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Does multinationality matter? Implications of operational hedging for the exchange risk exposure [☆]

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ABSTRACT

An important issue in global corporate risk management is whether the multinationality of a firm matters in terms of its effect on exchange risk exposure. In this paper, we examine the exchange risk exposure of US firms during 1983–2006, comparing multinational and non-multinational firms and focusing on the role of operational hedging. Since MNCs and non-multinationals differ in size and other characteristics, we construct matched samples of MNCs and non-multinationals based on the propensity score method. We find that the multinationality in fact matters for a firm's exchange exposure but not in the way usually presumed – the exchange risk exposures are actually smaller and less significant for MNCs than non-multinationals. The results are robust with respect to different samples and model specifications. There is evidence that operational hedging decreases a firm's exchange risk exposure and increases its stock returns. The effective deployment of operational risk management strategies provides one reason why MNCs may have insignificant exchange risk exposure estimates.

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1. Introduction

An important issue in global corporate risk management is whether the multinationality of a firm influences its exchange risk exposure. Existing studies of corporate exchange risk exposure (e.g., Jorion, 1990; Choi and Prasad, 1995; Allayannis and Ofek, 2001; Bodnar and Wong, 2003; Faff and Marshall, 2005) generally suggest that a firm's exchange exposure increases with a measure of its international operations. This underscores a popular presumption (e.g., textbooks by Eiteman et al., 2006; Shapiro, 2006) that multinational corporations (MNC) – with their higher degree of international operations – generally face greater exchange risk exposure than non-multinational firms. Multinationals are directly exposed to exchange risk through their international assets and liabilities as well as operating cash flows and hence are subject to both accounting and economic exchange exposures at home

and abroad. Non-multinational firms, on the other hand, only encounter indirect competitive exposures at home (or transaction exposures if they engage in international trade with domestic production). It follows that MNCs would have higher exchange risk exposures than non-multinationals if the combined accounting and economic exposures faced by the multinationals are greater than the domestic economic (or transaction) exposure of non-multinationals.

Theoretically, the opposite result, however, is also possible since the exchange exposure is not domicile-specific, but operation-specific. Marston (2001) develops a theoretical model where a purely domestic firm faces exchange risk because of competition with international firms and where MNCs may have smaller exposure elasticities than non-multinationals involved in domestic production and international trade. Hodder (1982) devises a model where the firm's exchange exposure depends on foreign liabilities as well as assets. Choi (1986, 1989) argues that, depending on the operating characteristics of the firms and the markets in which they operate, the accounting and economic effects of foreign operations (as well as the domestic and foreign economic exposure effects) may partially cancel out. These models suggest a theoretical possibility that the net exchange exposure faced by multinational firms may be greater or smaller than that of non-multinationals. Moreover, multinational firms – compared to comparable non-multinational firms – may possess superior capability for reducing

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exchange risk through financial hedging (e.g., Allayannis and Ofek, 2001) and operational strategies (e.g., Pantzalis et al., 2001).¹ This may contribute to a lowering of the measured, ex-post exchange risk faced by multinational firms. The issue of how the exchange risk exposures differ for multinationals versus other firms is thus an empirical one.

Numerous studies examine the exchange risk exposure of US firms at the market level, but little work has been done on the comparison of exchange risk exposures of US multinational versus non-multinational firms using a disaggregate sample.² Regarding non-US firms, He and Ng (1998) find no evidence of economically significant exchange exposures for Japanese MNCs for the period of 1979–1993. Considering time variability, Doukas et al. (1999), however, report that the exchange risk premium is larger for Japanese multinational and export firms than domestic firms for the period of 1975–1995, confirming the positive association between exchange exposure and international operations. Little empirical work has been done on the impact of operational hedging.

In this paper, we examine the exchange risk exposure of US firms comparing multinational and non-multinational firms and focusing on the role of operational hedging for the period of 1983–2006. Since multinational and non-multinational firms differ not only in terms of where their productive assets are but also in terms of their firm sizes and other characteristics, we adopt the propensity score method used by Villalonga (2004) to construct matched MNC and non-MNC samples. We find that the multinationality matters for exchange exposure, but not in the way usually presumed. The exchange risk exposure is actually significant for non-multinationals but not for MNCs even for the matched sample. The exchange risk coefficients are also larger, in absolute magnitude, for non-multinationals than for multinationals. The results are robust with respect to different samples and model specifications as well as estimation methods.

To understand why MNCs would have an insignificant exchange risk exposure, we further estimate the effect of operational hedging on the exchange exposure and stock returns. The results show that the effect of operational hedging, after controlling for financial hedging and other firm-specific variables, is significant in both lowering the exchange risk betas and in increasing stock returns. The effective deployment of operational risk management strategies provides one reason why MNCs may have insignificant exchange exposure despite their significant international operations.

The rest of the paper is organized as follows: Section 2 describes the data used in empirical work. Section 3 provides a benchmark estimation of exchange exposure for the undifferentiated total sample. Section 4 is our main section that estimates the exchange exposure for a matched sub-sample of MNCs and non-MNCs. Section 5 examines the effects of operational and financial hedging on the exchange risk exposure and stock returns, and Section 6 discusses our conclusions.

¹ If multinational firms are bigger than non-multinationals, firm size can influence the exchange risk exposures. Larger firms may have economies of scale in risk management (Nance et al., 1993), but smaller firms may have more incentives to hedge because of greater bankruptcy potentials. In this paper, MNC and non-MNC samples are matched by firm size, industry and other firm characteristics by a propensity score method.

² For studies on exchange exposure of industrial US firms using undifferentiated total samples, see Adler and Dumas (1984), Jorion (1990), Bodnar and Gentry (1993), Bartov and Bodnar (1994), Choi and Prasad (1995), Prasad and Rajan (1995), Chow et al. (1997a, 1997b), Domingues and Tesar (2001), Allayannis and Ofek (2001), Allayannis and Weston (2001), Koutmos and Martin (2003), Choi and Kim (2003), and Bodnar and Wong (2003). For similar undifferentiated studies for non-US firms, see, e.g., Bartram (2004), Faff and Marshall (2005), Muller and Verschoor (2006b, 2007), and Chue and Cook (2008).

