The Effect of Hedging on Firm Value and Performance: Evidence from the Nonfinancial UK Firms

Hany Ahmed*, Alcino Azevedo[1,]*, Yilmaz Guney*

*Hull University Business School
Cottingham Road, Hull HU6 7RX, UK

Abstract

We examine the effect of hedging with financial derivatives on firm value and financial performance, relying on a new dataset which comprises information on 288 nonfinancial firms listed in the FTSE-All share index at the London Stock Exchange (LSE) over the time period of 2005-2012. We focus on the hedging of the foreign exchange, interest rate and commodity price risks with futures, forward, option and swap contracts. Our findings show that the effectiveness of the risk management practices varies significantly across the financial risks and the derivative used for hedging. For instance, we find that the relationship between interest rate risk hedging and firm financial performance is negative for the overall hedging but positive for the hedging with forward contracts. Some of our results contradict previous findings reported in the literature which suggest that there is a positive association between hedging and firm value and financial performance. Also, we find that the 2008-2009 financial crisis did not affect significantly the established risk management practices and firm's commitment to financial risk hedging with derivatives.

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[1] Corresponding author: e-mail: a.azevedo@hull.ac.uk, tel.: +44(0)1482463107, fax: +44(0)1482463484.

1. Introduction

Strategic risk management has grown in importance in the last decades, moving from pure risk mitigation to value creation. The financial crisis of 2008-2009 has brought new scrutiny to the use of financial derivatives. The problems of the financial crisis were routed in the opaquely structured securitized U.S. mortgages whose ratings did not reflect the risk undertaken by the mortgage-backed security holders. The U.S. housing burst led the financial system to the verge of collapse, which caused the yet not fully resolved economic downturn. This damaged severely the reputation of the banking industry and created the perception that financial derivatives might be harmful tools, supporting Warren Buffet's view that "derivatives are financial weapons of mass destruction".[2]

Nevertheless, the derivatives that have caused most damage during the economic downturn have been those held by financial institutions. With few exceptions,[3] nonfinancial firms have dealt well with the derivatives securities held, which reinforces the view expressed in previous literature that nonfinancial firms use derivatives mostly for hedging.

Nonfinancial firms engage in risk management on a regular basis, as documented in surveys and annual reports. Yet, according to Modigliani and Miller (1958), investors can replicate whatever risk management strategy firms decide to follow and, if so, there is no need for hedging financial risks. Risk management theories (e.g., Smith and Stulz, 1985; Bessembinder, 1991; Froot et al., 1993; and Leland, 1998; Allayannis and Weston, 2001; and Carter et al., 2006) advocate, however, that, due to capital market imperfections, the use of derivatives for risk management strategies can affect firm value - for instance, by reducing expected taxes and financial distress costs, mitigating underinvestment and increasing debt capacity to take advantage of debt tax-shields.[4]

More recently, Aretz and Bartram (2009) provide empirical evidence and further theoretical arguments which support the view that hedging can create value. There are also studies which show that the effect of hedging on firm value is country-related and depends on the industry, firm size and degree of business geographic diversification, as well as on the holdings on

[2] See "Chairman's Letter to Shareholders, Berkshire Hathaway Inc, 2002 Annual Report.

[3] See, for instance, the case of Aracruz Celulose, a Brazilian firm, that reported US$2.1 billion losses due to exchange rate trading in the third quarter of 2008 (Zeidan and Rodrigues, 2013).

[4] Allayannis and Weston (2001) and Carter et al. (2006) study the effect of hedging on value; Smith and Stulz (1985) and Leland (1998) investigate the effect of hedging on debt capacity; Froot et al. (1993) examine the effect of hedging on investment policies.

liquid assets and operating hedging, and dividend policy and debt level and maturity (see, for instance, Bodnar et al., 2003).

With few exceptions, the literature has focused on the nonfinancial-non-public sector,[5] mostly examining, theoretically and or empirically, whether a specific risk or derivative-related hedging strategy affects firm value (e.g., Booth et al., 2004; Block and Gallagher, 1986; Bessembinder, 1991; Bartram, 2006; David et al., 2006; Bartram and Bodnar, 2007; Bartram et al., 2009; Allayannis et al., 2012);[6] or whether business geographic diversification affects the use of derivatives and, consequently, firm value (e.g., Berger and Ofek, 1995; Allayannis and Weston, 2001; Bartram et al., 2011; and Allayannis et al. 2012).

Tufano (1996), Haushalter (2000, 2001), Carter et al. (2006), Jin and Jorion (2006), Mackay and Moeller (2007) examine the association between the use of derivatives and value creation for specific industries.[7] For the airline industry, Carter et al. (2006) show that firms can benefit from following appropriate hedging strategies and firm value is positively associated with the "intensity" of hedging; for the oil and gas industry, Jin and Jorion (2006) investigate the effect of hedging on firms value and find out that there is no difference between hedgers and non-hedgers; for the oil refinery industry, Mackay and Moeller (2007) reports evidence that "hedging concave revenues leaving concave costs exposed each represent between 2% and 3% of the firm value".

Furthermore, Borokhovich et al. (2004) study the effect of outside directors on firms' commitment to the interest rate risk hedging, and Dhanani et al. (2007), relying on a questionnaire sent to 564 nonfinancial UK listed firms, investigate whether tax and regulatory arbitrage, managing the variability of reported earnings, managerial incentives, economies of scale and lowering the likelihood of financial distress are amongst the relevant reasons justifying managers' choices regarding interest rate risk hedging.

More recently, Bartram et al. (2011), based on a sample which includes 6,888 nonfinancial firms from 47 countries, show that the use of derivatives reduces firm's total risk, is

[5] For a study on the public sector see Brailsford et al. (2005), who examines the derivatives usage for the Australia Commonwealth's public sector.
[6] More specifically, Booth et al. (2004) focus on interest rate futures, Block and Gallagher (1986) on interest rate futures and options, Bessembinder (1991) on forward contracts, and Bartram (2006) on options contracts. David et al. (2006) study commodity price risk hedging and Bartram and Bodnar (2007), Bartram et al. (2009) and Allayannis et al. (2012) foreign exchange risk hedging.
[7] Tufano (1996) focuses on the gold mining industry, Jin and Jorion (2006), Mackay and Moeller (2007) on the oil industry, Haushalter (2000, 2001) on the oil and gas industry, and Carter et al. (2006) on the airline industry.

positively associated with firm value and is more prevalent in firms with higher exposures to interest rate, exchange rate and commodity prices risks; Allayannis et al. (2012) show that the use of derivatives for exchange rate risk hedging is associated with a significant value premium for firms where there is a strong internal (firm-level) or external (country-level) governance; and Perez-Gonzalez and Yun (2013) show that the use of weather derivatives is positively associated with firm value.

Despite the progress made, we have yet little theoretical explanation power to identify which firms ought to use derivatives. It is possible that the motivation for risk management may be due to factors not yet considered in risk management theories, such as earnings smoothing, industry competition, manager's self-interest, speculative purposes[8] or signalling,[9] which are difficult to study empirically. In addition, most empirical studies fail to account for the endogeneity of variables, which may describe different dimensions of the risk management strategy and financial policies, as stressed by Aretz and Bartram (2009).

There are also studies which provide mixed results on the effect of hedging on firm value and financial performance, for instance, those of Dhanani et al. (2007), which show that the effect of hedging on firm value varies across countries and is affected by the tax regimes and regulatory rules, and Fauver and Naranjo (2010), which reveals that the relationship between hedging and firm value is negative when firms have a weak corporate governance.

Additionally, conventional wisdom says that "mandatory" hedging, for instance through debt covenants, do not help to maximize firm value, yet Marami and Dubois (2012) show that "affirmative" covenants, such as those which require firms to comply with accounting rules, pay taxes and buy insurance, favours value creation and "voluntary" interest rate hedging do not have any effect on firm value; and Betty et al. (2011) show that creditors reward firms' commitment to hedging interest rate by reducing the interest rate charged in credit agreements. Faulkender (2005) report a strong association between the slope of the yield curve and the interest rate risk management; Geczy et al. (2007) show that managers can use derivatives to inflate their performance-based compensation and the information disclosed by firms turns difficult to distinguish between the use of derivatives for speculative and non-

[8] Although in perfect markets one would expect the gains from speculative hedging to be zero or negative - given the transaction cost incurred, Adam and Fernando (2006), Brown et al. (2006) results suggest that the gains from speculating ("selective" hedging) appear small.
[9] During the financial crisis period (2008-09), firms may have used derivatives for signaling investors that their business was protected against unfavorable market moves.

speculative purposes; and Aabo and Ploeen (2013) study the effect of business internationalization on foreign exchange hedging and conclude that higher levels of internationalization can reduce the need for foreign exchange hedging and show that there is an inverse U-shape relationship between internationalization and foreign exchange hedging for large listed nonfinancial German firms.

Our paper is distinct from previous literature in the following aspects: first, it studies simultaneously the usage of four financial derivative (futures -FU, forwards -FO, options -OP, and swaps -SW) for hedging three types of risk: interest rate -IR, foreign exchange rate -FX, and commodity price - CM); second, our data sample comprises information 288 firms over the time period of 2005-2012, regarding both the risks that are hedged and the derivatives used for hedging. Previous studies rely on data samples which focus either on a specific risk, without specifying which derivative(s) is(are) used for hedging, or on specific derivative without specifying for which risk(s) hedging it is used, or on the study of whether the use of derivatives for hedging is associated with firm value and performance, but where the "derivatives use" and "risk" are defined as variables that encompass all types of derivatives and risks, respectively;[10] and third, our regression models control for the 2008-09 financial crisis, a critical analysis which is yet absent from the current literature.

The rest of the paper is organized as follows. Section 2 describes the data sample, provides information on the procedures used to collect data for some regression variables and presents descriptive statistics on the most relevant aspects of the data sample. Section 3 defines the regression of variables and provides theoretical background for their inclusion in our regression analysis. Section 4 presents the regression models and related results. Sections 5 and 6 discuss some econometric concerns regarding our regression models and respective results and appropriate model robustness tests. Section 7 concludes.

