB	0.201	0.011	-0.309	1						
lnBus	0.080	-0.015	0.188	0.039	1					
LnSdy	-0.090	-0.018	-0.040	0.011	-0.170	1				
Pfund	0.226	0.266	0.054	0.088	-0.100	0.094	1			
HedgeN	0.286	0.070	0.083	-0.083	-0.035	0.104	-0.008	1		
HedgeF	0.155	0.079	0.056	0.081	0.020	-0.015	0.095	0.030	1	
Coefop	-0.004	-0.072	0.001	-0.073	-0.040	0.009	-0.063	0.010	-0.018	1

PANEL B: Non-ERM firms (Pooled 2005-2010: n = 681)

Variable	ROA	Lev	LnTA	LnMTB	lnBus	LnSdy	Pfund	Coefop	HedgeNL	HedgeFV
ROA	1									
Lev	0.210	1								
LnTA	0.005	0.127	1							
LnMTB	0.050	0.213	-0.250	1						
lnBus	-0.025	-0.152	0.023	-0.026	1					
LnSdy	-0.080	-0.001	-0.112	-0.023	-0.156	1				
Pfund	0.061	0.103	-0.134	0.161	0.002	0.008	1			
Coefop	0.011	0.010	-0.020	0.046	0.034	-0.084	0.028	1		
HedgeN	-0.014	0.017	0.122	-0.040	-0.004	-0.006	-0.092	0.015	1	
HedgeF	-0.008	0.053	0.036	0.044	0.126	-0.019	0.080	0.008	0.020	1

Table 5
Logistic Regression of Decision to Use Derivatives: Breakdown by Type of Derivative

PANEL A: Determinants of ERM adoption (fair values)

	(FV Hedging only)		(FV Hedging and Trading)	
Variable	Coeff	p-value	Coeff	p-value
SIZE	0.062	0.580	0.038	0.728
TvH	0.399	0.030	0.349	0.320
NoFors	0.404	0.001	0.419	0.001
Ln(sdvolatility)	0.051	0.268	0.046	0.315
GAAP quality	0.087	0.695	0.038	0.864
Pfund	0.824	0.056	0.858	0.047
PseudoR2		25.604		21.900
Wald chi-squared		0.034		0.029

PANEL B: Determinants of ERM adoption (notional values)

Variable	(Notional value - Hedging only)		(Notional value Hedging & Not for Hedging)	
	Coeff	p-value	Coeff	p-value
SIZE	0.062	0.575	0.043	0.698
TvH	0.001	0.660	0.001	0.122
NoFors	0.426	0.001	0.424	0.001
Ln(sdvolatility)	0.045	0.323	0.037	0.418
GAAP quality	0.002	0.992	0.041	0.848
Pfund	0.942	0.030	0.978	0.025
PseudoR^2		3.097		25.482
Wald chi-squared		0.031		0.034

Note: This table reports the results of the logistic regressions used to test hypothesis 1 (model equation 2.1) which predicts that the propensity of firms to adopt ERM is related to firm risk and complexity, as well as various other firm-specific risk and financial characteristics. Panel A reports the regression where derivative exposure is measured at fair value; Panel B where derivative exposure is measured at notional value. All data is based on 900 firm yearly observations for the period 2005-2009
GAAP quality = 1 if US GAAP, 0 if IFRS
ERM = 1 if firm has ever adopted ERM, 0 otherwise
SIZE = Market value of equity of stock as at 31 December
BTM = Ratio of book value of common equity to market value of equity
LEV = Leverage ratio, equals long term debt divided by long term debt plus common equity
NOFORS = number of non-domestic sales centres
PFUND = Ratio of market value of firm's sponsored defined benefit pension fund assets to obligation
TvH = total value of hedged transactions (either Fair value (Panel A) or notional value (Panel B))

Level of significance:
* significant at the 0.1 level
** significant at the 0.05 level
*** significant at the 0.01 level

Table 6
Determinants of volatility of stock return and impact of ERM and Derivatives Usage by Type of Derivative: OLS Regression

PANEL A: fair values

	(Hedging Only)		(Unhedged Only)		(Hedged and unhedged)	
Variable	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
GAAP quality	1.566	0.001	1.564	0.001	1.566	0.001
ERM firm	0.145	0.396	0.149	0.380	0.145	0.392
SIZE	0.056	0.526	0.058	0.511	0.056	0.525
Inverse mills ratio	0.519	0.019	0.520	0.019	0.520	0.119
TvH	0.001	0.826	-0.001	0.735	0.006	0.859
Nofors	-0.071	0.001	-0.071	0.001	-0.071	0.001
MTB	-0.067	0.422	-0.065	0.443	-0.058	0.421
Lev	-0.078	0.745	-0.080	0.740	-0.077	0.749
Covarearn	-0.018	0.080	-0.018	0.080	-0.018	0.080
Pension fund	0.119	0.715	0.124	0.703	0.119	0.714
F-statistic		14.201		14.209		14.199
Adj R2		0.152		0.152		0.152

