Implications of Accounting for Financial Instruments on Corporate Earnings Volatility in Taiwan

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Abstract

The Taiwan Statement of Financial Accounting Standards No. 34 - Accounting for Financial Instruments passed into law on December 25, 2003. This investigation determines how standard No. 34 impacts earnings volatility for those firms which use derivatives for hedging and for those firms that does not. The empirical results indicate that the non-electronics firms exhibit characteristics that when the interaction function of the two dummy variables is significant - that is, in the case of firms employing derivatives in the period following the introduction of TSFAS No. 34 - accounting earnings volatility is considerably affected. The estimated coefficients of the determinants are found that either include or exclude the inverted Mills ratio change considerably and thus exert a significant influence on the estimated earnings volatility.

Keywords: Accounting for Financial Instruments, Heckman two-stage method

I. Introduction

The wave of international financial liberalization has witnessed financial markets introducing various innovative financial instruments to help investors limit investment risk. Financial statements compiled using the accounting principle of historic cost cannot be applied to verify the true value of financial instruments. Since 1990, the US Financial Accounting Standards Board has issued numerous pronouncements regarding financial instrument accounting standards. For example, US Statement of Financial Accounting Standard (US SFAS) No. 105 regulates the disclosure of information on financial instruments involving off-balance-sheet risk and concentrations of credit risk, US SFAS No.107 regulates the disclosure of the fair value of financial instruments, and US SFAS No.119 regulates the disclosure of the fair value of financial instruments and derivatives. Furthermore, US SFAS No. 133, issued in 2000, principally deals with fair value, governs financial derivatives and hedging accounting treatment, and introduces changes in the off-balance-sheet or fair value required to be disclosed on the balance sheet. In an attempt to achieve such convergence, the International Accounting Standards Committee (IAS) studied financial instrument accounting standards from 1990, proposed extensive exposure drafts for public comment, and issued International Accounting Standard (IAS) No. 32 in 1995, to regulate financial instrument presentation and disclosure. To supplement IAS No.32, International Accounting Standard No. 39 was issued in 1998 and amended in 2003, to establish principles for recognizing, measuring, and disclosing information about financial instruments. Furthermore, in 2005, the International

Organization of Securities Commissions (IOSCO) accepted IAS No. 39's requirement of obligatory financial standards for firms with cross-border listings. Using fair value as a basis for accounting measurement has become the global standard.

To remain abreast of the development of global accounting principles regulating financial instruments, in 1997 the Taiwan Financial Accounting Standards Board announced the Taiwan Statement of Financial Accounting Standard (henceforth TSFAS) No.27, Disclosure of Financial Instruments, which established accounting principles governing the disclosure of financial instruments correlated with significant accounting policy, special attributes and settings, off-balance-sheet risk, concentration of credit risk, fair value, and trading of financial derivatives. The publication in 2003 of TSFAS No. 34, Accounting for Financial Instruments—primarily derived from IAS No. 39—established accounting standards including classification of financial instruments, accounting treatment of embedded derivatives, financial instrument recognition, financial asset impairment, and disclosure of hedging activities and financial instruments. Among these changes in accounting principles, the method of measuring financial instruments underwent the most reform, changing from the conventional costing, or the lower of cost or market, to the fair value. With the exception of held-to-maturity investments, equities with no active market prices which are unable to be reliably measured at fair value, and other derivatives geared against the preceding equities for paying off debts (which are valued differently), the measurement of the financial instruments, including of derivatives, held by firms is required to be performed at fair value. Liabilities of derivatives and traded financial instruments are also required to be measured at fair value.

The adoption of TSFAS No. 34 will formally recognize unrealized gains and losses from the use of financial instruments. Accounting conservatism will thus be no longer applicable, which will increase the fluctuation of financial statements. Specifically, when companies hold financial instruments in which an active market does not exist for the purpose of determining a market value, they must use the present value of future cash flows, the option pricing model, or other pricing models commonly used in markets to determine fair value. Because the choice of model parameters involves judgment, arbitrary changes in parameter estimation are likely to lead to significantly effects on financial statements. Thus, although TSFAS No. 34 was announced at the end of December 2003, the standard itself was to be implemented only in the fiscal year ending on December 31, 2006, with earlier adoption not being permitted. The Taiwanese authorities allowed companies a two-year preparatory period from the announcement to the official adoption, which shows that the introduction of the standard was expected to significantly impact companies. Hence, investors and authorities should pay close attention to how the adoption of TSFAS No. 34 influences accounting earnings volatility. Besides impacting earnings volatility, the question of whether this standard affects earnings quality and corporate valuation is a key issue for investors and authorities. As described above, the determinants of the method used to assess fair value are likely to influence corporate earnings quality.