[10] There are studies (e.g., Bodnar et al., 2003), which provide statistics on both the usage of several derivatives (forwards, futures, swaps, options and others) for hedging various types of risks (currency risk, interest rate risk and commodity risk), yet these studies have a qualitative nature where respondents are asked to rank the derivatives they use without linking each of the derivative to a specific risk management.

2. Data

2.1 Sample selection

Our data was collected from Thomson Reuters Datastream based on nonfinancial firms in FTSE-All Share Index, with matching hand-collected data from annual reports for the time period of 2005-2012.[11] We focus on nonfinancial firms listed in LSE only - since we wanted to avoid the cases where derivatives are used not for hedging but for speculative purposes. Our initial sample comprised information on 379 firms, yet, neglected 91 of these firms to avoid unbalanced panel dataset, leading to a final sample of 288 firms.[12]

The accounting information regarding hedging starts being more formally disclosed in annual reports in 2005 as a result of the new rules set by the Financial Accounting Standards Board (FASB). Also, since the mid of 2004, according to the FASB IAS 39 rules, firms were required to distinguish accounting information regarding hedging-related transactions from their underlying exposures. The new information disclosure rules (IAS 39), introduced more transparency, particularly in the reporting of derivatives usage and related risk management policies.

For each firm, we collect information on the types of risks she hedges and the derivatives used for hedging. This information is disclosed in annual reports through risk management related notes. Firms which do not disclose any risk management related information on the “Financial Instruments” or “Risk Management Policy” sections of their annual reports are classified as non-hedger for that year. Firms that disclose information which reveals they have used derivatives for hedging foreign exchange rate, interest rate and commodity prices risks are classified as foreign exchange hedgers (FXH), interest rate hedgers (IRH) or commodity price risk hedgers (CMH), respectively.

2.2 Variable description and descriptive statistics

Table 1 defines our regression variables (including the dummy variables), introduces the notation used in the paper for each of the regression variables, and states the data sources. Further information regarding some of these variables is provided in the next sections.

[11] The information on the usage of derivatives for hedging was hand-collected from annual reports.

[12] Since 2005 the quality of the information on hedging policies and usage of derivatives has improved significantly, but in the first years of our dataset time period this information regarding some firms and years was scarce.

[Insert Table 1]

Table 2 provides a descriptive statistics of our sample. Paned A refers to full sample which encompasses 2,304 observations, and panels B and C refer to firms with and without business abroad, respectively, with 1,855 and 449 observations respectively - firms with business abroad account for about 80.5% of total sample. The last column states the differences between the Panels B and C means which are statistically at 1% level for most of the variables. The proportion of the hedgers in the full sample is very similar to the proportion of hedgers in the samples which considers only the firms with business abroad or only the firms without business abroad - ranging between 82.1% and 84.2%.

Panel A shows that the percentage of the firms that use derivatives for hedging the foreign exchange, interest rate and commodity price risks are, respectively, 68.1%, 63.8% and 14.0%. These percentages change a little when we restrict the sample to the firms which have business abroad (panel B) - where the FXH increases significantly to 75.5%, the IRH decreases to 59.9% and the CMH increases slightly to 15.3% - and have not business abroad - where the FXH decreases significantly to 37.2%, the IRH increases significantly to 79.7% and the CMH decreases significantly to 8.7%. These differences are statistically significant at 1% level.

[Insert Table 2]

We split our sample into hedgers and non-hedgers depending on whether firms use financial derivatives (e.g., futures, forwards, options and swaps contracts) for hedging (e.g., hedging the foreign exchange, interest rate or commodity prices risks). Panel A states the percentage of hedgers and non-hedgers for the overall sample and each specific risk-related hedging (e.g., foreign exchange, interest rate and commodity prices risks) for the time period between 2005 and 2012. There is an increase in the percentages of FX, IR and CM hedgers, from 60.8% to 72.2%, from 59.7% to 63.2% and 12.5% to 15.3%, respectively.

Panel B reports information on the types of derivatives used for hedging each risk, which show that, for FX risk hedging, the most popular derivative used is the forward contract, followed by the swap and option contracts - futures contracts are only marginally used; for IR hedging, the most popular derivative used is the swap contract, followed by the option and forward contracts, respectively - again, futures contracts are only marginally used; for CM risk hedging, the most popular derivative used is the forward contract, followed by the swap, options and futures contracts, respectively. Over time, there is small but consistent increase in the use of forwards and swaps contracts for FX risk hedging - the use of futures and options contracts is more or less stable; there is an increase in the use of swap contracts and decrease in the used of option contracts for IR hedging - the use of futures and forwards contracts is more or less constant; and there is an increase in the use of forwards contracts for CM risk hedging - the use of futures, options and swap contracts is more or less constant.

[Insert Table 3]

Table 4 presents information for the time period between 2005 and 2012 regarding the number of hedgers (H>0) and non-hedgers (H=0) for the subsamples which consider firms with business abroad (GEO>0) or firms without business abroad (GEO=0) only. The results show that over time the percentage of hedgers with business abroad increased from 58.7% to 70.1% whereas the percentage of non-hedgers with business abroad declined from 19.8% to 12.2%. In contrast, the percentage of hedgers without business abroad increased from 16.7% in 2005 to 18.1% in 2007, and decreased to 14.9% in 2012, whereas the percentage of non-hedgers without business abroad declined from 4.9% to 2.8%.

Also, 80.5% of the firms of our sample have business abroad yet only 66.1% of our sample firms do hedge. Also, 19.5% of the firms of our sample do not have business abroad but only 16.4% are non-hedgers. This means that there are 16.4% of the firms of our sample which do not have business abroad but do hedge and 3.1% of our sample firms which do not have business abroad but do hedge. Finally, there is no evidence that the 2008-2009 financial crisis has led to significant changes in firms' behaviour regarding the use of derivatives for hedging.

[Insert Table 4]

Table 5 shows the pair-wise correlation matrix among our model regression variables. The correlation coefficients between some of the explanatory variables and the dependent variables are reasonable good, which indicates the relevance of those variables in affecting the value and performance and measures, although this is a univariate analysis. The interrelationships among these dependent variables are very strong, which implies that these proxies are consistent with one another.

[Insert Table 5]

3. Variable definitions

3.1 Dependent variables

This section presents the dependent variables we use for studying the effect of the use of derivatives on FX, IR and CM risk hedging. In line with the previous literature,[13] we use return on invested capital (ROIC) and return on assets (ROA) as proxies for the financial performance, and Tobin's Q as a proxy for firm value - following Allayannis and Weston (2001), Pramborg (2004), Mackay and Moeller (2007), Clark and Judge (2009), Jiao (2010), and Allayannis et al. (2012). As the distribution of Tobin's Q in our sample is skewed, we use the natural logarithm of Tobin's Q.[14] Below we provide further details the dependent variables of our regression models.

Return on Invested Capital (ROIC): we measure ROIC as earnings before finance costs and tax divided by the average of last year's and current year's total capital plus short term debt ad current portion of long term debt. This measure takes into account the book value of capital invested in existing assets, and we assume that the book values of debt and equity measure effectively the invested capital. Thus, the market value of invested capital will be inappropriate for firm operating performance measures in benchmarking with ROA results.

Return on Assets (ROA) is computed as earnings before finance costs and tax divided by the book value of total assets.

Tobin's Q is total assets less book value of equity plus market value of equity, scaled by the book value of assets.

3.2 Explanatory variables

In line with previous literature, we use the following variables in our regression models:[15]

Foreign exchange rate hedge: Allayannis and Weston (2001) find that the use of foreign exchange derivatives (FXH) in large U.S. nonfinancial firms has a positive relation with firm

[13] This is a common practice in the literature - see, for instance, Becher et al. (2011) and Perez-Gonzalez and Yun (2013).
[14] See, for instance, Allayannis and Weston (2001), Jiao (2010), and Allayannis et al. (2012).
[15] See, for instance, Allayannis and Weston (2001), Mackay and Moeller (2007), Becher et al. (2011), and Allayannis et al. (2012).

value. Allayannis et al. (2012) also report strong evidence that the use of foreign exchange derivatives for firms that have strong internal firm-level or external country-level governance is associated with a significant value premium. Bartram et al. (2011) show that the usage of effect of derivatives on firm value is statistically significant and positive, yet sensitive to the endogeneity problem.

Interest rate hedge: Allayannis et al. (2012) study the effect of interest rate and foreign exchange hedging on firm value across countries.

Commodity price hedge: Bartram et al. (2009) study the usage of derivatives for hedging the FX, IR and CM risks so as to investigate the determinants of hedging policies. Notice that while they focus on the use of derivatives for hedging different types of risks, without specifying which derivative(s) firms used for hedging each specific risk, we study the effect of the use of different types of derivatives for hedging specific financial risks.

Firm size: firm size is a factor commonly used to characterize firms, which can be strongly related with the firm value.[16] As proxy for firm size we use the natural logarithm of total assets and expect that small firms are less active in hedging.

Firm age: we use “natural logarithm of the firm’s age” for firm age. Following Bartram et al. (2011) results, we expect that new incorporated listed firms will be less active in hedging.

Leverage: we compute leverage as “total debt divided by total assets”. Purnanandam (2008) find a positive relation between leverage and foreign exchange hedging and leverage and commodity price hedging when financial distress costs hold, and Allayannis and Weston (2001) find a negative relation between leverage and firm value. Therefore, we expect a negative correlation between leverage and value creation.

Dividends: we use a dummy variable to control for dividend policy, which equals “1” if there are dividend payments and “0” otherwise. We expect a strong relation between firm value and dividend payments.[17]

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[16] See Allayannis and Weston (2001), and Pramborg (2004). Alkeback and Hagelin (1999) found that the use of derivatives is to be more common among large firms than medium or small firms.

[17] See Perez-Gonzalez and Yun (2013) who investigated risk management and firm value with regards to performance and capital structure. Their results estimate difference in firms’ value in related to dividend/asset ratio.

Investment growth: we use two ratios as proxies for growth: capital expenditures to total assets and R&D expenses to total assets - following Chernenko and Faulkender (2011).

Business diversification: we contend that firms with more diversified business are more likely to hedge. We use a dummy variable to control for business diversification, which equals "1" if firms operate in more than one business segment and "0" otherwise.

Geographical diversification: we conjecture that firms operating in a higher number of geographical locations are more likely to use derivatives.[18] We use a dummy variable to control for the extent of geographical diversification, which equals "1" if firms have business abroad and "0" otherwise.

