Currency Derivatives for Hedging: New Evidence on Determinants, Firm Risk, and Performance

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Abstract

Employing firm-level data for Korean firms, we find that firms with more export, more foreign currency debt, and higher exchange rate exposure are likely to use more currency derivatives for hedging. 2SLS regressions reveal that while more currency derivatives use does not lead to lower firm risk, such transactions, especially sell transactions, bring in higher firm values. Further, currency derivatives use by firms with high exposure is associated with lower firm risk but lower firm values as well. These findings suggest that currency derivatives work in hedging risk and protecting values for firms with low and manageable exposure.

JEL Classification: F31; G15

Key words: Currency derivatives for hedging; Determinants; Firm risk; Firm performance; Korean firms

1. INTRODUCTION

Corporate management of foreign exchange rate exposure generally involves financial activities as well as operating activities.[1] The financial activities for hedging include currency derivatives, financings through foreign-currency (FC, hereafter) denominated debt, and internal transactions with foreign subsidiaries, among others. Existing studies offer mixed evidence on the effectiveness of currency derivatives. While several studies show positive hedging effects of financial derivatives (e.g., Allayannis & Ofek, 2001; Allayannis & Weston, 2001; Bartram, Brown, & Conrad, 2011; Bartram, Brown, & Minton, 2010; Clark & Judge, 2009; Graham & Rogers, 2002; Guay, 1999), other studies cast doubt on their effectiveness in exposure management (e.g., Bali, Hume, & Martell, 2007; Guay & Kothari, 2003; Hentschel & Kothari, 2001).

In this paper, we revisit the current literature on currency derivatives by exploring two pertinent issues to the usage of currency derivatives for hedging: (1) What firm-specific factors influence the different level of currency derivatives use; and (2) whether hedging with currency derivatives reduces firm risk and enhances firm performance.

First, we examine what firm attributes contribute to the usage of currency derivatives for hedging. As the degree of a firm's hedging need would depend on various firm attributes such as levels of FC income and payment, positions of FC assets and liabilities relative to domestic-currency assets and liabilities, the extent of exporting and importing activities, FC borrowing, foreign exchange risk, we differentiate buy and sell transactions of currency derivatives and examine how firm-specific factors are related to each of these transactions. In this analysis, we further compare the determinants of currency derivatives use among firms with different levels of exchange rate exposure. Existing studies show that firms with greater foreign exchange rate exposure are more likely to use currency derivatives (e.g., Bae &

[1] Operating activities for managing exchange rate exposure include domestic-currency invoicing, matching and offsetting, and exchange rate pass-through, among others.

Kwon, 2013; Geczy, Minton, & Schrand, 1997).[2] As our dataset enables us to measure the *expected* exchange rate exposure which reflects inherent exchange rate risk associated with firms' business activities prior to the usage of hedging tools and thus differentiate firms with different levels of the expected exchange rate exposure, we are able to make new inferences about the nature of hedging activities with currency derivatives for our sample firms. We use this classification to investigate how firm characteristics explain the currency derivatives use for hedging.

Second, we investigate the effects of hedging with currency derivatives on firm risk and performance. The effectiveness of hedging with currency derivatives rests on two aspects of outcome. The first one is the risk management aspect of whether the usage of currency derivatives lowers exchange rate exposure associated with variabilities of cash flows and stock returns. The second one is the firm performance aspect of whether this hedging activity affects firm performance and value positively through the reduced firm risk. In order to assess the effectiveness of hedging with currency derivatives, it is crucial to examine both aspects of hedging activities in a coherent manner.

Our paper focuses on firms in manufacturing and service industries in Korea, one of the premier developing countries, for empirical evidence. Korean firms have long depended on international trades and foreign capital over the last decades, which have made their firm values highly sensitive to exchange rate changes. In addition, the current accounting system has also contributed to the exchange rate exposure of Korean firms as it requires firms to report the translation gains and losses in asset values associated with exchange rate changes in the concurrent year's balance sheets. Consequently, with larger swings in the exchange rates, Korean firms have had much greater needs to manage their exchange rate risk than ever and thus have employed various hedging tools including currency derivatives products (see, e.g., Jung & Kwon, 2007). These observations naturally make Korean firms ideal research targets for the examination of the effectiveness of currency derivatives for hedging.

[2] Geczy, Minton, and Schrand (1997) show that firms with greater growth opportunities, tighter financial constraints and economies of scale in hedging activities are also more likely to use currency derivatives.

Our firm-level data over the period of 2005-2010 reveal that sample Korean firms on average engage in the transactions of currency derivatives equivalent to 3.75% of total assets and are more geared to hedge long positions, or receipts, of FCs by taking short positions in currency forwards. Our regression results show that firms with a higher export ratio, more FC debt, and higher exchange rate exposure are likely to use more transactions of currency derivatives, but firms with a higher import ratio, more intra-firm transactions with foreign subsidiaries are likely to engage in less transactions of currency derivatives. Our results also show that firms tend to take more short positions of currency derivatives when they have less intra-firm transactions with foreign subsidiaries but take more long positions when they have more FC debt.

After controlling for possible endogeneity issues, our 2SLS regression analyses show that while more usage of currency derivatives by Korean firms does not lead to lower firm risk, such transactions, particularly sell transactions, bring in higher market-based firm values measured by Tobin's q and industry-adjusted q. Our results further show that currency derivatives use by firms with high exchange rate exposure is associated with lower firm risk but also with low firm value, indicating that the lower firm risk resulting from hedging with currency derivatives for firms with high exposure is not materialized into higher firm value. This evidence may be attributed to the mismanagement of hedging strategies either due to the implementation of non-optimal hedges (e.g., under- or over-hedges) or due to the excessive costs associated with hedging. The flipped side of this evidence is that when firms have relatively low and manageable exchange rate exposure, currency derivatives work as an effective tool in hedging foreign exchange risk and protecting firm values. A robustness test using market-based risk-adjusted performance measures offers confirmatory evidence on the positive, though weak, effect of currency derivatives use on firm performance.

Our paper is organized as follows. Section 2 reviews related studies and presents main research issues of our paper. Section 3 presents the research design and data including regression models to investigate main research issues. Section 4 reports empirical results, with conclusion in Section 5.

2. LITERATURE LEVIEW AND MAIN RESEARCH ISSUES

While there is evidence supporting that firms use currency derivatives for hedging purposes, not for investing or speculating purposes,[3] extant studies offer mixed evidence on the effectiveness of currency derivatives in reducing foreign exchange risk. In a study of S&P 500 non-financial firms, Allayannis and Ofek (2001) report that the usage of currency derivatives reduces exchange rate exposure. Nydahl (1999) and Chang and Lin (2005) offer similar evidence on the effects of currency derivatives on firm risk for firms in Sweden and Taiwan, respectively. On the contrary, several studies report no clear relationship between currency derivatives use and foreign exchange risk (e.g., Hentschel & Kothari, 2001; Guay & Kothari, 2003). For example, based on their findings that the amount of currency derivatives possessed by most of U.S. firms in their study is economically trivial, Guay and Kothari (2003) cast doubts on the effectiveness of currency derivatives in reducing firm risk.

Regarding the effect of hedging with currency derivatives on firm value, the literature offers rationales in supportive of both positive and negative valuation effects. On the one hand, several studies have advanced rationales for the positive effect of corporate hedging with derivatives on firm value: reduced corporate tax liability generated by less volatile profits (Graham & Smith, 1999; Smith & Stulz, 1985); reduced cost of underinvestment associated with a reduction in the agency conflict between bondholders and shareholders (Bessembinder, 1991; Froot, Scharfstein, & Stein, 1993); reduced financial distress costs that also facilitate higher leverage (Leland, 1998; Smith & Stulz, 1985). On the other hand, other studies have referred to rationales for the negative or no valuation effects of hedging with currency derivatives: ineffective and complex risk management program (Copeland & Joshi, 1996; Hagelin & Pramborg, 2004); managerial motives to invest in value-reducing projects with protected capital (Tufano, 1996); failure to implement optimal hedge ratios and excessive costs of using currency derivatives (Bae,

[3] See, e.g., Allayannis and Ofek (2001) and Brown (2001).

Kim, & Kwon, 2016); underdeveloped derivatives markets and constraints in managing foreign exchange risk (Allayannis, Brown, & Klapper, 2003; Clark & Judge, 2009).

Empirically, existing studies offer mixed evidence too. In a study of large U.S. nonfinancial firms for 1990-1995, Allayannis and Weston (2001) report that FC hedging is associated with higher firm value. Carter, Rogers, and Simkins (2006) also find that firm value is positively related to hedging future jet fuel requirements of 28 U.S. airline companies in such a way that airlines hedging their fuel costs command 5-10% higher firm value than their counterparts. Hagelin (2010) and Clark and Mefteh (2010) offer similar evidence for firms in Sweden and France, respectively. In contrast, Guay and Kothari (2003) question the validity of the Allayannis and Weston (2001) results and demonstrate that derivative positions held by nonfinancial firms are small in economic magnitude, making it difficult to interpret the implications of previous research. Jin and Jorion (2006) find no evidence of any significant positive effect of derivatives hedging on firm value for 119 U.S. oil and gas producers. Bartram, Brown, and Fehle (2009) report no valuation effects for currency derivatives users, though their results show a significant positive valuation effect for firms using all derivatives but without any financial price pressure.

In light of the rationales and empirical evidence for and against value creation through hedging with currency derivatives, the mixed results suggest that there might be a more complicated relationship between currency derivatives use and value creation. For example, firms often fail to employ optimal hedge ratios or proper transactions of currency derivatives for hedging, thus either over- or under-hedging their exchange rate exposure. Then, the consequence would be such that while currency derivatives use may reduce foreign exchange risk, this reduction in risk may not necessarily lead to an increase in firm value due to the non-optimal hedging and/or excessive costs of hedging (Bae, Kim, & Kwon, 2016). To this end, our paper takes empirical approaches distinctively different from those in the existing studies. First, we employ both accounting-based and market-based measures of firm risk and performance due to the notion that accounting- and market-based measures often lead to different evidence and implications.

In all analyses, we conduct 2SLS regressions in order to control for potential endogeneity issues that firms with higher risk and/or better performance may more likely engage in hedging with currency derivatives. Second, we employ risk-adjusted performance measures in addition to conventional performance measures in order to consider the level of firm risk associated with firms' hedging activities, which supposedly affect both firm risk and performance. In this way, our paper will offer comprehensive evidence on hedging-firm performance relations. Third, we investigate the effect of hedging with currency derivatives on firm performance and value for subgroups of firms divided by (high and low) levels of *expected* exchange rate exposure. It is reasonably expected that firms would engage in different levels of transactions of currency derivatives for hedging based on their own inherent levels of exchange rate exposure.