2. Data and descriptive statistics

We use firm-specific multinational and non-multinational corporate data for the US to estimate the exchange risk exposures based on monthly data for the period from January 1983 to December 2003. We also study the impacts of financial and operating hedging based on annual data during the period of 2000–2006 when firms reported fair values for derivatives in their financial statements according to the FASB 133 enacted in 1999. The sample period used in exposure estimations covers 21 years of the flexible exchange rates with full economic and currency cycles after the oil shock and the high interest rate regime in the early Reagan era. Monthly time series of dividend-adjusted stock returns are obtained from the University of Chicago CRSP (Center for Research in Security Prices) tapes. A total of 889 firms with complete data for the entire sample period are selected. From this total sample, 240 multinational firms incorporated in the US are identified. Dunning (1973) defines an MNC as a firm that has production facilities located in more than one country. Hence, a firm with foreign sales or profits but without any foreign production facilities is not an MNC. We follow the screening method used in the *Directory of Multinationals* (1998) and classify MNCs as firms that have over \$500 million foreign sales with at least three country representations in the *Compustat* (North America) database as of the end of 1996, which is close to the midpoint of our sample period.³ As will be discussed in more detail, a matched MNC and non-MNC sample is also created using the propensity score method used by Villalonga (2004).

Given the aggregation problem indicated by Khoo (1994), Choi and Prasad (1995), and Muller and Verschoor (2006a), we estimate the exchange risk exposure at a firm level. The results are presented by groups of MNCs versus non-MNCs and also by industry. In the industry analysis, we use the four-digit Standard Industrial Classification (SIC) code. However, due to the limited number of MNCs for certain industries during the period of 1983–2003, we streamlined major industry categories in the SIC code into six: agriculture, forestry and fishing, mining and construction (0100–1799), manufacturing (2000–3999), transportation, communication, electric, gas and sanitary services (4000–4991), wholesale and retail trade (5000–5999), finance, insurance and real estate (6000–6799), and services (7000–8900). Public administration (9000–9899) is excluded because of its unique characteristics. While we recognize that this broader industry categorization may mask some detailed industry characteristics, this breakdown provides us with sufficient sample space within each industry.

The exchange rate variable used is the Real Broad Index series, which is the price-adjusted value of the multilateral trade-weighted basket of 35 foreign currencies per one US dollar, as published in the *Federal Reserve Bulletin*. This is a new real multilateral exchange rate index series, prepared by the Fed, and replaces the discontinued G-10 effective exchange rate index. A reciprocal of this index is used to calculate the rate of changes in the dollar value of the composite foreign currency. In bilateral exchange rate models, the rate of change in inflation-adjusted, dollar/pound exchange rate and the dollar/100 yen exchange rate are used. The market return is measured by changes in value-weighted CRSP dividend-adjusted stock market index. Instrumental variables used in

³ The actual list of MNCs in the *Directory of Multinationals* excludes financial companies and some high-tech firms in order to keep the total number of US and non-US multinational firms at 500. The *Directory* changed its definition of MNCs somewhat over the sample period. We have used the 1996 standard through the entire sample period. Our list of 240 US MNCs stems from the application of the *Directory* standard to the dataset obtained from *Compustat*. The *Directory of Multinationals* has been used to screen MNCs in existing work (e.g., Fatemi, 1984) and (Doukas and Travlos, 1988) and is superior to an alternative specification such as the foreign sales ratio.

conditional models are obtained from *Compustat* or from the *International Financial Statistics* published by the IMF.

Table 1 provides descriptive statistics for the data used in the study, divided by MNCs and non-multinationals according to the classification discussed above. In Panel A for the total raw unmatched sample, it is immediately clear that MNCs, as a group, are much larger than non-multinationals. The average asset size for MNCs is almost 40 times that of non-multinationals; a similar relative scale is seen between the two groups in terms of sales and the market value of equity as well. While the estimation of the exchange exposure can still proceed with the firm size included as an independent variable, it may be more appropriate to adjust the two samples directly for firm size and other characteristics. Therefore, we follow Villalonga (2004) and created a matched sample of MNCs and non-MNCs by dynamically matching the propensity scores estimated by a probit model for multinational and non-multinational firms within each industry. Specifically, for each year during 1983–2003, each MNC is matched, within its industry, with one or more non-multinationals whose propensity scores, as of the previous year-end, are within $\pm 25\%$ of the corresponding asset size of that particular MNC. This process is repeated until all MNCs are compared with firms in the non-MNC sample. In the case that no matches are found, the firm is dropped from the matched sample. The propensity scores are constructed for all firms in the total unmatched sample for the 21-year time period from the predicted values of a probit model indicating whether a firm is a MNC. The explanatory variables in the probit model (signs are all significant and are in parentheses) include constant (–), risk (–), profitability (+), and size (+). In this specification, risk is the variance of the firm's return on assets (ROA) over the three previous years, profitability is the average ROA over the three previous years, and size is the natural logarithm of total sales.⁴

There are sufficient firm-specific observations (or average number of firms) even after matching. In total, there are 33,996 and 61,200 firm-month observations (135 and 243 firms on average) in the MNC and non-MNC matched samples, respectively. This compares with the original unmatched sample of 60,480 and 163,548 firm-month observations (and 240 and 649 firms) of MNCs and non-MNCs, respectively. Panel B reports descriptive statistics for the MNC and non-MNC samples matched by propensity scores and industry. Firm sizes, measured by sales, asset or equity values, are now comparable between the two groups, although multinationals are still somewhat larger than non-multinationals due to the $\pm 25\%$ deviation rule permitted by the matching scheme. The foreign sales ratios are much larger for MNCs than non-MNCs, as they should be, in both the unmatched and matched samples. In the matched sample, MNCs have an average foreign sales ratio of 34% compared with 9% for non-MNCs, a narrower gap compared to 39% versus 4% in the unmatched sample.

3. A preliminary benchmark estimation for the total sample

In this section, which is prior to the estimation of the exchange exposures by the MNC and non-MNC sub-samples, we perform a preliminary benchmark estimation of the exchange exposures of the firms in the total monthly sample for the period from January 1983 to December 2003. The sample includes both the basic unmatched total sample and the matched sample based on the propensity score matching method discussed above. Two empirical models – the standard two-factor model (2F) and the extended Fama–French model (FF) – are estimated using both the multilat-

eral and bilateral exchange rates. The purpose of this preliminary section is twofold: First, we show the consistency with existing work that estimates the exchange risk exposure coefficients for the aggregate sample without differentiating between multinational and non-multinational firms. Second, we validate the empirical models of our main results for the multinational and non-multinational sub-sample analysis contained in subsequent sections.