Financial crisis: we control for the effect of financial crisis time-period using dummy variable, which equals "1" for the time period of 2008-09 and "0" otherwise.

Time effects: we use year dummies to control for time-fixed effects for 2005-2012.

Sector effects: we control for sector-fixed effects through industry indicator variables based on two-digit Standard Industrial Classification (SIC) codes. The firms' industrial codes have been converted into an index taking values which range from 1 to 9.

4. The regression models and results

4.1. The models

We test the impact of the use of derivatives on firm value and performance using the regression models below, where *t* refers to "time" and *i* to "firm":

$$Y_{i,t} = \alpha + \theta_1 FXH_{i,t} + \theta_2 IRH_{i,t} + \theta_3 CMH_{i,t} + \beta X'_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $Y_{i,t}$ represents the ROIC, ROA and Tobin's Q; α is the constant term; $FXH_{i,t}$, $IRH_{i,t}$ and $CMH_{i,t}$ are hedging dummy variables which equal "1" if firms hedge foreign exchange, interest rate or commodity price risks, respectively, and "0" otherwise; θ_1, θ_2, θ_3 and β are the regression coefficients to be estimated; X' is a vector which represents a set of firm-related control variables - size, age, leverage, dividends, investment growth, business diversification,

[18] Pramborg (2004) suggests that firm value is positively related to geographical diversification and firms' net long positions in foreign currency.

geographical diversification - and a control variable to account for hedging during the financial crisis; and $\varepsilon_{i,t}$ is the regression error term.

$$Y_{i,t} = \alpha + \theta_1 FXFU_{i,t} + \theta_2 FXFO_{i,t} + \theta_3 FXOP_{i,t} + \theta_4 FXSW_{i,t} + \beta X'_{i,t} + \varepsilon_{i,t} \quad (2)$$

where $FXFU_{i,t}$, $FXFO_{i,t}$, $FXOP_{i,t}$ and $FXSW_{i,t}$ are dummy variables which equal "1" if firms hedge foreign exchange risk with futures, forwards, options or swaps contracts, respectively, and "0" otherwise.

$$Y_{i,t} = \alpha + \theta_1 IRFU_{i,t} + \theta_2 IRFO_{i,t} + \theta_3 IROP_{i,t} + \theta_4 IRSW_{i,t} + \beta X'_{i,t} + \varepsilon_{i,t} \quad (3)$$

where $IRFU_{i,t}$, $IRFO_{i,t}$, $IROP_{i,t}$ *and* $IRSW_{i,t}$ are dummy variables which equal "1" if firms hedge interest rate risk with futures, forwards, options or swaps contracts, respectively, and "0" otherwise.

$$Y_{i,t} = \alpha + \theta_1 CMFU_{i,t} + \theta_2 CMFO_{i,t} + \theta_3 CMOP_{i,t} + \theta_4 CMSW_{i,t} + \beta X'_{i,t} + \varepsilon_{i,t} \quad (4)$$

where $CMFU_{i,t}$, $CMFO_{i,t}$, $CMOP_{i,t}$ and $CMSW_{i,t}$ are dummy variables which equal "1" if firms hedge commodity price risk with futures, forwards, options or swaps contracts, respectively, and "0" otherwise.

$$Y_{i,t} = \alpha + \theta_i FX(derivatives)_{i,t} + \theta_i IR(derivatives)_{i,t} + \theta_i CM(derivatives)_{i,t} + \beta X'_{i,t} + \varepsilon_{i,t} \quad (5)$$

where $FX(derivatives)_{i,t}$ is "1" if firms hedge *foreign exchange* risk with *future, forward, option*, or *swap*, respectively, and "0" otherwise; $IR(derivatives)_{i,t}$ is "1" if firms hedge *interest rate* risk with futures, forwards, options or swaps contracts, respectively, and "0" otherwise; $CM(derivatives)_{i,t}$ is "1" if firms hedge commodity price risk with futures, forwards, option or swaps contracts, respectively, and "0" otherwise.

4.2. The regression results

Table 6 presents the OLS regressions for the impact of the use of derivatives on firms' financial performance (e.g., models 1 to 5 for the ROIC and models 6 to 10 for the ROA). Model 1 studies the effect of hedging FX, IR and CM risks on firm value, without accounting for which type(s) of derivatives is(are) used; Models 2, 3 and 4 studies separately the effect of the use of specific derivatives for hedging different types financial risk on firm value; and model 5 studies altogether the effect of the use of specific derivatives for hedging different types of financial risks.

The results from model 1 show that firms' financial performance is positively associated with foreign exchange hedging, negatively associated with interest rate hedging and positively associated with CM hedging, the former two are statistically significant at 5% and 1%, respectively, and the latter is not statistically significantly. Note that in this analysis we control for several relevant firms' characteristics and for the time and industry fixed effects. These findings suggest that the relationship between hedging with derivatives and firm's financial performance depends on the type of risk that is hedged.[19]

The results from model 2 show that the coefficient for the FX risk hedging with forward contracts is positive and statistically significant whereas the coefficients for the FX risk hedging with the other two derivative contracts are insignificant. The results from model 3 reveal that the coefficients for the IR risk hedging with futures, options and swaps contracts are negative and statistically significant whereas the coefficients for the IR risk hedging with forwards is positive and statistically significant. These are very interesting findings since they reveal that hedging IR risk with forward contracts can increase firms' financial performance whereas hedging with futures, options and swaps destroys value. The results from model 4 show that the coefficient for CM risk hedging with swap contracts is positive and statistically significant whereas the coefficients for the CM risk hedging with futures, forwards and options are insignificant. In model 5 we combine models 2, 3 and 4, yet, the quality of the results does not change, except for the IR hedging with futures coefficient, which becomes insignificant.

Focusing now on the effect of hedging with derivatives on firms' financial performance but using the results for the ROA measure (see columns 7 to 11 of table 6), we find that our findings for the ROIC do not change qualitatively, except for the coefficients of IR risk hedging with futures contracts, which for model 10 (compared to for model 5) becomes significant, and the coefficients for CM risk hedging with swap contracts, which for models 9 and 10 (compared with for models 4 and 5) becomes insignificant.

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[19] Li and Yu's (2010) findings suggest that the usage of derivatives is a double-edged sword. See also Chen (2011) for the findings of derivatives use and performance.

[Insert Table 6]

Table 7 reports results on the effect of hedging with derivatives on firm value using Tobin's Q.[20] Models 1-5 control for firm's characteristics, e.g., profitability, size, age, leverage, dividends, investment growth, financial crisis hedging, and business diversification, business geographic diversification, financial crisis period and year and industry fixed effects.

More specifically, model 1 results show that FX and CM risk hedging are positively associated and IR risk hedging is negatively associated with firm value, with all coefficients statistically significant. These results are qualitatively similar to those we attain for the relationship between hedging with derivatives and firm financial performance - see model 1, table 6. Model 2 results show that hedging FX risk with forwards is positively associated with firm value and hedging FX risk with options is negatively associated with firm value, being the results for hedging FX risk with futures and swap contracts insignificant. Model 3 results show that hedging IR risk with futures, options and swap contracts is negatively associated with firm value and hedging IR risk with forwards is positively associated with firm value - with all coefficients statistically significant. Model 4 results show that hedging CM risk with futures, options and swap contracts is positively associated with firm value and statistically significant, whereas the coefficient for hedging the CM risk with forward contracts is insignificant. Finally, considering all risks and financial derivatives together (see model 5, table 7) we conclude that qualitatively the results do not change, except the coefficient for hedging FX risk with futures, which becomes significant, and the coefficient for hedging IR risk with futures, which becomes insignificant. Most of the control variables used in models 1-5 are statistically significant and the R^2 ranges between 33% and 34%, which is high relatively to those of models 1-10 of Table 6.

[Insert Table 7]

5. Endogeneity and self-selection bias

5.1. Endogeneity

Some of the factors considered in our regression models can impact both hedging policies and strategies and firm value and financial performance. To address this endogeneity problem

[20] Regarding using Tobin's Q as a proxy for firm value, we follow the methodology of Pramborg (2004), Mackay and Moeller (2007), Jiao (2010), and Allayannis et al. (2012).

stemming from omitted variable case, our regression models are estimated by the two-stage least squares instrumental variables (IV) approach with a generalized method of moments (2SLS-GMM), which can also account for potential heteroskedasticity and autocorrelation misspecifications. In the first stage, we run a regression model for each specific financial risk (e.g., FX, IR and CM risk) which provides information on the factors affecting the usage of the different types of derivatives with some exogenous variables and external instruments.[21] In the second stage, we use the fitted values obtained from the first stage, which inform us of the probability of the usage of each derivate, as instruments to proxy for the use of the corresponding derivative usage. These results are reported in Table 8.

The *F-statistics* and R^2 values for the first-stage estimations for ROIC and Tobin's Q confirm that the models are quite fitted. For the second-stage estimations, we report several statistics for diagnostic tests (i.e., under-identification, weak identification, Hansen J statistic and C statistic) which confirm the validity of the instruments - they satisfy the relevance and exclusion conditions.

First, the LM test of under-identification is reported to check whether the regression model is identified and excluded instruments are relevant in the second stage. We reject the null hypothesis that the model is under-identified. Second, the Wald F statistics of weak identification tests indicate that the excluded instruments are correlated with the endogenous regressors but only weakly. Third, Hansen J statistic is used to test the validity of all instruments. We reject the null hypothesis about the validity of instruments in both of second-stage models of Table 8 which suggests that at least one of our instruments is not valid. Fourth, Hayashi's C statistic (known as "difference-in-Sargan statistic") tests a subset of the orthogonality conditions for suspected exogenous variables including the control variables. For C statistics, we consider the variables leverage, dividends, investment growth and diversification policy. We reject the relevant null hypothesis stating that the specified variables are proper instruments in both of second-stage models of Table 8. These diagnostics suggest that a better set of instruments could enhance the robustness of the results.