3. RESEARCH DESIGN AND DATA

3.1. Analysis of Determinants of Currency Derivatives Use

As the first research issue, we examine firm attributes that contribute to currency derivatives use for hedging in the following regression model. These firm attributes include variables representing FC inflows and outflows associated with exporting and importing activities, profitability and liquidity positions, FC borrowing, firm risk including cash flow volatility, beta risk and foreign exchange risk, tax liabilities, and other firm characteristics such as firm size, growth potential, and age, among others.

$$\begin{aligned} FCDEV_i &= \alpha_0 + \alpha_1 EXPORT_i + \alpha_2 IMPORT_i + \alpha_3 NFCDEBT(or\ FCFDEBT)_i + \alpha_4 INTTR_i \\ &+ \alpha_5 DIVER_i + \alpha_6 FSIZE_i + \alpha_7 MB_i + \alpha_8 EBITDA_i + \alpha_9 LEV_i + \alpha_{10} OCFVOL_i + \alpha_{11} BETA_i \\ &+ \alpha_{12} TAX_i + \alpha_{13} AGE_i + \alpha_{14} PastFCDEV_i + \sum_{j=1}^{J} \alpha_{14+j} YEAR_{j,i} + \sum_{y=1}^{Y} \alpha_{14+J+y} IND_{y,i} + \mu_i \end{aligned} \quad (1)$$

In regression model (1), the dependent variable of *FCDEV* represents the total transaction amount of currency derivatives used for hedging purposes including forwards, futures, risk insurance, options, and swaps, relative to total assets. Considering that transactions of currency forwards and currency swaps often last longer than a year, the previous year's *FCDEV*, *PastFCDEV*, is also included in the

regression model to examine whether the currency year's *FCDEV* is affected by the previous year's.

Korean firms are more geared to hedge their long positions, or receipts, of FCs mainly resulting from their exporting activities, by taking short positions in currency derivatives, especially currency forwards. If properly hedged, this strategy would offer protection with the guaranteed pre-determined amount of local currency. In order to investigate the potentially different firm-specific factors related to buy (or long) and sell (or short) transactions, we employ *FCDEV-Buy* and *FCDEV-Sell* as dependent variables in place of *FCDEV* in regression equation (1), where *FCDEV-Buy* and *FCDEV-Sell* represent buy and sell transactions of currency derivatives, respectively, including forwards, futures, and risk insurance contracts. Note that options and swaps contracts are not included in *FCDEV-Buy* or *FCDEV-Sell* due to the difficulty in identifying buy or sell transactions of these contracts.

As firms with greater exchange rate exposure are more likely to use currency derivatives (Bae & Kwon, 2013; Geczy, Minton, & Schrand, 1997), we further compare the determinants of currency derivatives use between firms with high and low levels of exchange rate exposure. A brief description of explanatory variables along with their measurements is given below:

The first group of variables are related to firms' overseas business activities. *EXPORT* represents export ratio and is measured as a proportion of total export amount to total sales. *IMPORT* represents a firm's import ratio. Because data on a firm's import ratio are regarded as the firm's trade secrets and thus are not publicly available, we proxy a firm's import ratio by relating the firm's sales composition to the imported input share of sales of the sector or industry where the produced goods belong. The imported input shares of sector sales are collected from the input-output tables reported by the Bank of Korea.[4] *NFCDEBT* represents net amount of FC financing, measured by the difference between total FC debt and total FC assets, where total FC debt is the sum of FC-denominated short-term

[4] For example, if a firm produces goods belonging to the pulp, paper, and paperboard sector (KSIC 17), the sector's imported input share of 25.56% (2007 year basis) is used as a proxy for the firm's import ratio. If a firm is diversified with multiple goods, the weighted average of the imported input shares of sector sales for the multiple goods is used as the firm's import ratio. See Bae and Kwon (2013) for the detailed measurement of import ratio.

debt and long-term debt, liquidity long-term debt, and FC-denominated bonds. *FCFDEBT* represents FC-denominated financial debt, relative to total assets. *INTTR* represents the degree of internal transactions of each firm with foreign subsidiaries, measured by the amount of internal transactions relative to the firm's total sales.

The second group of variables are related to firms' domestic business activities. *DIVER* represents the degree to which a firm's operations are diversified into different lines of business. *DIVER* is included in the regression model to consider the effect of the firm's diversification on the relation between a firm's derivatives transactions and its risk level reported in the literature (e.g., Bartram et al., 2009). For *DIVER*, we employ the widely-used Caves weighted index of diversification based on the firm's sales (Caves et al., 1980). A higher value of *DIVER* indicates a greater diversification of a firm's operations. *FSIZE* represents firm size, and is measured by the natural log of the sum of the market values of common stock and preferred stock and the book value of debt. *MB* is the market to book value ratio and proxies growth potential. It is expected that a firm with higher growth potential is more likely to engage in hedging with currency derivatives in order to preserve the value of internally-generated funds. *EBITDA* represents a firm's profitability ratio, measured by the sum of EBIT, depreciation, and amortization divided by total assets. *LEV* is total debt to total assets ratio. *OCFVOL*, a measure of firm risk, represents volatility of operating cash flows. *BETA* represents market risk. *TAX* represents tax payment divided by pre-tax income, and enters the regression model to examine whether hedging with currency derivatives is related to lower corporate tax liability (Graham & Smith, 1999; Smith & Stulz, 1985).

The last group of variables include year and industry dummies. *YEAR* is year dummies and included to control for fixed-time effects such as sudden rebounds and adjustments in exchange rates during the sample period. *IND* is industry dummies, spanning twenty-two industries from food and beverage (KSIC 10) to publishing (KSIC 58) based on two-digit KSIC, and is included to consider the potential differences in industries with respect to the risk level and the ease of hedging (Jin & Jorion,

2006). Since firms may change their industry classifications as time goes by, the sales item with the highest actual sales is used to identify each firm's primary industry.

3.2. Measurement of Exchange Rate Exposure

Existing studies have estimated exchange rate exposure using regression models of observed stock returns and exchange rate changes, but the majority of these studies offer weak evidence on the existence of exchange rate exposure or the need to manage exchange rate risk (e.g., Dominguez & Tesar, 2006; Dumas & Solnik, 1995; He & Ng, 1998; Jorion, 1990, 1991; Kwon, Bae, & Chung, 2005). As Bodnar and Marston (2002) and Bartram, Brown and Minton (2010) point out, however, this approach to the measurement of exchange rate exposure would fail to uncover the true level of exchange rate exposure. Because a firm's observed stock returns would have already reflected the outcomes of hedging activities, an examination of the observed stock returns is more likely to reveal insignificant exchange rate exposure. In order to overcome this measurement problem, we measure *expected* exchange rate exposure, which reflects a firm's exposure level inherent in its basic business activities prior to the use of hedging tools, by the estimation model developed by Bodnar and Marston (2002).[5] If the exchange rate exposure is expressed in the form of elasticity, the elasticity of a firm value, δ, in terms of net profit, π, to a change in the exchange rate, Er, can be presented by:[6]

$$\delta = \frac{d \ln \pi}{d \ln Er} = h_1(R/\pi) - h_2(M/\pi) = (h_1/r) - h_2((1/r)-1) = h_1 + (h_1 - h_2)(\frac{1}{r} - 1) \qquad (2)$$

In equation (2), the expected exchange rate exposure inherent in the firm's basic business activities is determined by three firm attributes: (a) foreign sales or export ratio (h_1); (b) foreign expenses (that is, costs of imported materials for final products) or import ratio (h_2); and (3) profit margin r. The relationship between export ratio and import ratio is a key factor in determining both the magnitude and

[5] Employing Bodnar and Marston's (2002) model, Bartram, Brown, and Minton (2010) and Bae, Kwon, and Park (2017) empirically measure the expected exchange rate exposure of automobile companies in the U.S. and manufacturing firms in Korea, respectively.

[6] For the detailed derivation of equation (2), see Bodnar and Marston (2002).

the direction of a firm's exchange rate exposure, and the firm's profit margin plays a role in the determination of the magnitude of exchange rate exposure. In equation (2), if a firm's export ratio is greater than its import ratio, the firm will be exposed to a greater exposure where the firm's value increases (decreases) as the exchange rate goes up (down). It is also shown that the expected exchange rate exposure becomes bigger as the firm's ability to generate profits represented by the profit margin weakens.

3.3. Analysis of the Effects of Currency Derivatives on Firm Risk

As hedging with currency derivatives aims to mitigate volatility of uncertain cash flows to changes in exchange rates, we assess the effects of currency derivative on firm risk by examining the volatilities of profitability and performance measures. Unlike previous studies, we employ both accounting-based and market-based measures of firm risk in order to obtain full and complete evidence on the hedging-firm risk relation. For accounting-based risk measures, we use two volatility measures of profitability of ROE and ROA, *ROEVOL* and *ROAVOL*. For market-based risk measures, we employ the volatility of Tobin's q (*QVOL*) and the volatility of industry-adjusted Tobin's q (*IQVOL*).[7]

Due to the potential endogeneity issue that firms with high or low risk may merely use currency derivatives for hedging more often, we perform 2SLS regression analyses to uncover the unbiased hedging-firm risk relation for Korean firms which used currency derivatives for hedging purposes during our sample period. In the 1st stage, we estimate a regression model of $FCDEV_{t+1}$ using $FCDEV_t$ as an instrument variable and other variables as control variables including firm size (*FSIZE*), market to book ratio (*MB*), Profitability ratio (*EBITDA*), product diversification (*DIVER*), total debt ratio (*LEV*), Beta risk (*BETA*), and year (*YEAR*) and industry (*IND*) dummy variables. The instrument variable of $FCDEV_t$ is selected based on the following criteria: (a) its largest and significant (at the 1% level) regression

[7] Lee and Li (2012) also use the volatility of Tobin's q as a proxy variable of market-based risk in their study of the diversification-firm value relation.

coefficient (0.716) in the regression model of the determinants of *FCDEV* (regression equation (1)); (b) its t-value (8.10) being greater than the threshold (absolute) value of 3.0 in the 1st stage; and (c) significant F-values of all 1st stage regressions. We then estimate the following regression model in the 2nd stage using the pre-estimated $FCDEV_{t+1}$ as the key test variable:

$$RISK_{i,t+1} = c_0 + c_1 FCDEV_{i,t+1} + c_2 FCDEV_{i,t+1} \, x \, EXED_{i,t} + c_3 EXED_{i,t} + c_4 FSIZE_{i,t} + c_5 MB_{i,t} + c_6 EBITDA_{i,t} + c_7 DIVER_{i,t} + c_8 LEV_{i,t} + c_9 BETA_{i,t} + \sum_{j=1}^{J} c_{9+j} YEAR_{j,i} + \sum_{y=1}^{Y} c_{9+J+y} IND_{y,i} + \mu_{i,t} \quad (3)$$

In regression model (3), the dependent variable of *RISK* is represented by *ROEVOL* and *ROAVOL* as accounting-based volatility measures of profitability and *QVOL* and *IQVOL* as market-based volatility measures of firm value, and the key test variable is *FCDEV*. In order to assess the effects of buy vs. sell transactions of currency derivatives on firm risk, we also employ *FCDEV-Sell* and *FCDEV-Buy* in place of *FCDEV* as key test variables after these two variables are estimated from the 1st stage regression models using previous year's *FCDEV-Sell* and *FCDEV-Buy* as instrument variables in the similar manner as *FCDEV*. Note that two variables of *OPTION* and *SWAP* are included in the regressions of *FCDEV-Sell* and *FCDEV-Buy* to control for the usage of options and swaps contracts We further examine the potential difference in the hedging-firm risk relation between firms with high exchange rate exposure and firms with low exposure by including an interactive variable of *FCDEV x EXED*, where *EXED* is an indicator variable with a value of 1 for firms with higher-than-median expected exchange rate exposure and 0 otherwise.