The two-factor (2F) model expresses the firm i 's excess stock return at time t , R_{it} , as a function of excess market return, R_{mt} , and the exchange risk factor R_{et} :

$$R_{it} = \alpha_i + \beta_m R_{mt} + \beta_e R_{et} + v_{it} \quad (1)$$

The coefficient, α_i , is the individual firm intercept, β is the market or exchange risk exposure coefficient in the fixed effect specification, and v_{it} is a normally distributed idiosyncratic error term. The excess return in the left-hand side is defined as dividend-adjusted monthly firm return (in decimal) over the 30-day US Treasury bill interest rate. The market risk factor is the value-weighted, dividend-adjusted return on stocks listed on the NYSE, AMEX and NASDAQ in excess of the 30-day US Treasury bill rate. The exchange risk factor is the real exchange rate (the US dollar per unit of the foreign currency). This implies a random walk assumption that actual exchange rate changes are the same as unexpected exchange rate changes.⁵ Two measures of real exchange rates are used: a reciprocal of the real multilateral series from the *Federal Reserve Bulletin* and the real bilateral exchange rate, defined as the US dollar value of one British pound or 100 Japanese yen (obtained from the *International Financial Statistics*) adjusted by the relative consumer inflation of the two countries. In both measures, an increase in exchange risk factor indicates an appreciation of the foreign currency or a depreciation of the US dollar in real terms. Eq. (1) can also be extended to incorporate nonlinearity as well as a lagging exchange risk factor (e.g., Muller and Verschoor, 2006a). This model has been used in numerous empirical studies (see Footnote 1).

We also use the extended Fama and French (FF) model (1992, 1993) with the addition of the exchange risk factor. In effect, we are adding the Fama–French size and book-to-market factors in Eq. (1) to obtain:

$$R_{it} = \alpha_i + \beta_m R_{mt} + \beta_e R_{et} + \beta_{SMB} SMB_t + \beta_{HML} HML_t + v_{it} \quad (2)$$

where SMB_t (Small minus Big) and HML_t (High minus Low) are size and book-to-market factors as defined, respectively, by Fama and French. These two FF factors are obtained from Wharton School WRDS database and are the same as those from Kenneth French's website. Similar to Eq. (1), we also extend the model to consider the effect of a nonlinear or a lagged exchange risk factor.⁶

The two models are estimated by pooled time series-cross sectional panel regressions, with the fixed effect specification. The fixed effect model assumes varying intercepts across time and firm but a constant error variance, while the random effect model assumes varying error variances but a constant intercept. Although the estimation results from both specifications are comparable,

⁵ We also used an orthogonalized exchange risk factor vis-à-vis the market return. In this specification, the exchange risk coefficient captures the “residual” exchange rate effect, net of that which operates through the overall market returns. The results from using the orthogonalized exchange risk factor are consistent with those from using the unorthogonalized exchange risk factor presented in the text. Bodnar and Wong (2003) discuss the implications of orthogonalized and unorthogonalized exposure coefficients.

⁶ Prior to estimation of Eqs. (1) and (2), we conducted an augmented Dickey–Fuller unit root test for all variables used in regressions and found that they are all stationary. Correlation analysis also did not suggest a multicollinearity problem between the exchange risk factor and other explanatory variables. Also, given the long time period (21 years) and more than 224,028 raw (and 95,196 matched) firm-month observations, estimations are done by panel regressions on monthly data in Tables 2–4.

⁴ These are variables as used by Villalonga (2004), but she uses additional explanatory variables in the probit model and iterates for model solutions. We are more parsimonious in this paper because of data limitation. Alternatively, we also used total asset instead of sales for firm size and obtained similar results.

Table 1
 Descriptive statistics for the total sample. This table provides descriptive statistics for the total sample of firms used in the paper. Panel A describes the total unmatched sample of US MNCs and non-MNCs, for the period from January 1983 to December 2003. MNCs are defined according to the criteria used in the *Directory of Multinationals*, and include firms that exceed \$500 million in foreign sales and have operating presence in at least three countries as of the end of 1996. Stock return and standard deviation (SD) of monthly returns are monthly averages; others are yearly averages. Since MNCs and non-MNCs may be different in size and other characteristics, we also created a matched sample in Panel B, where MNCs and non-MNCs are paired dynamically in terms of their propensity scores following Villalonga (2004). Specifically, for each year during 1983–2003, each MNC is matched, within its industry, with one or more non-MNCs whose propensity scores as of the end of the previous year are within $\pm 25\%$ of the corresponding propensity score of that particular MNC. The procedure is repeated until all MNCs are compared with firms in the non-MNC sample. In case no such matches are found, the firm is dropped from the sample. The propensity scores are constructed for all firms in total unmatched sample based on the predictive values from a probit model of whether a firm is a MNC. The probit model shows significance (signs in parentheses) for constant (–), risk (–), profitability (+), and size (+).

	MNC		Non-MNC		F (Z) Test for equality
	Mean	Median	Mean	Median	
<i>(A) Total unmatched sample</i>					
<i>The total number of firm-month observations during the data period of January 1983–December 2003 is 224,028, with 60,480 MNCs and 163,548 non-MNCs. The average numbers of firms for MNC and non-MNC samples are 240 and 649, respectively</i>					
Monthly stock return	.63%	.61%	.68%	.67%	16.4** (3.4**)
SD of monthly stock return	5.34%	N/A	5.51%	N/A	8.7**
Asset (\$ million)	424.58	365.34	10.84	9.91	394.6** (14.7**)
Sales (\$ million)	451.23	384.59	11.03	10.12	384.9** (16.9**)
Market value of equity (\$ million)	425.11	360.17	10.91	9.93	336.5** (11.5**)
Foreign sales ratio	.39	.37	.04	.03	17.3** (3.7**)
Book to market value of equity	.19	.19	.19	.19	1.0 (0.1)
Long term debt to total asset	.19	.19	.18	.18	1.0 (0.2)
<i>(B) Matched sample by propensity score</i>					
<i>The total number of firm-month observations during the data period of January 1983–December 2003 is 95,196, with 33,996 MNCs and 61,200 non-MNCs. The average numbers of firms for MNC and non-MNC samples are 135 and 243, respectively.</i>					
Monthly stock return	.69%	.68%	.69%	.68%	2.0 (0.2)
SD of monthly stock return	5.39%	N/A	5.21%	N/A	6.1**
Asset (\$ million)	132.47	116.74	108.92	95.67	53.8** (2.9**)
Sales (\$ million)	160.21	142.38	131.31	117.56	44.7** (3.3**)
Market value of equity (\$ million)	130.83	111.67	109.12	96.97	49.3** (2.9**)
Foreign sales ratio	.34	.33	.09	.08	20.4** (3.3**)
Book to market value of equity	.24	.23	.24	.24	1.6 (0.3)
Long term debt to total asset	.19	.18	.19	.18	1.8 (0.1)

** Indicates 5% level of significance, in two-tail tests.

the Hausman (1978) specification test indicates a preference for the fixed effect model over the random effect model because of the bias produced in the latter. Estimation of the models is done using the method developed by Chamberlain (1982, 1985) and Macurdy (1981, 1985) to obtain asymptotically efficient estimates after correction for conditional heteroskedasticity and serial correlation.⁷

Table 2 presents the benchmark estimation of models (1) and (2) for the matched and unmatched total sample, using the firm-level and multilateral and bilateral exchange rate data. On the whole, the results indicate that the exchange risk coefficients are more significant in the unmatched sample than in the matched sample. In the two-factor model, the contemporaneous exchange risk coefficient is significant in one of the three cases (and the lagged exchange risk coefficient is also significant) at the 10% level for the unmatched sample in Panel A. For the matched sample in Panel

B, none of the exchange risk coefficients in the 2F model are significant. Similarly, in the FF model, all three contemporaneous exchange risk coefficients are significant in the unmatched sample (Panel A), while none are significant in the matched sample (Panel B). The decline in the level of significance of the exchange risk factor in the matched sample as opposed to the unmatched sample is due to the elimination of idiosyncratic firm variables such as size, profitability and risk, which are already taken into account in the propensity score matching process. The strong versus weak dollar dummy and the exchange risk quadratic terms are all statistically insignificant.