[21] The instrumental variables employed are as follows: foreign sales ratio, foreign expenditures and multinational segments are relevant IVs for foreign exchange rate risk hedging (FXH); floating rate and fixed rate debts are strongly associated with interest rate risk hedging (IRH); commodity purchase, commodity raw materials and commodity oil & gas, mining, energy supplier are associated with commodity price risk hedging (CMH). We expect a positive relation between the selected IVs and the corresponding FXH, IRH and CMH variables.

Nevertheless, the 2SLS-GMM estimations in Table 8 suggest that the use of derivatives (any type) has no significant effect on firm's financial performance and, on the other hand, firm value is significantly and positively (negatively) associated with hedging FX (IR) risk with derivatives.

[Insert Table 8]

5.2. Self-selection bias

Another econometric concern arises when the dependent variable and explanatory variable(s) appear related although the source of relationship is not the exogenous causality but self-selection bias, i.e., in essence they are not related. For example, it is possible that firms with high financial performance are likely to employ hedging strategies in order to keep their financial performance. The treatment effect models can potentially address this problem. To this end, we model the decision to hedge FX risk with derivatives as a function of foreign sales ratio, foreign expenditures and multinational segments, hedging IR risk with derivatives as a function of floating rate debt and fixed rate debt, hedging CM risk with derivatives as a function of commodity purchase, commodity raw material, and oil & gas, mining and energy supply. The results are reported in Table 9.

Our results show that for all models FX and CM hedging is positively related with firm and financial performance and IR risk hedging is negatively associated with ROIC and Tobin's Q - with all coefficients significant.

[Insert Table 9]

6. Further robustness checks

We provide further robustness tests using time-series analysis to examine the effect of hedging financial risks with derivatives over time. We replicate our regressions controlling for the firms' characteristics and the financial crisis period so as to study the effect on firm value of the usage of different derivatives. Table 10 reports the results of the time-series variation in the line of time-variant effect of the use of derivatives types, which show that the coefficients for hedging FX risk with futures and swap contracts are negatively associated with annual changes in firm value, the coefficients for hedging FX risk with forward contracts is positively associated with annual changes in firm value, and the coefficients for hedging FX risk with options are insignificant.

[Insert Table 10]

7. Conclusion

This research is distinct from previous literature in several aspects. First, our dataset contains information on both the financial risks that are hedged and the derivative(s) used for hedging. Previous studies rely on datasets which focus either on a specific financial risk, without specifying which derivative(s) is(are) used for hedging, or hedging with a specific derivative without specifying which risk(s) is(are) being hedged, or the usage of derivatives for hedging but where "derivatives" and "hedging" encompass all types of derivatives and risks. Second, we study the individual effect of hedging specific financial risks with various derivatives on firm value and financial performance - by interacting the financial risk that is hedged with the derivative used for hedging. Third, the time-period of our dataset allows the study of the effect of the 2008-09 financial crisis on firms' risk management policies, a relevant study which is not yet available in the literature.

Our findings reveal mixed results for the association between hedging and firm value and financial performance. For instance, the association between overall FX risk hedging (i.e. considering all derivatives together) and firm value and financial performance is positive and significant; the association between overall CM risk hedging and financial performance is positive and not significant, but the relation between hedging CM risk with swap contracts and financial performance is positive and significant; and the association between overall IR risk hedging and firm value and financial performance is negative and significant, but the relation between hedging IR risk with forwards contracts and firm value and financial performance is positive and significant. Further, we find that the recent financial crisis did not change hedging practices and respective effects on firms' value and financial performance.

The above results show that the effect of hedging on firm value and financial performance varies significantly across financial risks and that there are derivatives which are more effective in hedging certain types of risks, contributing favourably to value creation and financial perform. Some of the above findings can be helpful to improving current risk management practices and policies.

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Table 1 -Description of variables

This table provides the definitions and source of the variables used throughout the regressions. Notations are presented below for each variable in this analysis. The sample covers 288 nonfinancial listed firms in London Stock Exchange (LSE) under FTSE-All Shares for the period from 2005 to 2012. Data are collected from two sources, mainly, from firms' annual reports with regard to derivatives use for hedging financial risks, and firms' characteristics with regard to accounting details have been collected from Datastream. In the regression models, we also employ time and industry fixed effects as well as the 'Financial crisis' variable, which is "1" for the years 2007, 2008 and 2009 and "0" otherwise.

Variables	Notation	Definition	Data Source
Derivatives use			
Hedge dummy	H	Dummy variable with value 1 if firm uses financial derivatives instruments for hedging foreign currency, interest rate or commodity price risks, and 0 otherwise.	Firm annual report
Foreign exchange hedge dummy	FXH	Dummy variable with value 1 if the firm reports the use of foreign currency derivatives contracts for hedging purposes, and 0 otherwise.	Firm annual report
FXFU dummy	FXFU	Dummy variable with value 1 if firm uses foreign exchange futures and 0 otherwise.	Firm annual report
FXFO dummy	FXFO	Dummy variable with value 1 if firm uses foreign exchange forwards, and 0 otherwise.	Firm annual report
FXOP dummy	FXOP	Dummy variable with value 1 if firm uses foreign exchange options and 0 otherwise.	Firm annual report
FXSW dummy	FXSW	Dummy variable with value 1 if firm uses foreign exchange swaps, and 0 otherwise.	Firm annual report
Interest rate hedge dummy	IRH	Dummy variable with value 1 if the firm reports the use of interest rate derivatives contracts for hedging purposes, and 0 otherwise.	Firm annual report
IRFU dummy	IRFU	Dummy variable with value 1 if firm uses interest rate futures and 0 otherwise.	Firm annual report
IRFO dummy	IRFO	Dummy variable with value 1 if firm uses interest rate forwards, and 0 otherwise.	Firm annual report
IROP dummy	IROP	Dummy variable with value 1 if firm uses interest rate options and 0 otherwise.	Firm annual report
IRSW dummy	IRSW	Dummy variable with value 1 if firm uses interest rate swaps, and 0 otherwise.	Firm annual report
Commodity hedge dummy	CMH	Dummy variable with value 1 if the firm reports the use of commodity derivatives contracts for hedging purposes, and 0 otherwise.	Firm annual report
CMFU dummy	CMFU	Dummy variable with value 1 if firm uses commodity futures and 0 otherwise.	Firm annual report
CMFO dummy	CMFO	Dummy variable with value 1 if firm uses commodity forwards, and 0 otherwise.	Firm annual report
CMOP dummy	CMOP	Dummy variable with value 1 if firm uses commodity options and 0 otherwise.	Firm annual report
CMSW dummy	CMSW	Dummy variable with value 1 if firm uses commodity swaps, and 0 otherwise.	Firm annual report
Firm characteristics			
Revenue	REV	Firm revenues or net sales	Datastream
Total Assets	AS	Firm total Assets	Datastream
Return on Invested Capital	ROIC	Earnings before finance costs and tax / Average of Last Year's and Current Year's (Total Capital + Short Term Debt & Current Portion of Long Term Debt)	Datastream
Return on Assets	ROA	Earnings before finance costs and tax / book value of total assets.	Datastream
Return on Equity	ROE	Earnings before finance costs and tax / book value of total shareholder equity.	Datastream
Operating Income	INC	represents the difference between sales and total operating expenses	Datastream
Profit Margin	PRO	Operating Income / Net Sales or Revenues.	Datastream
EPS	EPS	Earnings per share in pence.	Datastream
Firm Market Value	MV	The share price multiplied by the number of ordinary shares in issue.	Datastream
Tobin's Q	lnQ	Ln[total assets – book value of equity + market value of equity) /total assets. This measure is used as a proxy for firm value.	Datastream
Firm Size	lnZ	Natural logarithm of the book value of assets.	Datastream
Firm Age	lnG	Natural logarithm of the number of years since the stock of the firm first appears in London Stock Exchange (LSE).	Datastream
Leverage	LEV	Book value of total debt, including short and long debt / book value of total assets.	Datastream
Floating Rate Debt	FLO	Equals 1 if firm has borrowings debt in floating rate.	Firm annual report
Fixed Rate Debt	FIX	Equals 1 if firm has borrowings debt in fixed rate.	Firm annual report
Dividends	DIV	Dividends per share (DPS) in pence.	Datastream
Dividends dummy	DIVDM	Dummy variable with value of 1 if DPS is positive, and 0, otherwise.	Datastream
CAPEX/assets	CAPXAS	Capital expenditures / book value of assets.	Datastream
R&D/assets	RDAS	Research & development expense / book value of assets.	Datastream
Business diversification	IND	Equals 1 if the firm has more than one business segments and 0 otherwise.	Datastream
Geographical diversification	GEO	Equals 1 if the firm has positive geographical diversification and operates in multinational segments locations, and 0 otherwise.	Datastream
Multinational segments	SGM	Counts the number of multinational segments if a firm operates in other countries (outside of UK).	Firm annual report
Foreign Sales Ratio	FSR	The ratio of foreign sales to revenues or net sales.	Firm annual report
Foreign Expenditures	FEX	The ratio of foreign expenditures to revenues or net sales.	Firm annual report
Commodity Purchases	CMP	Equals 1 if the firm has committed commodity purchase contracts.	Firm annual report
Commodity Raw Materials	CMR	Equals 1 if the firm has committed commodity raw material purchase contracts for operations.	Firm annual report
Commodity Oil & Gas, Mining, Energy	CMO	Equals 1 if the firm has committed sales or support Oil & Gas, mining or energy.	Firm annual report

Table 2 - Descriptive Statistics

This table shows summary statistics for 288 nonfinancial firms listed in LSE from the period 2005 to 2012. Panel A presents derivatives use and firms' characteristics variables. First, we show the descriptive statistics for hedge dummy that indicates whether the firms do hedging in regards to use any type of derivatives against financial risks. Foreign exchange, interest rate and commodity hedge are presented overall in terms of dummy variables (FXH, IRH and CMH) and in addition for each type of derivatives use; future (FU), forward (FO), option (OP) and swap (SW). Second, firms' characteristics are reported in regards to financial positions and financial ratio measures that indicate performance. Financial positions are reported as follows; revenues, total assets, operating income, and firm market value are in billions of sterling. Financial ratio measures are reflected in ROIC, ROA, ROE and PRO; earning per share (EPS) and dividends per share reported in pence (DIV). Tobin's Q is used as a proxy for firm value. Other firm-specific characteristics are size, age, leverage, investment growth based on CAPEX/assets and R&D/assets, and diversification policy in which whether a firm has business and geographical (GEO) diversification. We also consider borrowing policy which is presented in floating and fixed rated borrowing. For multinational trading, we report the number of multinational operations segments outside the UK, the ratio of foreign sales to total revenue, and the ratio of foreign expenditures to revenues or net sales. For commodity price risks, we use a dummy variable that is 1 if the firm with matching information from annual reports notes about any of the following; commodity purchase, commodity raw material or oil &gas, mining, energy supplying. Second, Panel B presents variables in sub-sample that matching firms information, which have geographical diversification only and Panel C for firms that do not have geographical diversification. The last column presents difference in mean of two sub-samples in panels B and C. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. The non-ratio explanatory variables to be used for the regression models are measured using 2005 prices. All variables are defined in Table 1.