3.4. Analysis of the Effects of Currency Derivatives on Firm Performance

We examine whether currency derivatives use leads to better firm performance. Similar to the analyses of the hedging-firm risk relation, we conduct 2SLS regressions to control for the potential endogeneity issue on the hedging-firm performance relation that firms with good or bad performance may merely engage in hedging with currency derivatives more often. In the 1st stage, a regression model of

$FCDEV_{t+1}$ is estimated using $FCDEV_t$ as an instrument variable and a set of control variables including firm size (*FSIZE*), sales growth (*SG*), R&D ratio (*RND*), total debt ratio (*LEV*), firm age (*AGE*), foreign investor ownership (*FOR*), controlling shareholder ownership (*OWN*), and year (*YEAR*) and industry (*IND*) dummy variables. In the 2nd stage, the estimated $FCDEV_{t+1}$ enters as key test variable into the following regression model of firm performance.

$$PERF_{i,t+1} = \beta_0 + \beta_1 FCDEV_{i,t+1} + \beta_2 FCDEV_{i,t+1} x\ EXED_t + \beta_3 EXED_t + \beta_4 FSIZE_{i,t} + \beta_5 EBITDA_{i,t} + \beta_6 SG_{i,t} + \beta_7 RND_{i,t} + \beta_8 LEV_{i,t} + \beta_9 AGE_{i,t} + \beta_{10} FOR_{i,t} + \beta_{11} OWN_{i,t} + \sum_{j=1}^{J} \beta_{11+j} YEAR_{j,i} + \sum_{y=1}^{Y} \beta_{11+J+y} IND_{y,i} + \eta_{i,t} \quad (4)$$

In regression equation (4), the dependent variable, *PERF*, is firm performance, represented by *ROE* and *ROA* as accounting-based measures of profitability and *Q* (Tobin's q) and *IQ* (industry-adjusted Tobin's q) as market-based measures of firm value, and the key test variable is $FCDEV_{t+1}$. We also test the effects of *FCDEV*'s two components, *FCDEV-Sell* and *FCDEV-Buy*, on firm performance by replacing $FCDEV_{t+1}$. A positive and significant regression coefficient of β_1 would indicate an implementation of optimal hedges of currency derivatives through which currency derivatives use leads to better firm performance.[8] A negative and significant regression coefficient of β_1 would indicate that a firm engages in inefficient hedging transactions which generate excess losses from currency derivatives transactions. Finally, an insignificant regression coefficient of β_1 would imply that while currency derivatives transactions do not incur excess losses, they still fail to lead to better firm performance but merely reduce foreign exchange risk through optimal hedges. In examining the hedging-firm performance relation, we further investigate if the valuation effect of hedging with currency derivatives would differ based on a firm's level (high and low) of exchange rate exposure by adding an interactive variable of *FCDEV* x *EXED*.

Table I summarizes the definitions and measurement of variables used in regression models.

[8] As noted in the earlier section, better firm performance from the currency derivatives use may be attributed to the mitigation of the underinvestment problem, reduced corporate tax liability, and/or reduced financial distress costs.

3.5. Data

The sample firms in our study consist of all Korean industrial firms listed on the Korea Exchange for the period of 2005-2010. Hence, our sample includes firms in the manufacturing and service industries which were exposed to exchange rate risk and engaged in exporting and importing activities. We chose our sample period of 2005-2010 as this period is characterized by greater volatility of Korean won (KRW) against USD and thus is more suitable for a study of assessing the effectiveness of hedging with currency derivatives than pre-2005 or post-2010 periods. In addition, our sample period allows us to examine the effect of the global financial crisis in late 2007 on hedging with currency derivatives.

For each firm's currency derivatives transactions, we obtain the transaction amount of currency derivatives trading by examining the section of "transactions (purchases and sales) of financial derivatives" in each firm's annual operating reports during the sample period. We include currency derivatives that are traded for hedging purposes and thus exclude those traded for investment or speculative purposes. We collect the data for export ratios and operating margin ratios necessary to estimate the expected exchange rate exposure and other financial data from TS2000, the database of Korean Listed Companies Council. For exchange rate changes, we use changes in nominal exchange rates, rather than changes in real exchange rates, considering the relatively smaller changes in daily inflation rates.

4. EMPIRICAL RESULTS

4.1. Usage of Currency Derivatives by Korean Firms

Table II reports the transaction amount (relative to total assets) by types of currency derivatives by Korean firms during our sample period of 2005-2010. The transactions of currency forwards, currency futures, and currency risk insurance are further broken down into buy (long) and sell (short) transactions.[9]

[9] Currency risk insurance is a part of export insurance system offered by Korea Trade Assurance Corporation (KTAC) since 2000 for exporting and importing firms and works in a similar way to the currency forward contracts.

Our sample firms on average engage in the transactions of currency derivatives equivalent to 3.75% of total assets. Among several types of currency derivatives, currency forwards represent the largest transaction amount of 1.47% relative to total assets, of which short currency forwards (1.23%) are substantially more used than long currency forwards (0.24%) by sample firms. Hence, these findings indicate that Korean firms are more geared to take short positions in currency forwards as a way to hedge their long positions, or receipts, of FCs generated mainly from their exporting activities.

When sample firms are divided by the levels of expected exchange rate exposure (EXE), high EXE firms on average engage in significantly larger transaction amounts of currency derivatives than low EXE firms (5.37% vs. 2.13%). This finding is consistent with evidence in existing studies that firms with greater exchange rate exposure are more likely to use currency derivatives (e.g., Bae & Kwon, 2013; Geczy, Minton, & Schrand, 1997). Looking into different types of currency derivatives, high EXE firms use significantly larger transaction amounts of currency forwards, currency risk insurance, and currency options than low EXE firms, whereas low EXE firms engage in larger transaction amounts of currency swaps than high EXE firms.

It is also shown that sample Korean firms incur an average loss of 0.08% of total assets from currency derivatives transactions during our sample period, and that high EXE firms incur significantly larger transaction losses than low EXE firms (0.14% vs. 0.01%). These findings suggest the possibilities of ineffective and complex risk management programs (Copeland & Joshi, 1996; Hagelin & Pramborg, 2004), implementation of non-optimal hedges and excessive costs of currency derivatives use (Bae, Kim, & Kwon, 2016); and/or constraints in managing foreign exchange risk (Allayannis, Brown, & Klapper, 2003; Clark & Judge, 2009).

4.2. Summary Statistics

It recovers a firm's losses and collects the firm's profits associated with exchange rate changes by comparing the exchange rate guaranteed by KTAC with the actual exchange rate at the settlement time.

Table III reports mean and median values of key measures of firm risk and performance, other firm characteristics related to hedging activities, and expected exchange rate exposure (*EXE*) for the full sample and two subsamples of firms with high and low EXE.

Comparing two subsamples of firms based on levels of EXE, striking differences are observed for most of the firm-attribute variables. High EXE firms exhibit higher values of firm value volatilities (*QVOL* and *IQVOL*), profitability (*ROE* and *ROA*), export ratio (*EXPORT*), import ratio (*IMPORT*), FC financial debt (*FCFDEBT*), intra-firm transactions (*INTTR*), sales growth (*SG*), debt ratio (*LEV*), and market risk (*BETA*). In contrast, low EXE firms carry higher values of profitability volatilities (*ROEVOL* and *ROAVOL*), firm values (*Q* and *IQ*), operating profitability (*EBITDA*), market to book value ratio (*MB*), tax liability (*TAX*), R&D ratio (*RND*), and foreign investor ownership (*FOR*). Interestingly, there is little difference in firm size (*FSIZE*), product diversification (*DIVER*), firm age (*AGE*), or controlling shareholder ownership (*OWN*) between the two groups of firms.

4.3. Regression Results on the Determinants of Currency Derivatives Use

Table IV reports regression results on the determinants of total-, sell-, and buy-transaction amounts of currency derivatives, *FCDEV*, *FCDEV-Sell*, and *FCDEV-Buy*, respectively. We estimate Tobit regression models to take into account the values of the dependent variables not being less than zero.

For firms' total transaction amounts of currency derivatives for hedging, *FCDEV* is significantly positively related to *EXPORT*, *FCFDEBT*, *FSIZE*, *EBITDA*, *LEV*, *BETA*, and *PastFCDEV*, but is significantly negatively to *IMPORT*, *INTTR*, and *MB*. Hence, a firm with a higher export ratio, more FC debt, a larger size, higher operating profitability, a higher debt ratio, and higher market risk is likely to engage in more transactions of currency derivatives for hedging. A firm with higher *FCDEV* in the previous year, *Past FCDEV*, is also likely to use more transactions of currency derivatives in the current year. On the contrary, a firm with a higher import ratio, more intra-transactions with foreign subsidiaries, and a higher market to book ratio is likely to engage in lower transaction amounts of

currency derivatives. The negative relation of *INTTR* with *FCDEV* suggests that intra-transactions of Korean firms with their foreign subsidiaries play a role as an effective hedging tool by reducing the need for hedging with currency derivatives.

Panel A of Table IV also show some differences in the determinants between *FCDEV-Sell* and *FCDEV-Buy* transactions for the full sample. Firms tend to engage in larger amounts of sell transactions of currency derivatives when they have less FC debt than FC assets (*NFCDEBT*), less intra-firm transactions with foreign subsidiaries (*INTTR*), higher operating profitability (*EBITDA*), and greater market risk (*BETA*). On the other hand, firms are likely to buy larger amounts of currency derivatives when they have more FC debt *(FCFDEBT)*, whose evidence is as expected because firms with more FC debt would need more FC derivatives to hedge foreign exchange risk associated with their FC debt.