Another notable result in Table 2 is that the exchange risk coefficients are more significant in the FF model than in the standard 2F model. For instance, in the unmatched firm sample, all three contemporaneous exchange risk factors in the FF model are significant compared with one in the 2F model. All size and book-to-market factors included in the FF model are significant at the five percent level, and their presence seems to boost the significance of the exchange risk factor. Overall, the weak performance of the exchange risk factor in the 2F model is consistent with the results reported in existing works (Footnote 1) that also use unmatched aggregate firm sample. It is comforting, though, that whether significant or not, all contemporaneous and lagged

⁷ To address the issue of potential variability in error terms, we also used the GARCH (1,1) model to consider the impact of varied exchange rate volatility in different time periods. The GARCH (1,1) structure is identified by following the procedure suggested by Bollerslev (1986). The results of the GARCH estimation for the exchange risk factor from the aggregate sample are comparable to those from the panel regressions in the 2F model, and are somewhat inferior to those in the FF model.

Table 2

Exchange risk exposure for the aggregate sample: benchmark estimation. This table reports the results of the extended two-factor and Fama–French models estimated by pooled panel regressions with the fixed-effect specification for the aggregate unmatched and matched monthly samples for the period from January 1983 to December 2003. In both models, the left-hand side variable is the value-weighted, dividend-adjusted stock return for a firm. In the extended two-factor model, explanatory variables include two Fama–French (1992, 1993) factors – SMB_t (Small minus Big) and HML_t (High minus Low) available from the French website – in addition to excess market return (the value-weighted return on stocks listed on the NYSE, AMEX, and NASDAQ in excess of the 30-day US treasury bill interest rate), and the exchange risk factor. The exchange risk factor is the rate of change in the value of the foreign currency against the US dollar using the real multilateral exchange rate series published by the *Federal Reserve Bulletin*. An increase in the exchange risk factor indicates an appreciation of the foreign currency or a depreciation of the US dollar. In addition to the contemporaneous exchange risk factor, lagged and squared exchange risk factors are also included. A strong/weak dollar dummy variable is identified as before and after February 1985 by a regime switch regression. Estimations are done using the procedure developed by Chamberlain (1982, 1985) and Macurdy (1981, 1985) to obtain asymptotically efficient estimates after correction for conditional heteroskedasticity and serial correlation. The unmatched sample in Panel A includes all NYSE, AMEX, and NASDAQ firms for which data are available with positive values for the market and book values of equity as of the end of December in the preceding year. The matched firm samples of MNCs and non-MNCs in Panel B are constructed by the propensity score method based on the predictive values from a probit model (see Table 1). Panel C reports the exchange risk exposure coefficients using the bilateral real exchange rates for the value of one British pound and one hundred Japanese yen against the US dollar, adjusted by the consumer inflation rates of the two countries, based on the matched aggregated sample by propensity scores. Data sources: Compustat, Compact Disclosure, CRSP, International Financial Statistics, the Federal Reserve Bulletin, and WRDS.

Variables	Two-factor model			Fama–French model		
	1	2	3	1	2	3
<i>(A) Total unmatched sample</i>						
Excess market return	.98**	.98**	.98**	.99**	.99**	.99**
Exchange risk factor	–.10*	–.09	–.09	–.12*	–.13*	–.13*
Exchange risk factor lagged		–4.32*			–2.84	
Exchange risk factor squared			.00			.00
Strong/weak dollar			.01			.01
Size factor (<i>SMB</i>)				.15**	.14**	.15**
Book-to-market factor (<i>HML</i>)				.23**	.23**	.24**
Adjusted R^2	.77	.77	.78	.84	.84	.85
F-Statistics	60.1**	62.2**	69.5**	78.7**	80.9**	86.5**
<i>(B) Matched sample by propensity score</i>						
Excess market return	.94**	.94**	.94**	.94**	.94**	.94**
Exchange risk factor	–.07	–.07	–.07	–.08	–.08	–.08
Exchange risk factor lagged		–.02			–.01	
Exchange risk factor squared			.17			.98
Strong/weak dollar			.00			.00
Size factor (<i>SMB</i>)				.11**	.11**	.11**
Book-to-market factor (<i>HML</i>)				.20**	.20**	.20**
Adjusted R^2	.81	.81	.82	.87	.87	.87
F-Statistics	71.5**	72.6**	75.1**	94.6**	96.4**	98.9**
<i>(C) The bilateral exchange rate exposures for the matched sample</i>						
Variables	Two-factor model					
	1		2		3	
	\$/¥	\$/£	\$/¥	\$/£	\$/¥	\$/£
Excess market return	.95**	.95**	.95**	.95**	.95**	.95**
Exchange risk factor	–.05	–.05	–.05	–.05	–.05	–.05
Exchange risk factor lagged			–.02	–.00		
Exchange risk factor squared					–5.25*	–2.55
Strong/weak dollar					.01	.01
Adjusted R^2	.59	.46	.59	.47	.62	.48
F-Statistics	19.7**	25.6**	19.9**	26.9**	28.7**	27.2**
Variables	Fama–French model					
	1		2		3	
	\$/¥	\$/£	\$/¥	\$/£	\$/¥	\$/£
Excess market return	.95**	.95**	.95**	.95**	.95**	.95**
Exchange risk factor	–.06	–.06*	–.06	–.07	–.06	–.06
Exchange risk factor lagged			–.01	–.00		
Exchange risk factor squared					–6.49*	–.19
Strong/weak dollar					.00	.00
Size factor (<i>SMB</i>)	.09**	.09**	.09**	.09**	.09**	.09**
Book-to-market factor (<i>HML</i>)	.19**	.19**	.19**	.19**	.19**	.19**
Adjusted R^2	.62	.56	.62	.56	.63	.56
F-Statistics	34.5**	39.4**	35.0**	40.0**	37.1**	40.5**

* Denotes significance at 10% level in two-tail tests.
 ** Denotes significance at 5% level in two-tail tests.

exchange risk factors, without exception, are negative. This shows that an increase in the real value of the foreign currency (or a decrease in US dollar) is associated with a decline in US stock returns.