	Panel A: Full Sample						Panel B: Sub-sample (GEO diversification > 0)						Panel C: Sub-sample (GEO diversification = 0)						Mean difference
Variable name	N	Mean	Std. dev.	Min.	Median	Max.	N	Mean	Std. dev.	Min.	Median	Max.	N	Mean	Std. dev.	Min.	Median	Max.	(B-C)
Hedge dummy	2304	0.825	0.380	0.000	1.000	1.000	1855	0.821	0.383	0.000	1.000	1.000	449	0.842	0.365	0.000	1.000	1.000	-0.021
Foreign exchange hedge dummy (FXH)	2304	0.681	0.466	0.000	1.000	1.000	1855	0.755	0.430	0.000	1.000	1.000	449	0.372	0.484	0.000	0.000	1.000	0.383 ***
FXFU dummy	2304	0.007	0.083	0.000	0.000	1.000	1855	0.009	0.093	0.000	0.000	1.000	449	0.000	0.000	0.000	0.000	0.000	0.009 **
FXFO dummy	2304	0.627	0.484	0.000	1.000	1.000	1855	0.712	0.453	0.000	1.000	1.000	449	0.276	0.448	0.000	0.000	1.000	0.436***
FXOP dummy	2304	0.083	0.276	0.000	0.000	1.000	1855	0.097	0.295	0.000	0.000	1.000	449	0.029	0.168	0.000	0.000	1.000	0.068***
FXSW dummy	2304	0.324	0.468	0.000	0.000	1.000	1855	0.354	0.478	0.000	0.000	1.000	449	0.200	0.401	0.000	0.000	1.000	0.154***
Interest rate hedge dummy (IRH)	2304	0.638	0.481	0.000	1.000	1.000	1855	0.599	0.490	0.000	1.000	1.000	449	0.797	0.402	0.000	1.000	1.000	-0.198***
IRFU dummy	2304	0.007	0.080	0.000	0.000	1.000	1855	0.008	0.090	0.000	0.000	1.000	449	0.000	0.000	0.000	0.000	0.000	0.008*
IRFO dummy	2304	0.049	0.216	0.000	0.000	1.000	1855	0.046	0.210	0.000	0.000	1.000	449	0.060	0.238	0.000	0.000	1.000	-0.014
IROP dummy	2304	0.116	0.320	0.000	0.000	1.000	1855	0.097	0.296	0.000	0.000	1.000	449	0.194	0.396	0.000	0.000	1.000	-0.097***
IRSW dummy	2304	0.627	0.484	0.000	1.000	1.000	1855	0.591	0.492	0.000	1.000	1.000	449	0.777	0.417	0.000	1.000	1.000	-0.186***
Commodity hedge dummy (CMH)	2304	0.140	0.347	0.000	0.000	1.000	1855	0.153	0.360	0.000	0.000	1.000	449	0.087	0.282	0.000	0.000	1.000	0.066***
CMFU dummy	2304	0.033	0.179	0.000	0.000	1.000	1855	0.038	0.192	0.000	0.000	1.000	449	0.011	0.105	0.000	0.000	1.000	0.027***
CMFO dummy	2304	0.083	0.276	0.000	0.000	1.000	1855	0.088	0.283	0.000	0.000	1.000	449	0.065	0.246	0.000	0.000	1.000	0.023
CMOP dummy	2304	0.040	0.197	0.000	0.000	1.000	1855	0.048	0.214	0.000	0.000	1.000	449	0.009	0.094	0.000	0.000	1.000	0.039***
CMSW dummy	2304	0.052	0.221	0.000	0.000	1.000	1855	0.059	0.236	0.000	0.000	1.000	449	0.020	0.140	0.000	0.000	1.000	0.039***
Firms' characteristics																			
Revenues (£b.)	2304	3.429	12.400	0.000	0.659	236.000	1855	3.834	13.600	0.000	0.649	236.000	449	1.754	3.634	0.000	0.684	25.400	2.080***
Total Assets (£b.)	2304	4.663	14.600	0.005	0.846	188.000	1855	5.142	16.000	0.005	0.755	188.000	449	2.685	5.354	0.008	1.058	47.300	2.456***
Return on Invested Capital	2304	0.122	0.200	-1.940	0.108	2.150	1855	0.129	0.212	-1.940	0.111	2.150	449	0.095	0.137	-0.741	0.095	0.556	0.034***
Return on Assets	2304	0.053	0.117	-2.790	0.054	1.430	1855	0.057	0.119	-2.790	0.056	1.430	449	0.039	0.110	-0.786	0.046	0.504	0.018***
Return on Equity	2304	0.231	1.610	-5.040	0.145	72.100	1855	0.251	1.780	-5.040	0.149	72.100	449	0.150	0.439	-1.360	0.127	6.840	0.101
Operating Income (£b.)	2304	0.457	1.608	-4.989	0.059	20.600	1855	0.529	1.776	-4.989	0.061	20.600	449	0.163	0.366	-0.152	0.054	3.600	0.366***
Profit Margin (PRO)	2304	0.010	3.400	-155.000	0.105	2.370	1855	-0.015	3.780	-155.000	0.104	0.917	449	0.117	0.622	-11.900	0.109	2.370	-0.132
EPS	2304	35.600	59.600	-32.600	19.700	869.000	1855	35.100	59.400	-32.600	19.200	869.000	449	37.600	60.400	0.000	22.000	805.000	-2.500
Firm Market Value (£b.)	2304	3.663	10.900	0.000	0.634	134.000	1855	4.196	12.000	0.000	0.682	134.000	449	1.463	2.740	0.000	0.576	25.100	2.732***
Tobin's Q	2304	0.407	0.497	-1.890	0.330	2.710	1855	0.452	0.508	-1.890	0.377	2.710	449	0.220	0.400	-0.839	0.135	1.820	0.232***
Firm Size	2304	13.700	1.750	8.590	13.600	19.100	1855	13.700	1.820	8.590	13.500	19.100	449	13.900	1.420	8.990	13.900	17.700	-0.200*
Firm Age	2304	2.900	0.911	0.000	3.040	4.530	1855	2.900	0.929	0.000	3.040	4.530	449	2.930	0.832	0.000	3.090	3.870	-0.030
Leverage	2304	0.224	0.184	0.000	0.204	1.000	1855	0.212	0.174	0.000	0.193	1.000	449	0.273	0.212	0.000	0.272	0.954	-0.061***
Floating Rate Debt	2304	0.886	0.318	0.000	1.000	1.000	1855	0.883	0.321	0.000	1.000	1.000	449	0.900	0.301	0.000	1.000	1.000	-0.017
Fixed Rate Debt	2304	0.712	0.453	0.000	1.000	1.000	1855	0.702	0.457	0.000	1.000	1.000	449	0.753	0.432	0.000	1.000	1.000	-0.051**
Dividends	2304	12.700	19.000	0.000	7.360	195.000	1855	12.600	20.000	0.000	6.720	195.000	449	13.200	14.000	0.000	9.350	81.000	-0.600
Dividends dummy	2304	0.829	0.377	0.000	1.000	1.000	1855	0.820	0.384	0.000	1.000	1.000	449	0.866	0.341	0.000	1.000	1.000	-0.046**
CAPEX/assets	2304	0.047	0.049	0.000	0.034	0.601	1855	0.047	0.049	0.000	0.033	0.601	449	0.048	0.048	0.000	0.034	0.246	-0.002
R&D/assets	2304	0.018	0.056	0.000	0.000	0.755	1855	0.020	0.055	0.000	0.000	0.755	449	0.010	0.058	0.000	0.000	0.552	0.010***
Business diversification	2304	0.571	0.495	0.000	1.000	1.000	1855	0.597	0.491	0.000	1.000	1.000	449	0.465	0.499	0.000	0.000	1.000	0.132***
Geographical diversification	2304	0.805	0.396	0.000	1.000	1.000	1855	1.000	0.000	1.000	1.000	1.000	449	0.000	0.000	0.000	0.000	0.000	1.000
Multinational segments	2304	17.500	29.300	0.000	6.000	180.000	1855	21.700	31.200	0.000	9.000	180.000	449	0.000	0.000	0.000	0.000	0.000	21.700***
Foreign Sales Ratio	2304	0.517	0.389	0.000	0.591	1.000	1855	0.642	0.329	0.000	0.759	1.000	449	0.000	0.000	0.000	0.000	0.000	0.642***
Foreign Expenditures	2304	0.856	0.351	0.000	1.000	1.000	1855	0.974	0.159	0.000	1.000	1.000	449	0.367	0.483	0.000	0.000	1.000	0.607***
Commodity Purchases	2304	0.165	0.371	0.000	0.000	1.000	1855	0.184	0.387	0.000	0.000	1.000	449	0.087	0.282	0.000	0.000	1.000	0.097***
Commodity Raw Materials	2304	0.072	0.259	0.000	0.000	1.000	1855	0.083	0.275	0.000	0.000	1.000	449	0.029	0.168	0.000	0.000	1.000	0.054***
Commodity Oil & Gas, Mining, Energy	2304	0.104	0.306	0.000	0.000	1.000	1855	0.120	0.325	0.000	0.000	1.000	449	0.040	0.196	0.000	0.000	1.000	0.080***

Table 3

Summary Statistics on Hedging the Popularity of Hedging and Derivatives Contracts

Table 3 reports statistics on the popularity of hedging for each financial risk and derivative contract, for the period between 2005 and 2012. Panel A reports the number and the percentage of hedgers and non-hedgers for the FX, IR and CM risks. The percentage of hedgers and non-hedgers is computed based on a total sample of 288 firms. Panel B shows the popularity of each derivatives contract (FO, FU, OP and SW) for hedging different types of risks (FX, IR and CM).