When firms are divided by the levels of exchange rate exposure, notable differences in their determinants are observed between high and low EXE firms, while there are also many similarities as shown in Panels B and C. Those firm attributes that influence *FCDEV* of high vs. low EXE firms differently include *IMPORT, NFCDEBT, DIVER, OCFVOL, BETA*, and *TAX*. More specifically, firms with high EXE are likely to engage in more transactions of currency derivatives when they have greater product diversification (*DIVER*), higher volatility of operating cash flows (*OCFVOL*), and more tax liability (*TAX*). On the contrary, firms with low EXE tend to engage in more of such transactions when they import more (*IMPORT*), possess more FC debt than FC assets (*NFCDEBT*), and/or have higher market risk (*BETA*).

4.4. Regression Results on the Effects of Currency Derivatives Use on Firm Risk

Table V reports the regression results from the 2nd stage regression models of the 2SLS analysis on the effects of currency derivatives usage on firm risk. Panels A and B show results using accounting-based volatility measures of *ROEVOL* and *ROAVOL* and market-based volatility measures of *QVOL* (volatility of Tobin's q) and *IQVOL* (volatility of industry-adjusted Tobin's q), respectively, as dependent variables.

Looking at the regression estimates of control variables, their relationships with firm risk are generally in line with our expectations. A firm with smaller size (*FSIZE*), higher market to book ratio (*MB*, or higher growth potential), lower operating profitability (*EBITDA*), higher debt ratio (*LEV*), higher market risk (*BETA*), and more transactions of currency options (*OPTIONS*) tends to have higher *ROEVOL* and *ROAVOL*. It is also worth noting that the indicator variable of *EXED* carries positive and significant (at least at the 5% level) regression estimates in all models, whose result indicates that the higher the expected exchange rate exposure, the higher the firm risk represented by volatility measures of profitability.

As shown in Models (1), (3), (5), and (7) in Panel A, none of the key test variables, *FCDEV*, *FCDEV-Sell*, or *FCDEV-Buy*, is significantly related to either *ROEVOL* or *ROAVOL*. Hence, the usage of currency derivatives by Korean firms does not reduce accounting-based volatility measures of profitability. Compared to low EXE firms, however, high EXE firms command lower firm risk of both measures of profitability volatility through the usage of currency derivatives, as evidenced by the negative and significant (at the 5% level) regression estimates of the interactive variable of *FCDEV x EXED*. In fact, lower firm risk associated with hedging for high EXE firms is attributed mainly to the sell (or short) transactions of currency derivatives, *FCDEV-Sell*, rather than the buy transactions of currency derivatives.

Panel B shows the effects of currency derivatives use on market-based risk measures of *QVOL* and *IQVOL*. Compared to those in Panel A, the regression models of market-based risk measures in Panel B offer a better fit with higher explanatory power as evidenced by higher adjusted R-squares. Overall, the regression results in Panel B for market-based risk measures are similar to those in Panel A for accounting-based risk measures, but a few notable differences are observed. On the one hand, *FCDEV* and *FCDEV-Buy* do not show any significant regression coefficient, indicating that the usage of currency derivatives by Korean firms does not lead to any meaningful reduction in market-based firm risk. On the other hand, *FCDEV-Sell* carries a significant (at least at the 10% level) but positive regression

estimate in all regressions of *QVOL* and *IQVOL*. This result indicates that greater sell transaction amounts of currency derivatives by Korean firms fail to reduce firm risk but increase their volatilities of market value. This evidence raises the possibility of engaging in non-optimal (e.g., over-hedging) short hedging of currency derivatives by Korean firms. It is also shown that unlike the results in Panel A, there is no significant difference in the effects of firms' usage of currency derivatives on market-based risk measures between firms with high vs. low exchange rate exposure.

The evidence on the insignificant effects of *FCDEV* on both accounting- and market-based risk measures reported in Table V is somewhat surprising but consistent with the evidence of no clear relationship between currency derivatives use and foreign exchange risk reported in existing studies (Guay & Kothari, 2003; Hentschel & Kothari, 2001). As Guay and Kothari (2003) note, the transaction amounts of currency derivatives by Korean firms (3.75% relative to total assets as shown in Table II) may be economically too small to produce any economically meaningful benefits of risk reduction.

4.5. Regression Results on the Effects of Currency Derivatives Use on Firm Performance

We now turn to regression results on the relationships between currency derivatives use and firm performance. Table VI presents regression estimates from the 2nd stage regression models of the 2SLS analysis with dependent variables of two accounting-based measures of profitability, *ROE* and *ROA*, in Panel A, and two market-based measures of firm value, *Q* and *IQ*, in Panel B.

As shown in Panel A, the three key test variables of *FCDEV, FCDEV-Sell* and *FCDEV-Buy* carry insignificant regression estimates in all regression models except for *FCDEV-Buy* in Model (3). Accordingly, higher transaction amounts of currency derivatives do not lead to an increase in firm value, though not reducing firm value. While these results may be interpreted as implying effective hedging activities by Korean firms through which the gains (losses) from currency derivatives use effectively offset the losses (gains) on the values of the underlying exposed assets, these results offer strong evidence that more usage of currency derivatives fails to lead to value creation such as reduced costs of

underinvestment, reduced tax liabilities, or reduced costs of financial distress, as noted for the benefits of currency derivatives use in the existing literature. It is also worthwhile to note that the 2nd stage regression models of *ROE* (Models 1 through 4) have substantially low explanatory power, as evidenced by the low adjusted R-squares (less than 0.067). Panel A further shows that there is little difference in the effect of currency derivatives use on accounting-based firm performance between high and low EXE firms.

Similarly to the evidence on firm risk in Table V, the regression models of market-based performance in Panel B exhibit substantially higher adjusted R-squares than those of accounting-based performance in Panel A. Hence, the regression models with identical explanatory variables explain a larger portion of the variation in the market-based performance measures than they do in the accounting-based performance measures.

The regression estimates of *FCDEV* are all positive and significant (at least at the 10% level) for the models of both *Q* and *IQ*, indicating a strong positive relationship between *FCDEV* and firm value. Hence, more currency derivatives use is associated with higher firm values in terms of both raw Tobin's q and industry-adjusted Tobin's q. *FCDEV-Sell* also carries a positive and significant regression coefficient in Models (3) and (4) of *Q* as dependent variable, but *FCDEV-Buy* has no significant regression estimate. Hence, only sell transactions of currency derivatives bring in a positive impact on firm value.

When *FCDEV* is combined with *EXED*, the interactive variable of *FCDEV x EXED* carries a negative and significant (at the 10% level) regression estimate. Hence, the currency derivatives use by firms with high exchange rate exposure does not enhance but decrease firm value. Given the observation that firms with high exchange rate exposure engage in hedging with currency derivatives more frequently and in greater amounts, these results suggest that hedging with currency derivatives by Korean firms with high exchange rate exposure is often mismanaged either due to the implementation of non-optimal hedges (e.g., under- or over-hedges) or due to the excessive costs associated with hedging.

These results also suggest that when firms have relatively low and manageable exchange rate exposure (that is, low EXE), currency derivatives transactions work as an effective tool in hedging receipts of FC income and protecting firm value from exchange rate risk.

4.6. Robustness Test of Effects of Currency Derivatives Use on Firm Risk and Performance

We perform a robustness test to ensure that our results on the effects of currency derivatives use on firm risk and performance are not sensitive to different model specifications. As firms' hedging activities with currency derivatives aim to enhance or at least preserve firm values by reducing exposure to exchange rate changes, we employ risk-adjusted performance measures and examine the mutual effects of currency derivatives use on firm risk and performance. The risk-adjusted performance measures are widely used in investment performance evaluation such as the Sharpe ratio (Sharpe, 1996) and the Appraisal ratio (Brown et al., 2008).[10]

Table VII reports 2nd stage regression results of accounting-based risk-adjusted performance measures of *ROE/ROEVOL* and *ROA/ROAVOL* in Panel A and market-based risk-adjusted performance measures of *Q/QVOL* and *IQ/IQVOL* in Panel B. Similarly to our earlier analyses of firm risk and firm performance, $FCDEV_{t+1}$, $FCDEV\text{-}Sell_{t+1}$, *and* $FCDEV\text{-}Buy_{t+1}$ are estimated using $FCDEV_t$, $FCDEV\text{-}Sell_t$, and $FCDEV\text{-}Buy_t$, respectively, as instrument variable and other variables as control variables in the 1st stage.

In Panel A, none of *FCDEV*-related test variables carries a significant regression estimate in the regressions of the accounting-based risk-adjusted performance measures of *ROE/ROEVOL* and *ROA/ROAVOL*, confirming our earlier evidence of little impact of currency derivatives use on accounting-based performance. For market-based risk-adjusted performance, *FCDEV* in Panel B exhibits a negative regression estimate in all models of (1), (2), (5), and (6), but shows a significant (at the

[10] Lee and Li (2012) use similar risk-adjusted performance measures to unveil diversification-firm performance relations.

5% level) coefficient only in Model (5), indicating weak evidence of the positive effect of currency derivatives use on market-based risk-adjusted performance. The interactive variable of *FCDEV x EXEC* shows a negative relationship with both *Q/QVOL* and *IQ/IQVOL*, but none of the estimated coefficient is statistically significant. Overall, the regression results in Table VII are in general consistent with those on the hedging-firm performance relation reported in Table 6 that currency derivatives use for hedging by Korean firms brings in a positive, though weak, effect on firm value.

5. CONCLUSION

We have analyzed currency derivatives use for hedging with respect to its firm-specific determinants and impacts on firm risk and performance and applied research methodologies distinctively different from those in the existing literature to firm-level data for Korean firms. A preliminary analysis shows that firms with high exchange rate exposure engage in significantly larger transactions of currency derivatives than firms with low exposure, consistent with evidence in the literature and offering validity of our empirical data.

2SLS regression analyses show that more usage of currency derivatives by Korean firms does not lead to lower firm risk, regardless of accounting- or market-based volatility measures, whereas more sell transactions of currency derivatives contribute to the increase in firm risk. The insignificant hedging-firm risk relation is surprising but consistent with the evidence of no clear relationship between currency derivatives use and foreign exchange risk reported in existing studies. As Guay and Kothari (2003) note, the transaction amounts of currency derivatives by Korean firms (3.75% relative to total assets as shown in Table II) may be too small to produce any economically meaningful benefits of risk reduction. Our results also show that firms with high exposure command lower firm risk through currency derivatives use.

Regarding the hedging-firm performance relation, more transactions, particularly sell transactions, of currency derivatives are associated with higher market-based performance, while they have little

impact on accounting-based profitability measures. Hence, Korean firms' usage of currency derivatives fails to improve their profitability, but is perceived more favorably by the market. Our results further show that currency derivatives use by firms with high exposure is associated with lower firm values. Combined with our evidence of lower firm risk for these firms that use currency derivatives more frequently and in larger amounts, these results indicate that the lower firm risk resulting from hedging with currency derivatives is not materialized into higher firm value for these firms. This evidence may be attributed at least in part to the mismanagement of hedging strategies either due to the implementation of non-optimal hedges (e.g., under- or over-hedges) or due to the excessive costs associated with hedging. In fact, this evidence further implies that when firms have relatively low and manageable exposure, currency derivatives work as an effective tool in hedging foreign exchange risk and protecting firm value.