We also used the bilateral real exchange rate for the matched firm sample in Panel C. The two bilateral exchange rates used are the US dollar value of one British pound or one hundred Japanese yen in real terms. The results show a statistically insignificant contemporaneous coefficient for the dollar-yen risk in both the 2F and FF models, and also one significant nonlinear exchange rate change

term in both 2F and FF models, all at the 10% level. The dollar/pound risk coefficient is significant in one case in the FF model, and none in the 2F model.⁸ These results are weak but comparable to the multilateral exchange rate results for the matched sample. Note that the matched firm sample is a more conservative case, that is, it generates fewer significant exchange risk coefficients than the

⁸ We also estimated the dollar/euro exposure coefficient for the period of January 1997–December 2003. The results are qualitatively the same as those for the dollar/pound.

Table 3
Exchange risk exposures for US MNCs versus Non-MNCs (matched and unmatched sample). This table reports the result of the extended two-factor and Fama–French models estimated by pooled panel regressions with the fixed-effect specification for the total unmatched sample and for the matched MNC and non-MNC samples for the period from January 1983 to December 2003. The matching is done by the propensity score method (see Table 1). The left-hand side variable is the value-weighted, dividend-adjusted stock return for a firm. The exchange risk factor is the rate of change in the value of the foreign currency against the US dollar using the real multilateral exchange rate series published by the *Federal Reserve Bulletin*. An increase in the exchange risk factor indicates an appreciation of the foreign currency or a depreciation of the US dollar. Estimation is done by the same method as used in Table 2. Presented below are the coefficients for the linear exchange risk factor. See Table 2 for the model and data.

Industry description (SIC code)	N	Two-factor			Fama–French		
		MNC	Non-MNC	F-test	MNC	Non-MNC	F-test
<i>(A) All firms</i>							
Unmatched sample	224,028	-.04	-.10*	3.8*	-.07	-.13**	33.6**
Matched sample	95,196	-.00	-.08	1.8	-.02	-.09*	3.7*
Agriculture, forestry and fishing; mining; construction (0100–1799)	4,416	-.03	-.05	2.7	-.10	-.12	1.8
Manufacturing (2000–3999)	48,900	-.05	-.04	1.9	-.02	-.05	1.8
Transportation, communication, electric, gas, and sanitary services(4000–4991)	12,216	.03	-.24**	33.6**	.06	-.35**	44.8**
Wholesale and retail trade (5000–5999)	10,272	-.06	-.25**	38.2**	-.10	-.16**	16.3**
Finance, insurance, and real estate (6000–6799)	8,292	-.14	-.15	1.4	-.10	-.19*	2.8*
Services (7000–8900)	11,100	-.02	-.04	2.1	-.01	-.04	2.1
F-test for the null of equal exchange risk exposure coefficients across industries		13.8**	31.2**		10.5**	44.1**	
<i>(B) The breakdown of the non-MNC sample</i>							
		Firms with international trade			Pure domestic firms		
		N	Two-factor	Fama–French	N	Two-factor	Fama–French
Unmatched sample	59,136		-.13*	-.14**	104,412	-.08	-.11*
Matched sample	26,412		-.07	-.04	34,788	-.07	-.15**
F-test for the equality of coefficients			2.7	47.2**		1.4	18.5**

N = the number of firm-month observations.

* Denotes significance at 10% level, in two-tail tests.

** Denotes significance at 5% level, in two-tail tests.

unmatched sample. Overall the generally insignificant exchange risk coefficients from the total firm sample are consistent with the similar results reported in existing work.

4. Exchange exposures of MNCs versus non-MNCs

Our primary interest is in the exchange exposure coefficients from the sub-samples of multinational and non-multinational firms, reported in Table 3. We note, in Panel A, that the F-test shows that the MNC and non-MNC samples are distinct in terms of their exchange risk coefficients. The null hypothesis of identical aggregate exchange exposure coefficients across the MNC and non-MNC samples is rejected for the unmatched raw sample in both 2F and FF models and for the matched sample in the FF model.

More specifically, we see that the exchange exposure coefficients are negative in all cases in Table 3, as in Table 2. However, it is remarkable that the unmatched sample for all firms in the first row of Panel A shows that the exchange risk coefficients are statistically significant for the non-multinational sample, but not for the MNC sample, and this is true in both the 2F model and the FF model. Similarly, in the FF model for the matched sample, the exchange risk coefficient is significant for the non-multinational sample, but not so for the MNC sample. Moreover, it is noteworthy that across models and samples the exchange risk coefficients are larger, in absolute magnitude, for non-multinationals than MNCs. The popular notion in existing work (e.g., Doukas et al. 1999; Allayannis and Ofek, 2001; Faff and Marshall, 2005), as well as textbooks such as Eiteman et al., (2006) is that the firm's exchange exposure increases with the degree of international operations. The present finding that the exchange exposure coefficients of MNCs are actually less significant (and smaller in magnitude) than those of non-MNCs provides concrete evidence against this notion.

Our finding that MNCs have lower exchange risk exposures than non-MNCs, however, is not difficult to understand. Multinationals operate in various currency zones and the exchange risk exposures of their operating cash inflows and outflows in various countries may cancel out each other, causing a reduction in net exposure. In effect, this is a natural form of exposure netting which is a meth-

od of operational hedging outlined in Shapiro (2006). In addition, MNCs may be more efficient in implementing effective exchange risk management than non-multinational firms. Dumas (1978) argues that the currency exposure contains an “operational” element that may lessen the exchange-rate effect on the firm's market value. For example, MNCs' ability to shift production from one country to another to protect themselves from the unexpected fluctuations of foreign exchange movements would tend to reduce their currency exposures. Therefore, MNCs, with their ability to engage in operational and financing hedging as well as natural risk reduction due to geographic diversification, should be able to offset some of the exchange exposures they face in foreign markets.

A similar pattern is observed in the industry results in Panel A (only the results for the matched sample are reported). In the non-MNC sample, out of the total of six industries, the linear exchange rate coefficients are significant and negative for two industries (transportation, communication and utilities; wholesale and retail trade) in both the 2F and FF models, and for one additional industry (finance, insurance and real estate) in the FF model. In contrast, none of the six industries show a significant exchange risk coefficient for MNCs in either model. Marston (2001) and Bodnar et al. (2002) suggest that the exchange risk exposure may increase with product and input substitutability, independent of whether the firm is a domestic or international firm. Finance, and wholesale and retail trade may have high product and input substitutability because of the homogeneity of the services they provide (i.e. commodity-like services). Choi et al. (1992), Chamberlin et al. (1997) and others document significant exchange risk exposure for US financial firms, while most studies of manufacturing firms (Footnote 1) report generally insignificant results for the aggregate sample. The significance of the exchange risk exposure for transportation, communication and utilities may reflect the nature of global competition in these industries. However, consistent with existing work, manufacturing firms show insignificant exchange exposure coefficients in either sample or in either model.