	2005	2006	2007	2008	2009	2010	2011	2012
Panel A: Hedging Activities								
Foreign Exchange Rate								
Hedgers	175	185	191	195	202	204	208	208
	60.8%	64.2%	66.3%	67.7%	70.1%	70.8%	72.2%	72.2%
Non-hedgers	113	103	97	93	86	84	80	80
	39.2%	35.8%	33.7%	32.3%	29.9%	29.2%	27.8%	27.8%
Interest Rate								
Hedgers	172	177	182	186	189	192	190	182
	59.7%	61.5%	63.2%	64.6%	65.6%	66.7%	66.0%	63.2%
Non-hedgers	116	111	106	102	99	96	98	106
	40.3%	38.5%	36.8%	35.4%	34.4%	33.3%	34.0%	36.8%
Commodity Price								
Hedgers	36	39	37	42	40	41	44	44
	12.5%	13.5%	12.8%	14.6%	13.9%	14.2%	15.3%	15.3%
Non-hedgers	252	249	251	246	248	247	244	244
	87.5%	86.5%	87.2%	85.4%	86.1%	85.8%	84.7%	84.7%
Panel B: Types of Derivatives								
Foreign exchange Rate Derivatives								
Future	1	3	3	2	2	2	2	1
	0.3%	1.0%	1.0%	0.7%	0.7%	0.7%	0.7%	0.3%
Forward	163	168	174	180	188	189	192	191
	56.6%	58.3%	60.4%	62.5%	65.3%	65.6%	66.7%	66.3%
Option	18	23	24	25	27	26	27	22
	6.3%	8.0%	8.3%	8.7%	9.4%	9.0%	9.4%	7.6%
Swap	84	84	90	92	96	97	104	99
	29.2%	29.2%	31.3%	31.9%	33.3%	33.7%	36.1%	34.4%
Interest Rate Derivatives								
Future	1	1	1	1	2	3	3	3
	0.3%	0.3%	0.3%	0.3%	0.7%	1.0%	1.0%	1.0%
Forward	16	13	15	14	14	12	15	14
	5.6%	4.5%	5.2%	4.9%	4.9%	4.2%	5.2%	4.9%
Option	37	41	37	33	31	31	29	28
	12.8%	14.2%	12.8%	11.5%	10.8%	10.8%	10.1%	9.7%
Swap	169	173	178	185	188	189	185	178
	58.7%	60.1%	61.8%	64.2%	65.3%	65.6%	64.2%	61.8%
Commodity Price Derivatives								
Future	9	11	10	11	8	9	9	9
	3.1%	3.8%	3.5%	3.8%	2.8%	3.1%	3.1%	3.1%
Forward	18	23	23	25	26	24	25	28
	6.3%	8.0%	8.0%	8.7%	9.0%	8.3%	8.7%	9.7%
Option	11	13	14	12	12	10	10	11
	3.8%	4.5%	4.9%	4.2%	4.2%	3.5%	3.5%	3.8%
Swap	15	14	13	16	16	16	15	14
	5.2%	4.9%	4.5%	5.6%	5.6%	5.6%	5.2%	4.9%

Table 4

Summary Statistics for Hedging Activities in Geographical Diversification

Table 4 presents summary statistics on hedgers vs. non-hedgers based on sub-sample of firms that have geographical diversification (GEO > 0) and sub-sample of firms that do not have geographical diversification (GEO = 0). Hedgers (H > 0) and non-hedgers (H = 0) are reported for each year during the period from 2005 to 2012. In each column, total no. of firms are reported in each year and following by percentage of firms to the total sample of data collection. The summary statistics below covers the total average of observations during the whole period that shows the percentage of sub-sample that has geographical diversification and other does not have; in each sub-sample under this category, a comparison between hedgers vs. non-hedgers is also reported.

Hedging activities	2005		2006		2007		2008		2009		2010		2011		2012	
	H > 0	H =0	H > 0	H =0	H > 0	H =0	H > 0	H =0	H > 0	H =0	H > 0	H =0	H > 0	H =0	H > 0	H =0
Geographical Diversification (GEO)																
GEO > 0	169	57	178	50	182	45	189	41	196	36	203	34	204	34	202	35
	58.7%	19.8%	61.8%	17.4%	63.2%	15.6%	65.6%	14.2%	68.1%	12.5%	70.5%	11.8%	70.8%	11.8%	70.1%	12.2%
GEO = 0	48	14	49	11	52	9	51	7	49	7	44	7	42	8	43	8
	16.7%	4.9%	17.0%	3.8%	18.1%	3.1%	17.7%	2.4%	17.0%	2.4%	15.3%	2.4%	14.6%	2.8%	14.9%	2.8%
No. of firms	217	71	227	61	234	54	240	48	245	43	247	41	246	42	245	43
Percentage per year	75.3%	24.7%	78.8%	21.2%	81.3%	18.8%	83.3%	16.7%	85.1%	14.9%	85.8%	14.2%	85.4%	14.6%	85.1%	14.9%
Average 2005 - 2012																
GEO > 0:	80.5%															
GEO = 0:	19.5%															
GEO > 0, Hedger	66.1%															
GEO > 0, Non-hedger	14.4%															
GEO = 0, Hedger	16.4%															
GEO = 0, Non-hedger	3.1%															

Table 5
Pairwise Correlation Matrix between Related Variables

This table provides a correlation matrix for our sample. Pearson correlation coefficients for all dependents and independents variables. All variables are defined in Table 1. All variance inflation factors (VIFs) are less than 10, showing the absence of the multicollinearity problem in the regression models.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
1. Return on Invested Capital	1.000																						
2. Return on Assets	0.697																						
3. Tobin's Q	0.319	0.296																					
4. Foreign Exchange Hedge Dummy	0.072	0.073	0.022																				
5. Interest Rate Hedge Dummy	-0.037	-0.047	-0.225	0.267																			
6. Commodity Hedge Dummy	0.010	0.023	-0.048	0.177	0.190																		
7. Firm Size	-0.001	0.016	-0.247	0.297	0.468	0.409																	
8. Firm Age	0.010	0.006	-0.125	0.196	0.121	-0.005	0.139																
9. Dividends	0.138	0.120	0.084	0.153	0.169	0.080	0.315	0.213															
10. Leverage	-0.130	-0.128	-0.143	0.001	0.457	0.032	0.256	-0.048	0.090														
11. CAPEX/Assets	0.012	0.037	0.068	-0.065	-0.018	0.158	0.043	-0.044	-0.006	0.164													
12. R&D/Assets	-0.050	-0.062	0.299	0.028	-0.210	-0.090	-0.230	-0.111	-0.055	-0.217	-0.085												
13. Business Diversification	0.035	0.039	0.008	0.275	0.063	0.064	0.018	0.085	0.021	-0.098	-0.153	0.084											
14. Geographical Diversification	0.068	0.060	0.185	0.326	-0.163	0.076	-0.040	-0.013	-0.014	-0.131	-0.013	0.072	0.105										
15. Financial Crisis	-0.012	-0.042	-0.085	0.198	0.186	0.041	0.118	0.045	0.060	0.135	-0.015	-0.020	0.056	-0.028									
16. Foreign Sales dummy	0.068	0.060	0.185	0.326	-0.163	0.076	-0.040	-0.013	-0.014	-0.131	-0.013	0.072	0.105	1.000	-0.028								
17. Foreign Sales Ratio	0.016	0.042	0.169	0.162	-0.227	0.109	0.039	-0.059	-0.045	-0.197	0.036	0.128	0.125	0.653	-0.051	0.653							
18. Foreign Expenditures	0.040	0.023	0.123	0.538	-0.047	0.144	0.074	-0.008	0.041	-0.124	-0.045	0.096	0.184	0.684	0.039	0.684	0.472						
19. Multinational Segments	0.117	0.084	0.142	0.249	0.070	0.104	0.311	0.060	0.171	0.023	-0.004	0.000	0.099	0.294	0.033	0.294	0.320	0.223					
20. Floating Rate Debt	-0.009	-0.012	-0.134	0.209	0.439	0.129	0.340	0.144	0.123	0.339	-0.020	-0.202	-0.020	-0.021	0.126	-0.021	-0.100	0.040	0.064				
21. Fixed Rate Debt	-0.030	-0.023	-0.160	0.138	0.559	0.135	0.313	0.175	0.060	0.350	0.069	-0.193	0.025	-0.044	0.101	-0.044	-0.027	-0.023	0.073	0.358			
22. Commodity Purchases	0.009	0.015	-0.052	0.209	0.138	0.562	0.209	0.080	0.060	0.025	0.052	-0.087	0.033	0.104	0.041	0.104	-0.005	0.156	0.103	0.078	0.091		
23. Commodity Raw Material	-0.019	-0.006	-0.048	0.137	0.130	0.279	0.150	0.068	0.081	0.097	-0.008	-0.049	0.099	0.082	0.019	0.082	0.049	0.114	0.102	0.095	0.136	0.451	
24. Commodity Oil & Gas, Mining, Energy	-0.004	0.001	0.006	-0.077	-0.080	0.366	0.180	-0.177	-0.051	-0.044	0.243	-0.105	0.020	0.103	-0.046	0.103	0.297	0.140	-0.059	-0.026	-0.006	-0.060	-0.057