The weak and somewhat conflicting evidence on the effects of hedging with currency derivatives on firm risk and performance reported in our paper should not be interpreted as undermining the benefits of currency derivatives for hedging. Rather, our results highlight the importance of a proper management of currency derivatives hedging strategies with the implementation of optimal hedges and thorough cost-benefit analysis of currency derivatives use.

REFERENCES

Allayannis, G., Brown, G.W., & Klapper, L.F. (2003). Capital structure and financial risk: evidence from foreign debt use in East Asia, Journal of Finance 58, 2667-2709.

Allayannis, G. & Ofek, E. (2001). Exchange rate exposure, hedging, and the use of foreign currency derivatives, Journal of International Money and Finance 20, 273-296.

Allayannis, G. & Weston, J.P. (2001). The use of foreign currency derivatives and firm market value, Review of Financial Studies 14, 243-276.

Bae, S.C., & Kwon, T.H. (2013). Asymmetric foreign exchange exposure, option trade, and foreign currency denominated debt: Evidence from Korea, Asia-Pacific Journal of Financial Studies 42, 314-339.

Bae, S.C., Kim, H.S., & Kwon, T.H. (2016). Foreign currency debt financing, firm value, and risk: evidence from Korea surrounding the global financial crisis, Asia-Pacific journal of Financial Studies 45, 124-152.

Bae, S.C., Kwon, T.H., & Park, R.S. (2017). Management of exchange rate exposure with hedging activities: new approach and evidence, International Review of Economics and Finance, forthcoming.

Bali, T., Hume, S., & Martell, T. (2007). A new look at hedging with derivatives: will firms reduce market risk exposure? Journal of Futures Market 27, 1053-1083.

Bartram S., Brown, G.W., & Conrad, J. (2011). The effects of derivatives on firm risk and value, Journal of Financial and Quantitative Analysis 46, 967-999.

Bartram, S., G.W. Brown & Fehle F.R. (2009). International evidence on financial derivatives usage, Financial Management 38, 185-206.

Bartram, S., Brown, G.W., & Minton, B. (2010). Resolving the exposure puzzle: the many facets of exchange rate exposure, Journal of Financial Economics 95, 148-173.

Bessembinder, H. (1991). Forward contracts and firm value: Investment incentive and contracting effects,

Journal of Financial and Quantitative Analysis 26, 519-532.

Bodnar, G.M., & Marston, R.C. (2002). Exchange rate exposure: a simple model, in Choi, J., Power, M. (Ed.), Global Risk Management: Financial Operational and Insurance Strategies, International Financial Review 3, Elsevier Science, Amsterdam.

Brown, G.W. (2001). Managing foreign exchange risk with derivatives, Journal of Financial Economics 60, 401-448.

Brown, S., Goetzmann, W., Liang, B., & Schwarz, C. (2008). Mandatory disclosure and operational risk: evidence from hedge fund registration. Journal of Finance 63, 2785–2815.

Carter, D.A., Rogers, D.A., & Simkins, B.J. (2006). Hedging and value in the U.S. airline industry, Journal of Applied Corporate Finance 18, 21-33.

Caves, R., Porter, M., Spence, A., & Scott, J. (1980). Competition in the open economy: a model applied to Canada, Harvard University Press, Boston, MA.

Chang, Y.C., & Lin, H.J. (2005). The use of foreign currency derivatives and foreign-denominated debts to reduce exposure to exchange rate fluctuations, International Journal of Management 22, 598-604.

Clark, E., & Judge, A. (2009). Foreign currency derivatives versus foreign currency debt and the hedging premium, European Financial Management 15, 606-642.

Clark, E., & Mefteh, S. (2010). Foreign currency derivatives use, firm value and the effect of the exposure profile: evidence from France, International Journal of Business 15, 183-196.

Copeland, T.E., & Joshi, Y. (1996). Why derivatives don't reduce FX risk, McKinsey Quarterly No.1, 66-79.

Dominguez, K.M.E., & Tesar, L.L. (2006). Exchange rate exposure. Journal of International Economics 68, 188-218.

Dumas, B., & Solnik, B. (1995). The world price of foreign exchange risk. Journal of Finance 50, 445-479.

Froot, K.A., Scharfstein, D.S., & Stein, J.C. (1993). Risk management: coordinating corporate investment and financing policies, Journal of Finance 48, 1629-1658.

Geczy, C., Minton, B.A., & Schrand, C. (1997). Why firms use currency derivatives, Journal of Finance 52, 1323-1354.

Graham, J.R., & Rogers, D. (2002). Do firms hedge in response to tax incentive? Journal of Finance 57, 815-840.

Graham, J.R., & Smith, Jr., C.W. (1999). Tax incentives to hedge, Journal of Finance 54, 2241-2262/

Guay, W. (1999). The impact of derivatives on firm risk: an empirical examination of new derivatives users, Journal of Accounting and Economics 26, 319-351.

Guay, W., & Kothari, S. (2003). How much do hedge with derivatives? Journal of Financial Economics 70, 423-461.

Hagelin, N. (2010). Why firms hedge with currency derivatives: an examination of transaction and translation exposure, Applied Financial Economics 20, 55-69.

Hagelin, N., & Pramborg, B. (2004). Hedging foreign exchange exposure: risk reduction from transaction and translation hedging, Journal of International Financial Management & Accounting 15, 1-20.

He, J., & Ng, L. (1998). The foreign exchange exposure of Japanese multinational corporations. Journal of Finance 53, 733-753.

Hentschel, L., & Kothari, S.P. (2001). Are corporations reducing or taking risks with derivatives? Journal of Financial and Quantitative Analysis 36, 93-118.

Jin, Y., & Jorion, P. (2006). Firm value and hedging: Evidence from U.S. oil and gas producers, Journal of Finance 61, 893-919.

Jorion, P. (1990). The exchange-rate exposure of U.S. multinationals, Journal of Business 63, 331-345.

Jorion, P. (1991). The pricing of exchange rate risk in the stock market, Journal of Financial and Qualitative Analysis 26, 353-376.

Jung, S.C., & Kwon, T.H. (2007). Do firms' currency derivatives transactions reduce their exchange rate

exposure, Journal of Korean Academy of International Business, 18, 37-63.

Kwon, T.H., Bae, S.C., & Chung, J.M. (2005). Do foreign investors price foreign exchange risk differently? Journal of Financial Research 28, 555-573.

Lee, B.S., & Li, M-Y.L. (2012). Diversification and risk-adjusted performance: a quantile regression approach, Journal of Banking and Finance 36, 2157-2173.

Leland, H.E. (1998). Agency costs, risk management, and capital structure, Journal of Finance 53, 1213-1243.

Nydahl, S. (1999). Exchange rate exposure, foreign involvement and currency hedging of firms: some Swedish evidence, European Financial Management 5, 241-257.

Sharpe, W.F. (1966). Mutual fund performance. Journal of Business 39, 119–138.

Smith Jr., C.W., & Stulz, R.M. (1985). The determinants of firms' hedging policies, Journal of Financial and Quantitative Analysis 20, 391-405.

Tufano, P. (1996). Who manages risk? an empirical examination of risk management practices in the gold mining industry, Journal of Finance 51, 1097-1137.

TABLE I

Definitions and Measurements of Regression Variables

Variables	*Definitions*	*Measurements*
FCDEV	Transaction amount of currency derivatives	(forwards + futures + risk insurance + options & swaps) / total assets
FCDEV-Buy	Buy transactions (long position) of cur derivatives	(buy amount of cur forwards + cur futures + cur risk insurance) / total assets
FCDEV-Sell	Sell transactions (short position) of cur derivatives	(sell amount of cur forwards + cur futures + cur risk insurance) / total assets
OPTION	Currency option contracts	(currency call option + currency put option) / total assets
SWAP	Currency swap contracts	(currency swap + interest currency swap) / total assets
ROEVOL	Volatility of Return on equity	Ln(standard deviation of return on equity during t-1~t+1)
ROAVOL	Volatility of Return on assets	Ln(standard deviation of return on assets during t-1~t+1)
QVOL	Volatility of Tobin's q	Ln(standard deviation of Tobin's q during t-1~t+1)
IQVOL	Volatility of Industry-adjusted Tobin's q	Ln(standard deviation of Industry-adjusted Tobin's q during t-1~t+1)
ROE	Return on equity	Net income / total equity
ROA	Return on asset	Net income / total assets
Q	Tobin's q	(MV of common stock + MV of preferred stock + BV of debt) / total assets
IQ	Industry-adjusted Tobin's q	Tobin's q – (mean of Tobin's q in t and industry)
EXPORT	Export ratio	Exporting amount / sales
IMPORT	Import ratio	Proxied by industry import ratio (cost of imported raw materials / sales)
NFCDEBT	Net FC debt ratio	(FC debt – FC assets) / total assets
FCFDEBT	FC Financial debt ratio	FC long-term and short-term borrowing / total assets
INTTR	Intra-firm transactions with foreign subsidiaries	(Sales + purchases + profits + costs) / sales
DIVER	Product diversification	Caves' diversification index
FSIZE	Firm size	ln(sum of MVs of common and preferred stock + BV of debt in t)
EBITDA	Profitability	(EBIT + dep) / total assets
SG	Sales growth	(Sales in t – sales in t-1) / sales in t-1
LEV	Total debt ratio	Total debt / total assets
OCFVOL	Volatility of operating cash flow	Ln(standard deviation of operating cash flow in t~t-2)
BETA	Beta	Beta measured by the market model using daily stock and KOSPI returns
MB	Market to Book ratio	MV / BV of common stock
TAX	Tax ratio	Tax payment/pretax income
AGE	Firm age	ln(t - establishment t +1)
RND	R&D ratio	R&D expenses / total assets
OWN	Controlling shareholders ownership	Common shares held by largest shareholder / total common shares
FOR	Foreign investor ownership	Common shares held by foreign investors / total common shares
EXE	Expected exchange rate exposure	Estimated based on the Bodnar and Marston's (2002) *EXE* model