One can object to the definition of non-MNCs, which are defined above as a single category against which MNCs are compared. However, non-MNCs include firms that are purely domestic as well

as those engaged in domestic production plus international trade. Panel B provides a breakdown of non-MNCs into trading firms and purely domestic firms. Due to the difficulty of obtaining export and import data at the firm level, trading firms are assumed to be those with foreign sales, and domestic firms are those that indicate no foreign sales. There are 59,136 firm-month observations for trading firms compared with 104,412 for purely domestic firms in the raw unmatched sample.⁹ The results show that the exchange exposure coefficients are significant for trading firms but not for purely domestic firms in the two-factor model, while both trading and domestic firms may have significant exposure coefficients in the extended Fama–French model. However, as expected, the absolute magnitudes of exposures are greater for trading firms than for purely domestic firms in both models.

To pursue this point further, we now re-estimate the stock return models after sorting the firms by asset size, by book-to-market ratio, and by the foreign sales ratio. The size and book-to-market ratios are celebrated firm-specific risk factors used by Fama and French (1992). In addition, the use of firm size as a sorting criterion would help to control for the size difference within and between multinational and non-multinational samples, as well as aiding to reduce the potential survivorship bias. The foreign sales ratio was shown to be significant to differentiate MNC and non-MNC samples in Table 1. In addition, it serves to isolate the effect of international trade from that of foreign production. Estimation is performed for each sorted quartile portfolio for the multinational and non-multinational samples. The resulting exchange risk coefficients by quartile portfolio from the 2F and FF models are presented in Table 4.

The results for the unmatched sample in Panel A show that exchange exposures are much more significant for non-MNCs than MNCs. Nine out of twelve exchange risk coefficients, and four out of twelve, are significant, for non-multinationals in the FF and 2F models, respectively. For the MNC sample, none of the coefficients are significant in either model. Moreover, for each quartile sorted portfolio, the magnitude of the exchange coefficients, in absolute value, is invariably larger for non-MNCs than MNCs in either model. Similar results are obtained from the matched sample in Panel B – the exchange exposure coefficients are generally more significant and larger in absolute magnitude for non-MNCs than MNCs. The result with respect to foreign sales ratios is particularly assuring because the crucial difference between MNCs and non-MNCs remains regardless of the level of foreign sales ratios. These results reinforce the earlier results in Table 3.

5. Impact of corporate risk management

As discussed above, the measured ex-post exchange risk exposure coefficient is subject to bias due to corporate risk management. International operational strategies through multinational corporate networks, in particular, provide a way of realizing real risk reduction for the firm. Operational hedging is an additional tool of corporate risk management and may be complementary to financial hedging (Kim et al., 2006).¹⁰ Using the data for US multinationals for 1989–1993, Pantzalis et al. (2001) document the importance of operational hedges as measured by the breadth

⁹ In the matched non-MNC sample (non-MNCs matched to MNCs in terms of industry, size and other characteristics), there are 26,412 and 34,788 firm-month observations, respectively, for trading and domestic firm categories. Compared to the unmatched raw sample, the results are inferior in the matched sample, with a significant exchange exposure for purely domestic firms in the FF model.

¹⁰ Bodnar et al. (1998) report a tendency for US firms to hedge only a fraction of their exchange exposures via financial derivatives. Adam and Fernando (2006) report similar results for gold mining firms. This may reflect the fact that partial hedging is optimal in a risk-return trade-off sense. It is also consistent with the use of operational hedging in addition to financial hedging.

Table 4

Exchange risk exposure for MNCs vs. Non-MNCs for sorted portfolios. This table estimates the extended two-factor and Fama–French models for January 1983–December 2003 on sorted portfolios of MNC and non-MNC firms by three sorting devices: the asset size, the book-to-market ratio, and the foreign sales ratio. Estimation is performed for each sorted quartile portfolio for multinational and non-multinational firms in the unmatched and matched samples. Estimation method and data are the same as in Table 3. The results presented here are the coefficients of the contemporaneous exchange risk factor.

Sorted by	Portfolio	Two-factor model		Fama–French model	
		MNC	Non-MNC	MNC	Non-MNC
<i>(A) Unmatched sample</i>					
Size	A	-.06	-.10*	-.09	-.11*
	B	.02	-.12*	-.04	-.14*
	C	-.09	-.09	-.03	-.12*
	D	-.02	-.09	-.13	-.12*
Book-to-market	A	.04	-.12*	-.02	-.15**
	B	.03	-.07	-.03	-.13*
	C	-.08	-.09	-.07	-.07
	D	-.05	-.06	-.04	-.14*
Foreign sales ratio	A	-.07	-.14*	-.05	-.08
	B	.01	-.07	-.01	-.15*
	C	-.03	-.06	-.03	-.07
	D	-.05	-.09	-.11	-.10*
<i>(B) Matched sample by propensity score</i>					
Size	A	-.02	-.02	-.02	-.10*
	B	.04	-.05*	-.01	-.09*
	C	-.02	-.04	-.04	-.10*
	D	-.01	-.04*	-.01	-.04
Book-to-market	A	.02	-.08*	.01	-.07
	B	.01	-.02	-.08	-.19**
	C	-.01	-.05*	-.08	-.11*
	D	-.03	-.05	-.07	-.04
Foreign sales ratio	A	-.02	-.08*	-.05	-.09*
	B	.00	-.00	.01	-.05
	C	-.02	-.04	-.04	-.17*
	D	-.02	-.10*	-.06	-.18*

* Denotes significance at 10% level, in two-tail tests.

** Denotes significance at 5% level, in two-tail tests.

and depth of the MNC network. Miller and Reuer (1998) show that foreign direct investment reduces a firm's exchange exposure. Pringle and Connelly (1993) argue that, unlike financial derivatives, operational hedging can provide protection against unexpected future exchange rate changes as well as exposure of current transactional cash flows. Allayannis and Ofek (2001) report that the use of financial derivatives generally increases with the degree of a firm's international operations. Hence, to the extent that operational and financial hedging are effective in reducing the risk profile of the firm, they may lower the ex post exchange risk exposure of the firm.