PANEL B: notional values

	(Hedging Only)		(unhedged Only)		(Hedged and unhedged	
Variable	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
GAAP quality	1.693	0.001	1.564	0.001	1.594	0.001
ERM firm	0.130	0.442	0.147	0.385	0.118	0.485
SIZE	0.047	0.592	0.058	0.515	0.042	0.630
InvMills ratio	0.059	0.018	0.523	0.018	0.515	0.020
TvH	0.008	0.017	-0.004	0.916	0.006	0.014
Nofors	-0.07	0.001	-0.071	0.001	-0.070	0.001
MTB	-0.061	0.364	-0.067	0.427	-0.050	0.476
Lev	-0.088	0.713	-0.075	0.754	-0.084	0.724
Covarearn	-0.020	0.074	-0.018	0.080	-0.019	0.072
Pfund	0.153	0.635	0.123	0.705	0.147	0.648
F-statistic		14.883		14.196		14.925
Adj R^2		0.158		0.152		0.159

Table Note: This table reports the results of second stage OLS regressions used to test hypothesis 2 (model equation 2.2) which predicts a positive association between the firm's volatility of stock return and the lagged effect of ERM adoption, controlling for, and various other firm-specific risk and financial characteristics. Panel A reports the regression where derivative exposure is measured at fair value; Panel B where derivative exposure is measured at notional value. All data is based on 900 firm yearly observations for the period 2005-2009

GAAP quality = 1 if US GAAP, 0 if IFRS
ERM = 1 if firm has ever adopted ERM, 0 otherwise
SIZE = Market value of equity of stock as at 31 December
BTM = Ratio of book value of common equity to market value of equity
LEV = Leverage ratio, equals long term debt divided by long term debt plus common equity
NOFORS = number of non-domestic sales centres
PFUND = Ratio of market value of firm's sponsored defined benefit pension fund assets to obligation
Covearn = coefficient of variation of earnings before interest and taxes over past five years
InvMill = inverse mills ratio based on the predicted probability from the probit first stage regression
TvH = total value of hedged transactions (either Fair value (Panel A) or notional value (Panel B))

Table 7
Determinants of risk to reward ratio and impact of ERM and Derivatives Usage by Type of Derivative: OLS Regression

PANEL A: fair values

	Year 1		Year 2		Year 3	
Variable	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
GAAP quality	-2.202	0.001	-2.201	0.001	-2.269	0.001
ERM firm	1.049	0.143	1.053	0.137	0.940	0.186
Yr 1 implement	0.227	0.767				
Yr 2 implement			0.645	0.381		
Yr 3 implement					-1.126	0.146
Size	-0.218	0.555	-0.221	0.548	-0.185	0.614
Inverse mills ratio	-0.698	0.449	-0.700	0.448	-0.726	0.430
TvH	0.001	0.151	0.001	0.217	0.001	0.169
Nofors	-0.045	0.361	-0.044	0.363	-0.031	0.522
MTB	0.542	0.121	0.523	0.136	0.590	0.093
Lev	1.095	0.274	1.102	0.270	1.120	0.262
Covearn	-0.002	0.955	-0.003	0.950	-0.002	0.961
Pfund	2.398	0.077	2.303	0.090	2.755	0.046
F-statistic		2.806		2.178		2.294
Adj R2		0.035		0.035		0.021

PANEL B: notional values

	Year 1		Year 2		Year 3	
Variable	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Variable	-2.157	0.002	-2.138	0.002	-2.203	0.001
GAAP quality	1.042	0.145	1.016	0.150	0.919	0.194
ERM firm	0.349	0.650				
Yr 1 implement			0.679	0.356		
Yr 2 implement					-0.999	0.193
Yr 3 implement	-0.244	0.510	-0.258	0.484	-0.224	0.544
Size	-0.639	0.488	-0.678	0.460	-0.594	0.450
Inverse mills ratio	0.002	0.044	0.002	0.043	0.005	0.046
TvH	-0.035	0.475	-0.038	0.428	-0.027	0.575
Nofors	0.592	0.090	0.579	0.098	0.643	0.057
MTB	1.120	0.262	1.099	0.271	1.123	0.260
Lev	-0.004	0.923	-0.004	0.921	-0.004	0.932
Covearn	2.616	0.053	2.498	0.064	2.923	0.034
F-statistic		2.345		2.401		2.474
Adj R2		0.021		0.022		0.023

Table Note: This table reports the results of second stage OLS regressions used to test hypothesis 3 (model equation 4) which predicts a positive association between the firm's risk-reward ratio and the lagged effect of ERM adoption, controlling for, and various other firm-specific risk and financial characteristics Panel A reports the regression where derivative exposure is measured at fair value; Panel B where derivative exposure is measured at notional value. All data is based on 900 firm yearly observations for the period 2005-2009.
GAAP quality = 1 if US GAAP, 0 if IFRS
ERM = 1 if firm has ever adopted ERM, 0 otherwise
Yr 1 implement = 1 if firm has adopted ERM in 2007
Yr 2 implement = 1 if firm has adopted ERM in 2008, 0 otherwise
Yr 3 implement = 1 if firm has adopted ERM in 2009, 0 otherwise
SIZE = Market value of equity of stock as at 31 December
BTM = Ratio of book value of common equity to market value of equity
LEV = Leverage ratio, equals long term debt divided by long term debt plus common equity
TvH = total value of hedged transactions (either Fair value (Panel A) or notional value (Panel B))
NOFORS = number of non-domestic sales centres
PFUND = Ratio of market value of firm's sponsored defined benefit pension fund assets to obligation
Covearn = coefficient of variation of earnings before interest and taxes over past five years
InvMill = inverse mills ratio based on the predicted probability from the probit first stage regression