TABLE II
Usages and Profit/Loss of Currency Derivatives by Korean Firms

	Full sample (N=3,582)		*Firms with High EXE (N=1,792) (1)*		*Firms with Low EXE (N=1,790) (2)*		*Difference test (1)-(2)*	
	Mean	*Median*	*Mean*	*Median*	*Mean*	*Median*	*t-value*	*z-value*
FCDEV	0.0375	0.0000	0.0537	0.0000	0.0213	0.0000	6.975 ***	8.873 ***
- Long currency forwards	0.0024	0.0000	0.0034	0.0000	0.0015	0.0000	3.746 ***	3.925 ***
- Short currency forwards	0.0123	0.0000	0.0206	0.0000	0.0039	0.0000	6.962 ***	10.408 ***
- Long currency futures	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-	-
- Short currency futures	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-	-
- Long currency risk insurance	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-	-
- Short currency risk insurance	0.0002	0.0000	0.0004	0.0000	0.0001	0.0000	3.504 ***	4.237 ***
- Total currency options	0.0055	0.0000	0.0084	0.0000	0.0025	0.0000	4.130 ***	5.638 ***
- Total currency swaps	0.0054	0.0000	0.0041	0.0000	0.0068	0.0000	-3.703 ***	-0.976
Profit and Loss of currency derivatives	-0.0008	0.0000	-0.0014	0.0000	-0.0001	0.0000	-3.058 ***	-0.390

Note. The usage of currency derivatives represents all transactions of currency derivatives used for hedging purposes but not for investment purposes by Korean firms during 2005-2010. All currency derivatives are measured as relative to total assets. Profit and Loss of derivatives are measured as relative to sales. *EXE* = expected exchange rate exposure. *FCDEV* = transaction amount of currency derivatives for hedging relative to sales. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

TABLE III
Summary Statistics of Variables

Variables	*Full sample (N = 3,582)*		*High EXE firms (N = 1,792)*		*Low EXE firms (N = 1,790)*		*Difference test (High – Low)*	
	Mean	*Median*	*Mean*	*Median*	*Mean*	*Median*	*t-value*	*z-value*
ROEVOL	-2.985	-3.083	-2.904	-2.951	-3.067	-3.250	3.653***	6.375***
ROAVOL	-3.653	-3.670	-3.604	-3.589	-3.703	-3.784	2.705***	4.063***
QVOL	-2.046	-2.051	-2.148	-2.143	-1.944	-1.954	-6.432***	-6.105***
IQVOL	-2.129	-2.128	-2.212	-2.182	-2.045	-2.052	-5.508***	-4.629***
ROE	-0.045	0.060	0.011	0.060	-0.101	0.060	5.147***	1.388
ROA	0.015	0.033	0.024	0.032	0.007	0.035	4.369***	-0.940
Q	1.037	0.899	0.973	0.877	1.100	0.923	-7.428***	-4.891***
IQ	-0.028	-0.096	-0.058	-0.103	0.002	-0.083	-3.955***	-0.926
EXPORT	0.268	0.111	0.425	0.448	0.110	0.018	35.656***	29.309***
IMPORT	0.179	0.163	0.237	0.204	0.120	0.084	24.958***	24.889***
NFCDEBT	0.021	0.000	0.027	0.003	0.016	0.000	4.014***	1.486
FCFDEBT	0.034	0.000	0.047	0.010	0.022	0.000	12.076***	14.381***
INTTR	0.079	0.000	0.119	0.018	0.039	0.000	14.155***	18.468***
DIVER	0.304	0.113	0.305	0.102	0.303	0.127	0.114	0.050
FSIZE	19.501	19.137	19.547	19.141	19.454	19.135	1.731*	0.486
EBITDA	0.049	0.048	0.044	0.042	0.053	0.056	-3.872***	-7.549***
SG	0.101	0.068	0.116	0.078	0.086	0.061	2.621***	3.861***
LEV	0.436	0.446	0.458	0.471	0.413	0.416	6.904***	6.975***
OCFVOL	-3.198	-3.168	-3.152	-3.128	-3.244	-3.222	3.212***	2.955***
BETA	0.770	0.759	0.819	0.812	0.722	0.715	8.241***	7.980***
MB	1.202	0.829	1.061	0.757	1.344	0.917	-7.230***	-6.820***
TAX	0.162	0.212	0.149	0.202	0.174	0.224	-2.343**	-4.517***
AGE	3.458	3.611	3.474	3.611	3.442	3.638	1.468	-0.266
RND	0.013	0.004	0.012	0.004	0.014	0.004	-3.046***	2.001***
OWN	0.414	0.410	0.416	0.412	0.412	0.410	0.649	0.506
FOR	0.013	0.004	0.012	0.004	0.014	0.004	-5.326***	-4.097***
EXE	1.104	0.000	2.321	1.969	-0.114	-0.071	23.524***	22.010***

Note. This table reports mean and median values of firm characteristics and other variables related to hedging activities for sample Korean firms during 2005-2010. *EXE* = expected exchange rate exposure. See Table I for definitions and measurements of other variables.

TABLE IV.
Tobit Regression Results on the Determinants of Currency Derivatives Use

Panel A: Full sample						
Variables	*FCDEV*		*FCDEV-Sell*		*FCDEV-Buy*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
EXPORT	0.215***	0.210***	0.254***	0.261***	0.023*	0.022*
	(0.026)	(0.026)	(0.032)	(0.032)	(0.012)	(0.012)
IMPORT	-0.091*	-0.108**	-0.092	-0.119*	0.011	0.012
	(0.047)	(0.047)	(0.062)	(0.062)	(0.022)	(0.022)
NFCDEBT	-0.032		-0.465***		0.103***	
	(0.080)		(0.107)		(0.036)	
FCFDEBT		0.392***		-0.092		0.162***
		(0.104)		(0.146)		(0.046)
INTTR	-0.177***	-0.194***	-0.110**	-0.109**	-0.018	-0.026
	(0.043)	(0.043)	(0.047)	(0.048)	(0.020)	(0.020)
DIVER	0.022	0.023	0.056***	0.059***	0.025***	0.025***
	(0.016)	(0.016)	(0.019)	(0.019)	(0.007)	(0.007)
FSIZE	0.044***	0.043***	0.036***	0.032***	0.012***	0.013***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.002)	(0.002)
MB	-0.027***	-0.025***	-0.022**	-0.019**	-0.006*	-0.006*
	(0.007)	(0.007)	(0.009)	(0.009)	(0.003)	(0.003)
EBITDA	0.473***	0.479***	0.261*	0.283**	0.054	0.055
	(0.110)	(0.110)	(0.136)	(0.138)	(0.053)	(0.053)
LEV	0.152***	0.106**	0.010	-0.024	0.004	-0.002
	(0.044)	(0.045)	(0.055)	(0.057)	(0.021)	(0.021)
OCFVOL	0.005	0.002	0.017*	0.016	-0.000	-0.000
	(0.008)	(0.008)	(0.010)	(0.011)	(0.004)	(0.004)
BETA	0.037*	0.042**	0.081***	0.084***	0.010	0.012
	(0.020)	(0.020)	(0.026)	(0.027)	(0.010)	(0.010)
TAX	0.032	0.034*	0.013	0.016	0.005	0.004
	(0.020)	(0.020)	(0.025)	(0.025)	(0.010)	(0.010)
AGE	-0.008	-0.008	-0.014	-0.016	-0.005	-0.004
	(0.010)	(0.010)	(0.013)	(0.013)	(0.004)	(0.004)
PastFCDEV	0.716***	0.716***	0.659***	0.720***	1.643***	1.664***
	(0.037)	(0.036)	(0.065)	(0.065)	(0.136)	(0.136)
FCDEV-Sell					0.096***	0.085***
					(0.025)	(0.024)
FCDEV-Buy			2.069***	1.950***		
			(0.314)	(0.318)		
OPTION			0.077	0.122	0.095*	0.082
			(0.158)	(0.160)	(0.054)	(0.054)
SWAP			0.017	-0.142	-0.142	-0.159
			(0.414)	(0.422)	(0.152)	(0.151)
Constant	-1.255***	-1.238***	-1.091***	-1.009***	-0.394***	-0.406***
	(0.101)	(0.100)	(0.126)	(0.125)	(0.050)	(0.050)
YEAR, IND dummy	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	3,472	3,472	3,472	3,472	3,472	3,472
LR Chi-squared	1042.54***	1094.91***	695.52***	677.38***	502.98***	505.73***

Panel B: High EXE firms						
Variables	*FCDEV*		*FCDEV-Sell*		*FCDEV-Buy*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
EXPORT	0.181***	0.194***	0.139***	0.158***	-0.000	0.000

	(0.036)	(0.036)	(0.041)	(0.041)	(0.015)	(0.015)
IMPORT	-0.210***	-0.235***	-0.227***	-0.262***	-0.018	-0.017
	(0.068)	(0.068)	(0.084)	(0.086)	(0.032)	(0.032)
NFCDEBT	-0.321***		-0.533***		0.048	
	(0.103)		(0.126)		(0.043)	
FCFDEBT		0.095		-0.035		0.113**
		(0.138)		(0.172)		(0.055)
INTTR	-0.190***	-0.199***	-0.125**	-0.129**	-0.024	-0.030
	(0.051)	(0.052)	(0.055)	(0.057)	(0.023)	(0.023)
DIVER	0.039*	0.045**	0.056**	0.064**	0.025***	0.026***
	(0.022)	(0.022)	(0.024)	(0.025)	(0.009)	(0.009)
FSIZE	0.045***	0.040***	0.038***	0.032***	0.015***	0.015***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.003)	(0.003)
MB	-0.027**	-0.025**	-0.028**	-0.026**	-0.008	-0.007
	(0.011)	(0.011)	(0.013)	(0.013)	(0.005)	(0.005)
EBITDA	0.436***	0.432**	0.312	0.322	0.073	0.076
	(0.166)	(0.169)	(0.192)	(0.197)	(0.077)	(0.077)
LEV	0.135**	0.089	-0.029	-0.064	-0.020	-0.028
	(0.067)	(0.068)	(0.077)	(0.079)	(0.031)	(0.032)
OCFVOL	0.030***	0.028**	0.025*	0.024*	0.004	0.003
	(0.012)	(0.012)	(0.014)	(0.014)	(0.005)	(0.005)
BETA	0.014	0.022	0.078**	0.088***	-0.005	-0.003
	(0.028)	(0.029)	(0.033)	(0.034)	(0.012)	(0.012)
TAX	0.049*	0.053*	0.018	0.022	0.008	0.008
	(0.028)	(0.028)	(0.032)	(0.032)	(0.012)	(0.012)
AGE	-0.023	-0.023	-0.036**	-0.038**	-0.004	-0.004
	(0.014)	(0.014)	(0.016)	(0.016)	(0.006)	(0.006)
Past FCDEV	0.663***	0.691***	0.607***	0.676***	1.523***	1.533***
	(0.043)	(0.042)	(0.072)	(0.072)	(0.154)	(0.153)
FCDEV-Sell					0.095***	0.089***
					(0.026)	(0.026)
FCDEV-Buy			1.936***	1.820***		
			(0.363)	(0.370)		
OPTION			0.068	0.131	0.022	0.012
			(0.175)	(0.178)	(0.072)	(0.072)
SWAP			-0.083	-0.443	-0.181	-0.194
			(0.617)	(0.623)	(0.253)	(0.246)
Constant	-1.062***	-0.981***	-0.846***	-0.735***	-0.376***	-0.379***
	(0.136)	(0.135)	(0.153)	(0.152)	(0.065)	(0.064)
YEAR, IND dummy	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	1,741	1,741	1,741	1,741	1,741	1,741
LR Chi-squared	644.31***	655.51***	483.25***	466.58***	354.04***	356.53***