Table 6

OLS Regressions on Derivatives Use and Firm Performance

Table 6 presents coefficient estimates for the OLS regressions on performance measures; Return on Invested Capital (ROIC) and Return on Assets (ROA). Models 1 and 6 report regressions of the hedging activities against foreign exchange, interest rate, and commodity price risks. Models 2 and 7 present regressions of derivatives financial instruments use (future, forward, option and swap) for hedging foreign exchange rate risk. Models 3 and 8 report regressions of types of derivatives instruments use for hedging interest rate risk, and models (4) report the same types of derivatives instruments use for hedging commodity price risk. Models 4 and 9 report regressions of types of derivatives instruments use for hedging commodity price risk. Models 5 and 10 run regression of all types of derivatives financial instruments use for all types of financial risks being hedged on the performance measures. Standard errors are reported in parentheses below each coefficient estimate. All variables are defined in Table 1. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	ROIC					ROA				
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Foreign exchange hedge (FXH)	0.028**					0.015**				
	(0.012)					(0.007)				
Interest rate hedge (IRH)	-0.029***					-0.022***				
	(0.010)					(0.005)				
Commodity hedge (CMH)	0.010					0.003				
	(0.011)					(0.005)				
<u>Foreign Exchange Derivatives</u>										
Future		0.001			-0.015		0.002			0.003
		(0.020)			(0.020)		(0.011)			(0.011)
Forward		0.029***			0.032***		0.013**			0.014**
		(0.011)			(0.011)		(0.006)			(0.006)
Option		0.019			0.019		0.009			0.010
		(0.012)			(0.012)		(0.006)			(0.006)
Swap		-0.009			-0.009		-0.007			-0.006
		(0.010)			(0.010)		(0.005)			(0.005)
<u>Interest Rate Derivatives</u>										
Future			-0.058**		-0.046			-0.042**		-0.037**
			(0.029)		(0.029)			(0.018)		(0.018)
Forward			0.033**		0.034**			0.025**		0.026**
			(0.015)		(0.015)			(0.011)		(0.011)
Option			-0.039***		-0.042***			-0.014**		-0.015**
			(0.011)		(0.012)			(0.007)		(0.007)
Swap			-0.018*		-0.020*			-0.019***		-0.019***
			(0.011)		(0.011)			(0.005)		(0.005)
<u>Commodity Price Derivatives</u>										
Future				-0.017	-0.023				-0.005	-0.009
				(0.014)	(0.015)				(0.009)	(0.009)
Forward				-0.008	-0.023				0.002	-0.004
				(0.014)	(0.015)				(0.006)	(0.007)
Option				0.026	0.025				0.011	0.009
				(0.017)	(0.018)				(0.008)	(0.009)
Swap				0.029**	0.031**				0.004	0.004
				(0.013)	(0.014)				(0.006)	(0.006)
Firm size	-0.005	-0.006*	-0.004	-0.006**	-0.004	-0.001	-0.002	0.000	-0.002	0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Firm age	-0.005	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Dividends	0.002***	0.002***	0.002***	0.002***	0.002***	0.001***	0.001***	0.001***	0.001***	0.001***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CAPEX/assets	0.051	0.059	0.066	0.039	0.060	0.079	0.081	0.083	0.071	0.083
	(0.096)	(0.095)	(0.096)	(0.096)	(0.097)	(0.080)	(0.080)	(0.081)	(0.081)	(0.082)
R&D/assets	-0.223**	-0.192*	-0.222**	-0.184*	-0.231**	-0.166**	-0.141*	-0.164**	-0.139*	-0.168**
	(0.105)	(0.104)	(0.104)	(0.105)	(0.104)	(0.073)	(0.073)	(0.073)	(0.074)	(0.073)
Business diversification	0.010	0.009	0.015*	0.015*	0.014	0.007	0.007	0.010**	0.009*	0.008*
	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Geographical diversification	0.028***	0.032***	0.039***	0.042***	0.024**	0.013*	0.017**	0.019***	0.021***	0.013*
	(0.010)	(0.011)	(0.008)	(0.008)	(0.010)	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)
Financial crisis	-0.002	-0.015	0.013	0.001	-0.006	0.012	0.003	0.020	0.010	0.012
	(0.027)	(0.026)	(0.026)	(0.025)	(0.027)	(0.023)	(0.023)	(0.022)	(0.022)	(0.023)
Constant	0.070	0.068	0.044	0.072	0.065	-0.003	-0.002	-0.015	0.004	-0.011
	(0.074)	(0.078)	(0.074)	(0.074)	(0.082)	(0.055)	(0.058)	(0.056)	(0.057)	(0.061)
Time effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sector effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
No. of observations	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304
Adj. R^2	0.053	0.052	0.054	0.049	0.057	0.049	0.045	0.049	0.042	0.050

Table 7- OLS Regressions on Derivatives Use and Firm Value

Table 7 presents coefficient estimates for the OLS regressions on the impact of hedging financial risks (foreign exchange, interest rate, and commodity price) using derivatives financial instruments on firm value. The dependent variable is natural logarithm of Tobin's Q. Model (1) reports regressions of hedging financial risks (FX, IR, and CM). Model (2) presents regressions of derivatives financial instruments use (future, forward, option and swap) for hedging foreign exchange rate risk, models (3) report regressions of types of derivatives instruments use for hedging interest rate risk, and models (4) report the same types of derivatives instruments use for hedging commodity price risk. Thus, models (2), (3), and (4) report the effect of derivatives instruments use (FU, FO, OP, and SW) for each type of risk (FX, IR, and CM) separately on Tobin's Q. Models (5) run regression of all types derivatives financial instruments use for all types of financial risks being hedged on Tobin's Q. Standard errors are presented in parentheses below each coefficient estimate. All variables are defined in Table 1. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	Firm Value				
Variables	(1)	(2)	(3)	(4)	(5)
Foreign exchange hedge (FXH)	0.067***				
	(0.025)				
Interest rate hedge (IRH)	-0.080***				
	(0.024)				
Commodity hedge (CMH)	0.055**				
	(0.023)				
<u>Foreign Exchange Derivatives</u>					
Future		-0.034			-0.137***
		(0.044)			(0.041)
Forward		0.072***			0.079***
		(0.024)			(0.024)
Option		-0.077**			-0.079**
		(0.032)			(0.032)
Swap		0.018			0.014
		(0.022)			(0.022)
<u>Interest Rate Derivatives</u>					
Future			-0.115**		-0.085
			(0.051)		(0.061)
Forward			0.130***		0.111**
			(0.047)		(0.049)
Option			-0.064***		-0.067***
			(0.025)		(0.025)
Swap			-0.044*		-0.054**
			(0.023)		(0.024)
<u>Commodity Price Derivatives</u>					
Future				0.086**	0.084**
				(0.036)	(0.036)
Forward				-0.020	-0.050
				(0.028)	(0.031)
Option				0.082**	0.103**
				(0.041)	(0.041)
Swap				0.070***	0.057**
				(0.025)	(0.026)
ROA	1.162***	1.169***	1.156***	1.171***	1.149***
	(0.393)	(0.395)	(0.392)	(0.395)	(0.392)
Firm size	-0.066***	-0.071***	-0.063***	-0.069***	-0.072***
	(0.007)	(0.008)	(0.008)	(0.007)	(0.009)
Firm age	-0.042***	-0.047***	-0.041***	-0.043***	-0.047***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Leverage	0.101	0.020	0.065	0.027	0.076
	(0.082)	(0.079)	(0.082)	(0.080)	(0.083)
Dividends	0.004***	0.004***	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
CAPEX/assets	0.538**	0.596**	0.611**	0.552**	0.521*
	(0.270)	(0.269)	(0.268)	(0.275)	(0.276)
R&D/assets	2.295***	2.314***	2.300***	2.355***	2.250***
	(0.227)	(0.230)	(0.229)	(0.230)	(0.230)
Business diversification	-0.021	-0.023	-0.009	-0.013	-0.017
	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)
Geographical diversification	0.135***	0.142***	0.166***	0.166***	0.125***
	(0.022)	(0.023)	(0.021)	(0.021)	(0.023)
Financial crisis	-0.054	-0.077	-0.019	-0.048	-0.058
	(0.055)	(0.054)	(0.052)	(0.051)	(0.055)
Constant	1.070***	1.139***	1.014***	1.105***	1.197***
	(0.231)	(0.247)	(0.232)	(0.235)	(0.253)
Time effect	YES	YES	YES	YES	YES
Sector effect	YES	YES	YES	YES	YES
No. of observations	2304	2304	2304	2304	2304
Adj. R^2	0.331	0.33	0.33	0.329	0.337

Table 8 - Instrumental Variables Regressions on Hedging Financial Risks and Impact on Firm Performance and Value