We posit that the exchange risk exposure is a function of operational and financial hedging as well as a firm's multinationality, foreign sales ratio, size, and industry:

$$\beta_{ie,t} = \alpha_i + \beta_{MNC}MNC_{it} + \beta_d D_{it} + \beta_o O_{it} + \beta_b D_{it} \times O_{it} + \beta_{FS}FS_{it} + \beta_{size}Size_{it} + \sum_{k=1}^6 \beta_{it,Industry} Industry_{it,k} + v_{it} \quad (3)$$

where $\beta_{ie,t}$ is the foreign exchange exposure coefficient, MNC_{it} is a multinationality dummy (one if the firm is an MNC as per the definition in the *Directory of Multinationals* as discussed above, and zero otherwise), D_{it} and O_{it} are zero-one dummy variables for the use of financial derivatives and operational hedging, respectively. The financial hedging dummy indicates the use of currency derivatives such as forwards, futures, options and swaps. The operational hedging dummy = 1 indicates the use of any of the following

Table 5
 The effects of corporate risk management on the exchange risk exposure and stock return. The sample is the matched MNC and non-MNC samples for 2000–2006, using the fixed effect model. *Multinationality* is a zero-one dummy denoting the MNC status of the firm based on the criterion used in the *Directory of Multinationals*. *Financial hedging* and *operational hedging* are dummy variables indicating whether the firm reports the use of these respective hedging methods in their financial statements as per the *Compact Disclosure* database. An increase in the exchange risk factor indicates an appreciation of the foreign currency or a depreciation of the US dollar. For the definition of other variables, see Table 3.

(A) *The effect on the exchange risk exposure*
 The lefthand side variable is the annual average of exchange risk exposure coefficients as estimated in Table 3. Estimation is based on 1812 firm-year observations for 2000–2006

Variables	Model								
	Combined matched sample	MNC				Non-MNC			
		All exposure	– Exposure	+ Exposure	F test for equality	All exposure	– Exposure	+ Exposure	F test for equality
Multinationality	–.03 [*]								
Financial hedging	.00	.00	.00	.38	.00	.00	.00	.23	
Operational hedging	–.01 [*]	–.03 [*]	–.01	.94	–.01 [*]	–.01 [*]	–.01 [*]	.12	
Financial/operational hedging interaction	.00	.00	.00	.05	.00	.00	.00	.03	
Foreign sales ratio	–.02	–.03	–.03	.36	–.01	–.01	.00	.09	
Ln (Size in \$ Million)	–.00	–.00	–.00	.09	–.00	–.00	.00	.13	
Constant, industry and year dummies	Included								
Adjusted R ²	.30	.20	.22	.14	.19	.19	.16		
F-Statistics	26.7 ^{**}	16.1 ^{**}	20.1 ^{**}	9.0 ^{**}	15.9 ^{**}	18.1 ^{**}	10.9 ^{**}		

(B) *The effect on stock return*
 Estimation is based on 21,744 firm-month observations for January 2000–December 2006. The left-hand side variable is a firm's value-weighted, dividend-adjusted excess return of a firm. For the 2SLS method, instrumental variables in financial and operational hedging equations include system-wide exogenous variables such as firm size, book-market ratio, exchange rate volatility in the previous 12 months, the long-term debt ratio, the yield on 30-year US Treasury bond, and a constant. Since monthly financial and operational hedging data are unavailable, information obtained from quarterly or annual data are repeated for each month during the period. Presented below are the results from the second-stage estimation

Variables	Two-factor model		Fama–French model	
	OLS	2SLS	OLS	2SLS
Excess market return		.940 ^{**}		.936 ^{**}
Size factor (SMB)			.940 ^{**}	.935 ^{**}
Book-to-market factor (HML)			.108 ^{**}	.105 ^{**}
Foreign exchange return	–.005	–.004	.179 ^{**}	.180 ^{**}
Financial hedging	–.000	–.001	–.005	–.004
Operational hedging	.001 ^{**}	.001 [*]	–.000	.000
Financial and operational hedging interaction	.000	.000	.001 [*]	.001
Foreign debt to total debt ratio	.001	.001	.000	.000
Industry and year dummies	Included		.000	.000
Adjusted R ²	.73	.71	.83	.81
F-statistics	20.2 ^{**}	23.1 ^{**}	41.3 ^{**}	37.0 ^{**}

^{*} Denote significance at 10% level, in two-tail tests.

^{**} Denote significance at 5% level, in two-tail tests.

activities (using Shapiro's (2006) definition): risk shifting, exposure netting, risk sharing, marketing strategies, production shifting, and changes in input mix, etc. FS_{it} , the foreign sales ratio, captures variations in the effects of trading firms within the MNC and non-MNC samples as opposed to the multinationality dummy which indicates the presence of global production facilities. Firm size, $Size_{it}$, defined as the natural logarithm of company asset size in millions of US dollars, is included to capture the effect of economies of scale in risk management. *Industry* denotes six industry dummies as defined in Table 3.

Information concerning financial hedging and operating hedging is available from the corporate financial statements reported in *Compact Disclosure* database. While companies are not required to report their operating hedges, many firms disclose such activities, in varying detail, in the management discussion sections of their financial statements. For example, 24.3% of MNCs and 6.3% of non-MNCs in the matched sample disclosed operational hedging strategies during 2000, while 79.2% of MNCs and 51.6% of non-MNCs reported the use of financial derivatives including the use of both interest rate and currency derivatives. For 2000–2006, the correlation between operating and financial hedging dummies for the combined matched sample is 0.37. The Financial Accounting Standard Board (FASB) Rule No. 133 requires US firms to report the use of financial derivatives in their balance sheet at their fair

market values, effective June 15th, 1999. Prior to FASB 133, the derivative accounting practices varied widely as there was no clear valuation or disclosure rule concerning derivatives.¹¹ Consequently, companies started to provide relatively complete and detailed information on their financial hedging activities in their 1999 financial statements, but no consistent data are available until 2000. Therefore, we collected the annual financial and operating hedging data for our matched sample of MNCs and non-MNCs for the period from 2000 to 2006. Out of the total of 1812 firm-year observations in the MNC and non-MNC matched sample, 62%, or 1119 firm-year observations have data on financial derivatives or operating hedging during the 7-year period.

Table 5 uses the MNC and non-MNC matched sample for 2000–2006 to examine the effects of corporate risk management on the exchange risk exposures and stock returns, in Panel A and B respectively. Panel A provides estimated coefficients of Eq. (3) for the

¹¹ FASB 133 does not specify whether the corporate use of derivatives is for hedging or speculation. This issue is taken up and clarified in FASB 161 issued in March 2008. We do not address this issue here since our data period ends before this ruling. To the extent that derivatives are used for speculation purposes (which is unlikely to be pervasive for non-financial firms), this indicates another explanation for our estimation results concerning the coefficients of financial hedging variable in this section.

combined matched sample, and also for the separate MNC and non-MNC matched samples, based on annual firm-year data. The results show that the multinationality dummy variable is significant on the exchange risk exposure. This reiterates the earlier finding (Tables 3 and 4) that a firm's multinationality matters as a determinant of its exchange exposure, even after controlling for corporate risk management considerations.