Panel C: Low EXE firms

Variables	*FCDEV*		*FCDEV-Sell*		*FCDEV-Buy*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
EXPORT	0.232***	0.186***	0.290***	0.315***	0.039	0.033
	(0.052)	(0.052)	(0.071)	(0.074)	(0.028)	(0.028)
IMPORT	0.196**	0.193**	0.130	0.125	0.093**	0.095**
	(0.080)	(0.079)	(0.115)	(0.116)	(0.040)	(0.040)
NFCDEBT	0.579***		-0.602**		0.208***	
	(0.136)		(0.243)		(0.076)	
FCFDEBT		1.031***		-0.559		0.223**
		(0.169)		(0.349)		(0.095)
INTTR	-0.146*	-0.159*	-0.062	-0.051	-0.023	-0.026

	(0.085)	(0.084)	(0.100)	(0.101)	(0.041)	(0.041)
DIVER	-0.027	-0.032	0.024	0.029	0.010	0.008
	(0.025)	(0.024)	(0.033)	(0.033)	(0.012)	(0.012)
FSIZE	0.046***	0.048***	0.041***	0.037***	0.009**	0.010***
	(0.007)	(0.007)	(0.011)	(0.011)	(0.004)	(0.004)
MB	-0.026***	-0.026***	-0.008	-0.007	-0.003	-0.003
	(0.009)	(0.009)	(0.012)	(0.012)	(0.005)	(0.005)
EBITDA	0.347**	0.321**	0.105	0.143	0.035	0.033
	(0.156)	(0.155)	(0.220)	(0.222)	(0.084)	(0.085)
LEV	0.129**	0.100	0.017	0.005	-0.012	-0.009
	(0.063)	(0.062)	(0.091)	(0.092)	(0.034)	(0.034)
OCFVOL	-0.019*	-0.020*	0.008	0.008	-0.005	-0.006
	(0.011)	(0.011)	(0.017)	(0.017)	(0.006)	(0.006)
BETA	0.063**	0.064**	0.084*	0.079*	0.033**	0.035**
	(0.030)	(0.029)	(0.047)	(0.047)	(0.017)	(0.017)
TA	-0.000	0.000	0.005	0.005	0.000	0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)
TAX	0.000	-0.002	-0.015	-0.016	0.005	0.004
	(0.028)	(0.028)	(0.041)	(0.042)	(0.018)	(0.017)
AGE	0.001	0.002	0.004	0.002	-0.001	-0.000
	(0.014)	(0.014)	(0.022)	(0.022)	(0.007)	(0.007)
Past FCDEV	0.816***	0.770***	1.265***	1.279***	1.638***	1.675***
	(0.076)	(0.075)	(0.191)	(0.194)	(0.274)	(0.276)
FCDEV-Sell					0.110*	0.095
					(0.066)	(0.067)
FCDEV-Buy			2.459***	2.321***		
			(0.667)	(0.670)		
OPTION			-0.216	-0.155	0.269***	0.263**
			(0.472)	(0.453)	(0.103)	(0.104)
SWAP			0.255	0.255	-0.036	-0.041
			(0.561)	(0.573)	(0.204)	(0.206)
Constant	-1.436***	-1.473***	-1.345***	-1.270***	-0.381***	-0.401***
	(0.161)	(0.160)	(0.251)	(0.248)	(0.085)	(0.086)
YEAR, IND dummy	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	1,731	1,731	1,731	1,731	1,731	1,731
LR Chi-squared	373.94***	392.17***	169.98***	166.74***	185.23***	182.49***

Note. The dependent variable is *FCDEV*, *FCDEV-Sell*, and *FCDEV-Buy*, representing total-, sell-, and buy-transaction amount of currency derivatives, respectively. *EXE* = expected exchange rate exposure. See Table 1 for definitions and measurements of other variable. Standard errors are in parentheses. ***, ***, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE V

2SLS Regression Results on the Effects of Currency Derivatives Use on Firm Risk

Panel A: Accounting-based volatility								
Variables	*ROEVOL*				*ROAVOL*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
FCDEV	0.771	4.928**			0.346	3.126**		
	(0.568)	(2.183)			(0.448)	(1.571)		
FCDEV x *EXED*		-4.792**				-3.224**		
		(2.129)				(1.517)		
FCDEV-Sell			-0.464	2.607**			-0.899	2.171*
			(0.708)	(1.171)			(0.630)	(1.220)
FCDEV-Sell x *EXED*				-4.031***				-4.100***
				(1.521)				(1.487)
FCDEV-Buy			-2.353	3.849			0.006	5.107
			(4.972)	(10.572)			(4.361)	(8.602)
FCDEV-Buy x *EXED*				-6.669				-5.261
				(11.204)				(9.366)
EXED		0.450***		0.270**		0.393***		0.311***
		(0.163)		(0.123)		(0.138)		(0.112)
FSIZE	-0.088**	-0.083**	-0.059*	-0.054*	-0.071**	-0.067**	-0.049*	-0.045
	(0.035)	(0.033)	(0.030)	(0.029)	(0.031)	(0.029)	(0.029)	(0.028)
MB	0.156**	0.174**	0.207***	0.231***	0.133**	0.149***	0.174***	0.200***
	(0.068)	(0.068)	(0.067)	(0.068)	(0.053)	(0.052)	(0.053)	(0.055)
EBITDA	-1.610*	-1.488*	-1.976**	-1.852**	-1.147	-1.038	-1.479*	-1.327*
	(0.842)	(0.884)	(0.793)	(0.791)	(0.819)	(0.834)	(0.765)	(0.759)
DIVER	-0.159	-0.199*	-0.128	-0.140	-0.153	-0.188*	-0.126	-0.143
	(0.113)	(0.111)	(0.111)	(0.109)	(0.104)	(0.100)	(0.100)	(0.097)
LEV	1.655***	1.581***	1.686***	1.666***	-0.301	-0.369	-0.332	-0.364
	(0.328)	(0.339)	(0.315)	(0.314)	(0.291)	(0.296)	(0.283)	(0.281)
BETA	0.217*	0.209	0.278**	0.291**	0.253**	0.239**	0.318***	0.331***
	(0.131)	(0.131)	(0.129)	(0.128)	(0.122)	(0.120)	(0.122)	(0.121)
OPTION			2.858***	2.833***			2.256***	2.228***
			(0.598)	(0.597)			(0.495)	(0.493)
SWAP			-1.299	-0.559			-0.875	-0.027
			(1.257)	(1.271)			(1.093)	(1.079)
constant	-2.272***	-2.647***	-3.023***	-3.340***	-2.406***	-2.694***	-2.953***	-3.277***
	(0.678)	(0.659)	(0.589)	(0.579)	(0.604)	(0.592)	(0.573)	(0.569)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	886	886	886	886	886	886	886	886
Adjusted R-squared	0.130	0.069	0.199	0.199	0.057	0.029	0.098	0.095
Wald chi-squared	1565.52***	1758.67***	2105.44***	2196.60***	815.90***	873.90***	1056.05***	1070.97***
Panel B: Market-based volatility								
Variables	*QVOL*				*IQVOL*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
FCDEV	0.239	0.638			0.305	0.686		
	(0.218)	(0.749)			(0.256)	(0.805)		
FCDEV x *EXED*		-0.460				-0.489		
		(0.735)				(0.821)		
FCDEV-Sell			1.047**	1.556**			0.696*	1.229***
			(0.504)	(0.704)			(0.376)	(0.423)
FCDEV-Sell x *EXED*				-0.758				-0.880

				(0.857)				(0.594)
FCDEV-Buy			1.239	-1.611			0.129	-2.610
			(2.761)	(5.753)			(3.038)	(6.096)
FCDEV-Buy x *EXED*				3.794				3.667
				(6.055)				(6.956)
EXED		0.040		-0.006		0.159*		0.101
		(0.080)		(0.069)		(0.094)		(0.080)
FSIZE	0.013	0.013	0.011	0.010	-0.061***	-0.059***	-0.053**	-0.053**
	(0.017)	(0.017)	(0.017)	(0.017)	(0.022)	(0.022)	(0.023)	(0.022)
MB	0.431***	0.433***	0.411***	0.412***	0.362***	0.371***	0.354***	0.362***
	(0.031)	(0.030)	(0.034)	(0.034)	(0.033)	(0.033)	(0.037)	(0.036)
EBITDA	0.528	0.538	0.633	0.694	0.222	0.261	0.261	0.325
	(0.444)	(0.449)	(0.463)	(0.471)	(0.576)	(0.565)	(0.587)	(0.576)
DIVER	0.092	0.089	0.090	0.086	0.097	0.082	0.104	0.088
	(0.070)	(0.072)	(0.076)	(0.076)	(0.081)	(0.082)	(0.082)	(0.083)
LEV	-1.140***	-1.147***	-1.164***	-1.164***	-0.975***	-1.005***	-0.964***	-0.988***
	(0.162)	(0.162)	(0.163)	(0.162)	(0.184)	(0.185)	(0.184)	(0.185)
BETA	0.446***	0.445***	0.391***	0.400***	0.250***	0.225**	0.189**	0.188**
	(0.087)	(0.088)	(0.089)	(0.090)	(0.095)	(0.093)	(0.093)	(0.092)
OPTION			0.143	0.141			0.623**	0.592**
			(0.339)	(0.337)			(0.284)	(0.278)
SWAP			0.275	0.227			-1.014	-0.746
			(0.617)	(0.613)			(0.779)	(0.803)
Constant	-3.015***	-3.050***	-2.885***	-2.880***	-1.343***	-1.458***	-1.436***	-1.509***
	(0.354)	(0.356)	(0.365)	(0.369)	(0.439)	(0.441)	(0.458)	(0.450)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	886	886	886	886	877	877	877	877
Adjusted R-squared	0.409	0.407	0.391	0.389	0.200	0.205	0.196	0.202
Wald chi-squared	710.97***	723.23***	639.84***	686.17***	217.32***	236.27***	219.58***	253.45***

Note. The table reports 2nd stage regression results of accounting-based risk measures of *ROEVOL* and *ROAVOL* in Panel A and market-based risk measures of *QVOL* and *IQVOL* in Panel B as dependent variables. In the 1st stage, $FCDEV_{t+1}$ is estimated using $FCDEV_t$ as instrument variable and other variables as control variables. *EXED* is an indicator variable with a value of 1 for firms whose expected exchange rate exposure (EXE) is greater than its median value and 0 otherwise. See Table 1 for definitions and measurements of other variables. Firm-clustered standard errors are in parentheses. ***, ***, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE VI