This table presents 2SLS-GMM estimates on the impact of derivatives financial instruments use for hedging financial risks (foreign currency, interest rate, and commodity price) on firm performance based on ROIC and value based on Tobin's Q. We report the first stage estimates as the effect of firm characteristics on the use of derivatives regarding the foreign exchange, interest rate and commodity price hedging activities. The instrumental variables are Foreign sales ratio, Foreign expenditures, Multinational segments, Floating rate debt, Fixed rate debt, Commodity purchase, Commodity raw material, and Commodity oil & gas, mining, energy. The fitted values from the first stage regressions are used in running regressions of 2SLS-GMM in the second stage which examines the impact of derivatives use on performance and value. All variables are defined in Table 1. Standard errors are clustered at the firm level and are shown in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	ROIC				Tobin's Q			
Variables	1[st] Stage			2SLS-GMM	1[st] Stage			2SLS-GMM
	FXH	IRH	CMH		FXH	IRH	CMH	
Foreign exchange hedge				0.0075				0.0955**
				(0.0320)				(0.0467)
Interest rate hedge				-0.0328				-0.1992***
				(0.0206)				(0.0550)
Commodity price hedge				0.0043				0.0117
				(0.0204)				(0.0380)
ROA					0.1517**	-0.0553	0.0183	2.1206***
					(0.0682)	(0.0419)	(0.0319)	(0.3415)
Firm size	0.0558***	0.0735***	0.0465***	-0.0039	0.0575***	0.0675***	0.0476***	-0.0455***
	(0.0052)	(0.0051)	(0.0040)	(0.0045)	(0.0052)	(0.0051)	(0.0040)	(0.0085)
Firm age	0.0486***	-0.0279***	-0.0090	-0.0081	0.0459	-0.0132	-0.0112*	-0.0368***
	(0.0084)	(0.0084)	(0.0057)	(0.0053)	(0.0086)	(0.0083)	(0.0059)	(0.0129)
Leverage					-0.1126**	0.4838***	-0.0930***	0.2321***
					(0.0446)	(0.0462)	(0.0278)	(0.0862)
Dividends	-0.0001	0.0008**	0.0000	0.0018***	-0.0002	0.0007*	0.0000	0.0033***
	(0.0003)	(0.0004)	(0.0003)	(0.0002)	(0.0003)	(0.0004)	(0.0003)	(0.0006)
CAPEX/assets	0.3530**	-0.0289	0.3134***	0.1263	0.4173**	-0.3089**	0.3835***	0.4109
	(0.1571)	(0.1413)	(0.1084)	(0.0937)	(0.1630)	(0.1469)	(0.1120)	(0.2642)
R&D/assets	0.1796	-0.3193***	0.3171***	-0.2467**	0.1655	-0.1778**	0.2865***	2.4994***
	(0.1286)	(0.0873)	(0.0544)	(0.1044)	(0.1269)	(0.0847)	(0.0555)	(0.2232)
Business diversification	0.1207***	0.0551***	0.0294***	0.0167*	0.1165***	0.0610***	0.0252**	-0.0142
	(0.0154)	(0.0144)	(0.0104)	(0.0087)	(0.0155)	(0.0140)	(0.0106)	(0.0194)
Geographical diversification	0.0535*	-0.0487**	0.0064	0.0372**	0.0524**	-0.0558**	0.0082	0.1019***
	(0.0285)	(0.0277)	(0.0175)	(0.0168)	(0.0283)	(0.0270)	(0.0174)	(0.0264)
Financial crisis	0.5232***	0.3080***	0.0359	0.0122	0.5249***	0.2961***	0.0403*	-0.0019
	(0.0291)	(0.0296)	(0.0218)	(0.0316)	(0.0290)	(0.0293)	(0.0218)	(0.0609)
Constant	-1.3093***	-0.9123***	-0.6271	0.0413	-1.3190***	-0.9011***	-0.6400***	0.6368***
	(0.1201)	(0.1130)	(0.1124)	(0.0853)	(0.1214)	(0.1171)	(0.1126)	(0.2297)
Time effect	YES	YES	YES	YES	YES	YES	YES	YES
Sector effect	YES	YES	YES	YES	YES	YES	YES	YES
No. of observations	2304	2304	2304	2304	2304	2304	2304	2304
Centered R^2	0.5338	0.5305	0.5450	0.0613	0.5370	0.5564	0.5476	0.2779
F-Stat.	129.81	182.10	53.18	7.90	119.50	188.06	49.49	36.13
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Under-identification tests: Kleibergen-Paap rk LM statistic (χ^2)				238.757***				272.801***
Weak identification statistics: (Kleibergen-Paap rk Wald F statistic)				85.764				72.491
Over-identification test: Hansen J statistic (χ^2)				30.803***				83.566***
Orthogonality tests: C statistic (LEV, DIV, CAPEX/assets, RD/assets, GEO)				30.803***				83.566***

Table 9 - Treatment Effects Regressions on Hedging Financial Risks and Impact on Firm Performance and Value

This table presents treatment effects estimates on the impact of derivatives instruments use for hedging financial risks (foreign currency, interest rate, and commodity price) on return on invested capital (ROIC) and on Tobin's Q as proxies for performance and value. Columns 1 to 3 report treatment effects estimates for the impact of derivatives use to hedge the fluctuations in foreign exchange rate, interest rate and commodity price, separately, on performance. Columns 4 to 6 report also the estimated coefficients for the impact of derivatives use to hedge financial risks specified (FX, IR, and CM), separately, on firm value. We control for time and industry fixed effects. All variables are defined in Table 1. Standard errors are clustered at the firm level and are shown in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	ROIC			lnQ		
	FXH	IRH	CMH	FXH	IRH	CMH
	(1)	(2)	(3)	(4)	(5)	(6)
Foreign exchange hedge	0.032*	0.028**	0.028**	0.135***	0.067***	0.068***
	(0.020)	(0.011)	(0.011)	(0.042)	(0.024)	(0.024)
Interest rate hedge	-0.029***	-0.030*	-0.029***	-0.079***	-.089**	-0.080***
	(0.011)	0.016	(0.011)	(0.024)	(0.036)	(0.024)
Commodity price hedge	0.010	0.010	0.014	0.052*	0.055*	0.042
	(0.014)	(0.014)	(0.020)	(0.029)	(0.029)	(0.042)
ROA				1.167***	1.163***	1.161***
				(0.075)	(0.075)	(0.075)
Firm Size	-0.005	-0.005	-0.005	-0.067***	-0.066***	-0.066***
	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)
Firm Age	-0.005	-0.005	-0.005	-0.041***	-0.041***	-0.042***
	(0.005)	(0.005)	(0.005)	(0.010)	(0.010)	(0.010)
Leverage				0.101*	0.105*	0.100*
				(0.056)	(0.057)	(0.056)
Dividends	0.002***	0.002***	0.002***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CAPEX/assets	0.053	0.052	0.051	0.558***	0.538***	0.540***
	(0.089)	(0.089)	(0.089)	(0.189)	(0.189)	(0.189)
R&D/assets	-0.224***	-0.224***	-0.221***	2.289***	2.291***	2.287***
	(0.079)	(0.079)	(0.079)	(0.166)	(0.166)	(0.167)
Business diversification	0.010	0.010	0.010	-0.022	-0.021	-0.021
	(0.009)	(0.009)	(0.009)	(0.018)	(0.018)	(0.018)
Geographical diversification	0.026*	0.028**	0.028**	0.107***	0.136***	0.136***
	(0.014)	(0.012)	(0.012)	(0.028)	(0.024)	(0.024)
Financial crisis	-0.002	-0.002	-0.002	-0.051	-0.054	-0.055
	(0.020)	(0.020)	(0.020)	(0.042)	(0.043)	(0.042)
<u>Instrumental variables</u>						
Foreign sales ratio	-0.777***			-0.777***		
	(0.095)			(0.095)		
Foreign expenditures	2.484***			2.484***		
	(0.122)			(0.122)		
Multinational segments	0.015***			0.015***		
	(0.002)			(0.002)		
Floating rate debt		1.812***			1.812***	
		(0.147)			(0.147)	
Fixed rate debt		1.478***			1.478***	
		(0.070)			(0.070)	
Commodity purchases			2.887***			2.887***
			(0.178)			(0.178)
Commodity raw materials			0.264**			0.264**
			(0.131)			(0.131)
Commodity oil & gas, mining, energy			2.740***			2.740***
			(0.183)			(0.183)
Constant	0.069	0.070	0.067	1.058***	1.072***	1.077***
	(0.061)	(0.061)	(0.061)	(0.127)	(0.127)	(0.128)
Hazard lambda	-0.003	0.001	-0.005	-0.050*	0.008	0.014
	(0.012)	(0.010)	(0.015)	(0.026)	(0.022)	(0.032)
Wald chi2	139.890	155.400	157.250	1132.670	1109.740	1176.060
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Time effect	YES	YES	YES	YES	YES	YES
Sector effect	YES	YES	YES	YES	YES	YES
No. of observations	2304	2304	2304	2304	2304	2304

Table 10 - Time Series Analysis of The Impact of Types of Derivatives Use on Firm Value

This table reports a time series analysis of the impact of derivatives financial instruments (future, forward, option, and swap) use on the annual change in Tobin's Q as a proxy for firm value. The regressions models 1 to 3 use derivatives financial instruments (FU, FO, OP, and SW) for each type of financial risks (foreign exchange, interest rate, and commodity price) as proxied by dummy variables while holding changes in other variables constant. Model 1 presents the impact of foreign exchange derivatives use (FXFU, FXFO, FXOP, and FXSW) on the annual change of firm value. Model 2 represents the impact of both foreign exchange and interest rate derivatives use (FU, FO, OP, and SW) on the changes of firm value. Model 3 shows the impact of all types of derivatives instruments use per year for hedging financial risks (FX, IR, and CM) on the changes of firm value. Standard errors are presented in parentheses below each coefficient estimate. All variables are defined in Table 1. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	Δ Firm Value		
Variables	(1)	(2)	(3)
Foreign Exchange Derivatives			
Future	-0.0835***	-0.0843***	-0.1236***
	(0.024)	(0.022)	(0.027)
Forward	0.0340***	0.0348***	0.0353***
	(0.012)	(0.012)	(0.012)
Option	0.0084	0.0072	0.0062
	(0.021)	(0.021)	(0.021)
Swap	-0.0217**	-0.0219**	-0.0237**
	(0.009)	(0.010)	(0.010)
Interest Rate Derivatives			
Δ IRH	0.0321		
	(0.026)		
Future		0.0125	0.0136
		(0.036)	(0.036)
Forward		-0.0291	-0.0336*
		(0.018)	(0.019)
Option		-0.0071	-0.0074
		(0.013)	(0.013)
Swap		0.0101	0.0100
		(0.013)	(0.013)
Commodity Price Derivatives			
Δ CMH	-0.0007	0.0006	
	(0.036)	(0.036)	
Future			0.0344
			(0.027)
Forward			-0.0232
			(0.017)
Option			0.0255
			(0.023)
Swap			0.0167
			(0.018)
Δ ROA	-0.0991	-0.0967	-0.0975
	(0.105)	(0.105)	(0.105)
Δ Firm size	-0.3054***	-0.3016***	-0.3026***
	(0.067)	(0.066)	(0.067)
Δ Firm age	-0.0994	-0.1061	-0.1051
	(0.074)	(0.074)	(0.073)
Δ Leverage	0.2382**	0.2432**	0.2421**
	(0.115)	(0.116)	(0.116)
Δ Dividends	0.0003	0.0003	0.0003
	(0.000)	(0.000)	(0.000)
Δ CAPEX/assets	-0.3678	-0.3679	-0.3673
	(0.456)	(0.458)	(0.459)
Δ R&D/assets	1.3539***	1.3498***	1.3454***
	(0.437)	(0.441)	(0.441)
Δ Business diversification	0.0166	0.0148	0.0146
	(0.093)	(0.095)	(0.094)
Δ Geographical diversification	-0.0426	-0.0397	-0.0387
	(0.035)	(0.036)	(0.035)
Financial crisis	-0.0438	-0.0473	-0.0482
	(0.031)	(0.033)	(0.033)
Constant	0.0758***	0.0706***	0.0707***
	(0.014)	(0.017)	(0.017)
Year dummies	YES	YES	YES
No. of observations	2016	2016	2016
F	48.2400	42.4800	38.9200
Prob > F	0.0000	0.0000	0.0000