The result in Panel A also shows statistically insignificant coefficients for financial hedging. This is at odds with Allayannis and Ofek (2001) who report a significant impact of financial hedging on the exchange risk beta. They use the notional currency derivative use data for 378 non-financial Standard & Poors 500 firms during a single year of 1993. We use operational and financial hedging dummies with a size and industry-matched MNC and non-MNC sample of 1812 firm-year observations (or 259 firm averages per year) for the 7-year period of 2000–2006. The difference in time period (as well as our use of matched MNC and non-MNC sample) is important because our sample covers a period when the mandatory disclosure of the fair market value of interest rate and currency derivative usage is in effect.

The variable of importance in our paper is operational hedging, which has a significant and negative effect on the exchange risk beta in the combined matched sample as well as for five out of six cases in the divided MNC and non-MNC samples, albeit at the 10% level (two-tail test). In the divided sample, the effects of operating hedging on exchange risk beta are significant for both MNCs and non-MNCs (the latter presumably against the transaction exposure stemming from exports of domestic products). However, the absolute magnitude of the coefficient of the operating hedging variable is greater for MNCs than for non-MNCs. This suggests that MNCs, as a group, are engaged in operating hedging more and possibly more effectively than non-MNCs. This result is consistent with Kim et al. (2006) who report that "some globally diversified firms use very limited amounts of financial derivatives for hedging purposes despite higher levels of currency exposure (p. 836)." This result also leads us to conclude that the use of operational hedging is one reason why the ex post exchange risk coefficients are found to be both statistically and economically less important for MNCs than non-MNCs.

It is instructive to note that the signs of the operating hedging coefficient in the exchange exposure equation are negative and significant in Table 5 (Panel A), while the signs of exchange exposure coefficients in the stock return equation in Table 3 are also negative and significant. Combined, this would imply a significant and positive effect of operational hedging on stock return, because two negatives become positive, suggesting that the deployment of operating hedging strategies increases the firm's returns. We examine this possibility directly in Panel B of Table 5 by estimating the firm's stock return, using monthly data, as a function of its operating and financing hedging strategies and industry type, as well as the excess market return, the exchange rate changes, and the Fama–French variables included in Eq. (2). An interaction term between financial and operating hedging is also included. Since financial and operating hedging decisions may be endogenous along with stock returns, we also perform simultaneous estimation for these variables using the two-stage least square (2SLS) analysis. Following Choi and Kim (2003), both financial and operating hedging variables are estimated on a set of exogenous instruments such as firm size, the book-market ratio, exchange rate volatility in the previous 12 months, the long-term debt ratio, the yield on 30-year US Treasury bond, and a constant.

The results of the stock return equation in Panel B show a similar pattern as the exchange exposure equation: the financial hedging is insignificant while the operational hedging is significant. The financial derivatives use dummy is statistically insignificant in both the 2F model and the FF models, and regardless of whether

the equation is estimated in a single equation or simultaneous context. Again, this is at odds with the finding of Allayannis and Weston (2001) based on 1993 data that financial hedging is a value-enhancing strategy, but is consistent with Guay and Kothari (2003) who maintain that corporate derivative use is a small piece of non-financial firms' overall risk profiles. Allayannis and Weston (2001) examined the effect of financial hedging on firm value using the undifferentiated total firm data for a single year of 1993.¹² In contrast, we focus on the effect of hedging on firm returns using the MNC data for 2000–2006 when the fair market value disclosure of hedging became mandatory by the FASB 133.

In contrast to financial hedging, the coefficients of the operating hedging variable are significant in both 2F and FF models with single equation estimations, and also in the FF model with 2SLS estimation. The magnitude of the operating hedging coefficients indicate that the employment of operating hedging strategies increases the monthly stock return by 0.1% or the annual return by 1.2% in absolute terms. Chowdhry and Howe (1999) argue theoretically that operational hedging is particularly important when demand uncertainty is large. If so, operational hedging is more important for long term than short term time horizons because demand uncertainty is likely to be greater in the long term. This could help support our positive result on operational hedging based on 7-year data.

In sum, the results in this section support a notion that the finding of less significant ex-post exchange exposure coefficients for MNCs than non-multinationals may be due to the effective use of operating hedging by the former rather than financial hedging. As a cautionary note, the present result is a joint test conditional on the asset return generating model as well as the significance of exchange risk exposure.¹³

6. Conclusion

The period after the breakdown of the Bretton Woods system in 1971 has been accompanied by the globalization of national economies and exchange market volatility. This commonality of two major macro events might have contributed to the popular notion that a firm's exchange risk exposure would increase with the degree of its international operations.

In this paper, we examine how the exchange risk exposures faced by multinationals compares with that faced by non-MNCs. The results indicate that contrary to popular perception, the exchange risk exposures of US multinationals are actually statistically insignificant and smaller in absolute magnitude compared to those faced by matched non-MNCs for the period of 1983–2006. The results are robust across different empirical models and methods, different definitions of exchange risk factor, and different samples. In particular, the results are robust with respect to whether MNCs and non-MNCs are matched by firm size and industry or sorted by foreign sales ratios and Fama and French variables.

To help understand this result, we further examine the effects of corporate risk management on exchange risk exposure and stock returns. The estimation results suggest that operational hedging

¹² In addition, numerous papers examine the value relevance of hedging in a single industry (e.g., (Tufano (1996)) and (Adam and Fernando (2006)) for gold mining, Carter et al. (2006) for airlines, Jin and Jorion (2006) for oil and gas, Choi et al. (2008) for pharmaceutical and biotech). In addition, Frino et al. (2009) show that derivatives can be beneficial for mutual fund holders when there is fund outflows due to investor's liquidity demand.

¹³ This is a common problem shared by all empirical work that uses a stock return model. We tried to allay the problem a bit by using both the extended two-factor and Fama-French models. Brown (2001) notes a similar tune that the estimation of exchange exposure coefficients is a joint test with the pricing of exchange risk. However, in a technical sense, we do not need an asset pricing model in the present empirical work, only an asset return generating model.

strategies may be instrumental in reducing the firm's exchange risk exposure and, thereby, in enhancing the firm's market returns, and this is true after controlling for financial hedging and multinationality. Thus, to the extent that operational hedging is more prevalent for MNCs than non-multinationals, this provides one reason why MNCs may have both statistically and economically less significant exchange risk exposure than non-multinationals.

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