2SLS Regression Results on the Effects of Currency Derivatives Use on Firm Performance

Panel A: Accounting-based performance								
Variables	*ROE*				*ROA*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
FCDEV	-0.080	-1.736			-0.012	-0.119		
	(0.171)	(1.571)			(0.023)	(0.086)		
FCDEV x *EXED*		1.886				0.122		
		(1.621)				(0.090)		
FCDEV-Sell			0.215	0.078			0.024	0.030
			(0.153)	(0.165)			(0.039)	(0.057)
FCDEV-Sell x *EXED*				0.165				-0.005
				(0.199)				(0.068)
FCDEV-Buy			1.778**	2.642			0.311	0.555
			(0.787)	(2.844)			(0.224)	(0.682)
FCDEV-Buy x *EXED*				-1.099				-0.300
				(3.019)				(0.668)
EXED		-0.075		0.051		-0.001		0.006
		(0.072)		(0.051)		(0.006)		(0.006)
FSIZE	0.016**	0.013*	-0.003	-0.004	0.003	0.003	0.000	0.000
	(0.008)	(0.007)	(0.006)	(0.007)	(0.002)	(0.002)	(0.002)	(0.002)
EBITDA	0.777***	0.772**	0.823***	0.838***	0.360***	0.362***	0.365***	0.366***
	(0.253)	(0.301)	(0.261)	(0.270)	(0.065)	(0.067)	(0.065)	(0.068)
SG	-0.016	-0.035	-0.017	-0.024	-0.008	-0.010	-0.009	-0.010
	(0.045)	(0.061)	(0.044)	(0.049)	(0.008)	(0.008)	(0.008)	(0.008)
RND	0.541	0.810	0.902	0.901	0.205	0.226	0.272*	0.279*
	(0.550)	(0.775)	(0.678)	(0.696)	(0.155)	(0.155)	(0.145)	(0.144)
LEV	-0.218**	-0.217*	-0.228**	-0.235**	-0.059***	-0.059***	-0.060***	-0.060***
	(0.110)	(0.117)	(0.109)	(0.111)	(0.015)	(0.016)	(0.015)	(0.015)
AGE	0.017	0.019	0.020	0.019	0.002	0.002	0.002	0.002
	(0.029)	(0.029)	(0.028)	(0.028)	(0.003)	(0.003)	(0.003)	(0.003)
FOR	-0.005	-0.026	0.067	0.079	0.033	0.032	0.044**	0.046**
	(0.094)	(0.108)	(0.089)	(0.100)	(0.021)	(0.021)	(0.020)	(0.020)
OWN	0.038	-0.015	0.012	0.003	0.025*	0.022	0.022*	0.021
	(0.075)	(0.115)	(0.077)	(0.082)	(0.014)	(0.015)	(0.013)	(0.014)
OPTION			-0.867*	-0.870*			-0.117**	-0.118**
			(0.486)	(0.485)			(0.046)	(0.046)
SWAP			0.236	0.391			-0.032	-0.012
			(0.212)	(0.283)			(0.065)	(0.066)
Constant	-0.316**	-0.176	0.074	0.070	-0.047	-0.039	0.008	0.006
	(0.140)	(0.204)	(0.209)	(0.194)	(0.040)	(0.042)	(0.038)	(0.037)
YEAR, IND dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	886	886	886	886	886	886	886	886
Adjusted R-squared	0.022	0.027	0.065	0.066	0.208	0.204	0.224	0.226
Wald chi-squared	216.73***	182.25***	527.58***	704.21***	1772.50***	1640.22***	2879.78***	3929.94***
Panel B: Market-based performance								
Variables	*Q*				*IQ*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
FCDEV	0.358***	1.038**			0.139*	0.938**		
	(0.118)	(0.459)			(0.130)	(0.453)		
FCDEV x *EXED*		-0.771*				-0.907*		
		(0.490)				(0.468)		

FCDEV-Sell			0.548**	0.664*			0.132	0.604
			(0.263)	(0.361)			(0.316)	(0.395)
FCDEV-Sell x *EXED*				-0.182				-0.643
				(0.431)				(0.463)
FCDEV-Buy			1.509	-0.732			1.006	-1.046
			(1.619)	(3.000)			(1.939)	(3.279)
FCDEV-Buy x *EXED*				2.825				2.722
				(2.991)				(3.378)
EXED		0.017		-0.053		0.009		-0.048
		(0.052)		(0.045)		(0.049)		(0.042)
FSIZE	0.058***	0.060***	0.053***	0.054***	0.056***	0.058***	0.055***	0.057***
	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)	(0.013)
EBITDA	1.827***	1.820***	1.852***	1.859***	1.493***	1.477***	1.491***	1.514***
	(0.357)	(0.362)	(0.357)	(0.361)	(0.314)	(0.327)	(0.317)	(0.323)
SG	0.030	0.040	0.026	0.032	-0.014	-0.001	-0.013	-0.006
	(0.049)	(0.049)	(0.048)	(0.048)	(0.039)	(0.038)	(0.038)	(0.039)
RND	5.389**	5.267**	5.480***	5.446***	6.253***	6.101***	6.169***	6.184***
	(2.105)	(2.119)	(2.122)	(2.071)	(1.833)	(1.825)	(1.836)	(1.801)
LEV	0.347***	0.348***	0.345**	0.348***	0.330***	0.333***	0.311***	0.319***
	(0.128)	(0.128)	(0.134)	(0.131)	(0.115)	(0.115)	(0.120)	(0.116)
AGE	-0.021	-0.021	-0.017	-0.017	-0.006	-0.006	-0.007	-0.008
	(0.025)	(0.026)	(0.025)	(0.024)	(0.026)	(0.026)	(0.027)	(0.026)
FOR	0.211	0.217	0.247	0.227	0.102	0.108	0.107	0.085
	(0.154)	(0.156)	(0.151)	(0.152)	(0.152)	(0.152)	(0.149)	(0.150)
OWN	-0.148	-0.126	-0.154	-0.143	0.026	0.053	0.017	0.030
	(0.135)	(0.137)	(0.136)	(0.135)	(0.125)	(0.126)	(0.128)	(0.127)
OPTION			0.156	0.161			0.200	0.204*
			(0.115)	(0.115)			(0.122)	(0.120)
SWAP			0.102	-0.067			0.444	0.282
			(0.514)	(0.526)			(0.470)	(0.483)
constant	-0.328	-0.383	-0.227	-0.216	-1.413***	-1.477***	-1.392***	-1.407***
	(0.290)	(0.295)	(0.291)	(0.287)	(0.300)	(0.303)	(0.299)	(0.294)
YEAR, IND dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	886	886	886	886	886	886	886	886
Adjusted R-squared	0.362	0.355	0.351	0.350	0.253	0.245	0.252	0.252
Wald chi-squared	1669.26***	2599.58***	2840.39***	1703.13***	1853.90***	3434.30***	4702.70***	4638.72***

Note. The table reports 2nd stage regression results of accounting-based performance measures of *ROE* and *ROA* in Panel A and market-based performance measures of *Q* and *IQ* in Panel B as dependent variables. In the 1st stage, $FCDEV_{t+1}$ is estimated using $FCDEV_t$ as instrument variable and other variables as control variables. *EXED* is an indicator variable with a value of 1 for firms whose expected exchange rate exposure (EXE) is greater than its median value and 0 otherwise. See Table 1 for definitions and measurements of other variables. Firm-clustered standard errors are in parentheses. ***, ***, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE VII

Robustness Test for the Effect of Currency Derivatives Use on Risk-Adjusted Performance

Panel A: Accounting-based risk-adjusted performance								
Variables	*(ROE / ROEVOL)*				*(ROA / ROAVOL)*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
FCDEV	-0.090	-1.426			0.007	0.059		
	(0.201)	(1.044)			(0.012)	(0.044)		
FCDEV x *EXED*		1.526				-0.059		
		(1.098)				(0.045)		
FCDEV-Sell			-0.080	0.018			-0.008	-0.021
			(0.193)	(0.155)			(0.017)	(0.024)
FCDEV-Sell x *EXED*				-0.153				0.017
				(0.279)				(0.026)
FCDEV-Buy			-0.585	0.416			-0.077	-0.157
			(1.581)	(3.161)			(0.097)	(0.310)
FCDEV-Buy x *EXED*				-1.191				0.094
				(2.670)				(0.308)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR, IND dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	886	886	886	886	886	886	886	886
Adjusted R-squared	0.010	0.021	0.012	0.013	0.094	0.087	0.107	0.110
Wald chi-squared	40.36***	34.94***	39.52***	47.79***	705.72***	625.86***	1102.93***	1570.84***
Panel B: Market-based risk-adjusted performance								
Variables	*(Q / QVOL)*				*(IQ / IQVOL)*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
FCDEV	0.092	1.918			0.310**	1.341		
	(0.718)	(2.136)			(0.172)	(0.931)		
FCDEV x *EXED*		-2.285				-1.189		
		(2.065)				(0.980)		
FCDEV-Sell			-1.125	-1.983			0.017	-0.282
			(1.712)	(1.521)			(0.331)	(0.337)
FCDEV-Sell x *EXED*				2.342				0.584
				(1.975)				(0.484)
FCDEV-Buy			4.917	40.470			1.201	9.123
			(10.249)	(35.052)			(2.311)	(5.932)
FCDEV-Buy x *EXED*				-45.226				-10.058
				(36.383)				(6.590)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR, IND dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	886	886	886	886	877	877	877	877
Adjusted R-squared	0.074	0.069	0.069	0.056	0.159	0.146	0.160	0.157
Wald chi-squared	184.13***	203.77***	101.58***	91.46***	201.07***	185.09***	179.31***	179.10***

Note. The table reports 2nd stage regression results of accounting-based risk-adjusted performance measures of *ROE/ROEVOL* and *ROA/ROAVOL* in Panel A and market-based risk-adjusted performance measures of *Q/QVOL* and *IQ/IQVOL* in Panel B. In the 1st stage, $FCDEV_{t+1}$, $FCDEV\text{-}Sell_{t+1}$, and $FCDEV\text{-}Buy_{t+1}$ are estimated using $FCDEV_t$, $FCDEV\text{-}Sell_t$, and $FCDEV\text{-}Buy_t$, respectively, as instrument variable and other variables as control variables. *EXED* is an indicator variable with a value of 1 for firms whose expected exchange rate exposure (*EXE*) is greater than its median value and 0 otherwise. See Table 1 for definitions and measurements of other variables. Firm-clustered standard errors are in parentheses. ***, ***, and * indicate significance at the 1%, 5%, and 10% levels, respectively.