The accounting literature on financial instrument accounting standards has three strands. One strand is related to the possible economic effects on securities markets of announcing accounting standards for financial instruments. Cornett, Rezaee, and Tehranian (1996) focus on the influence of the announcement of fair value accounting standards on share prices of banking institutions. Nelson (1996) studies the relationship between market value of stockholder equity and disclosed fair value, following the adoption of accounting standards in the banking industry. Furthermore, Beatty, Chamberlain and Magliolo (1996) analyse the influence of applying new accounting standards for share returns in both banking and insurance firms. Moreover, Duangploy and Helmi (2003) examine how the announcement of US SFAS No. 133 influenced the presentation of financial statements by the 25 leading US domestic banks. Chalmers and Godfrey (2004) study tactics used by management in response to the Australia Financial Accounting Standard Board's requirement that firms disclose information about derivatives. Park (2005) investigates economic outcomes for financial holding companies following US SFAS No. 133. Furthermore, Wang et al. (2005) investigate how the adoption of US SFAS Nos. 119 and 133 affected bank share prices. Ahmed et al. (2006) further examine how the banking industry assesses derivative instruments in a way that influences corporate equality valuation, following the implementation of US SFAS No. 133. A second strand of research focuses on the degree to which announcements of financial instrument standards has impacted corporate hedging strategy and risk exposures. Related studies, such as that of Supanvanij and Strauss (2006), examine how the management of S&P 500 firms uses hedging to maximize utility both before and after US SFAS No. 133. Richie et al. (2006) investigate the implications for US multinational corporations operating with derivatives, hedging, and earnings volatility following US SFAS No. 133. Zhang (2009) suggests that firms whose risk exposures increased after the initiation of their derivatives programs engaged in more careful risk-management activities after the adoption of US SFAS No. 133. Ahmed et al. (2011) indicate that US SFAS No. 133 has increased the risk relevance of accounting measures of derivative exposures to bond investors, and has benefited banks in terms of reducing their cost of capital. A third strand of the research focuses on theoretical and model deduction. Hitz (2007) adopts a hypothetical perspective to examine the effectiveness of accounting fair value in influencing decision making. Finally, Reis and Stocken (2007) employ corporate strategic outcomes in the form of accounting measurement of both historic cost and fair value, in order to develop pricing model.

As can be seen from the literature review, the existing research mostly focuses on generating all the possible economic outcomes for the securities market following the issuance of financial instruments standards. However, the issuance of new standards directly affects the firms themselves, shifting the research priority from analysing firm's treatment of the accounting to the influence of new accounting standards on financial statements. Furthermore, analysing the influence of changes in accounting principles on financial statements can help firms understand how new accounting standards affect securities markets in general. For instance, Richie et al. (2006) investigate the impact of the issuance of US SFAS No. 133 on the use of derivatives for hedging by US multinational corporations, while Cheng et al. (2007) study the influences of US SFAS No. 106 on firm valuation and earnings quality. Thus, the issuance of standards for financial instruments is a key research issue, and provides a reference for examining the influence of TSFAS No. 34, regarding changes in the accounting treatment of financial instruments, on firm earnings volatility.

The rest of this paper is organized as follows: Section II describes data resources and presents the research design and empirical methods employed in this study. Section III presents the results of empirical analysis. Section IV provides a summary and conclusion.

II. Data Resources and Research Methodology

Taiwan Statement of Financial Accounting Standard No.34, Accounting for Financial Instruments, was issued on December 25, 2003, with the contents coming into force on January 1, 2006. Earlier adoption was not permitted. The standard requires financial instruments to be measured at fair value, and derivatives to be recognized and measured at fair value. This investigation examines the impact on corporate earnings volatility of implementing TSFAS No. 34. The following section describes the study period, data sources, research hypothesis, the empirical model constructed, and the operational definition of the variable.

II.A Study Period and Data Sources

As TSFAS No. 34 became effective on January 1, 2006, in order to evaluate whether the adoption of this standard impacted earnings volatility, this investigation initially sorts the sample into two groups, namely firms with operational derivative instruments, and those with and non-operational derivative instruments. Because firms with operational derivatives hold greater numbers of more complex underlying derivative instruments than do firms with non-operational derivative instruments, the financial statements for the final period of each quarter must recognize more unrealized gains or losses as regulated by TSFAS No 34. Therefore, in order to gauge the influence of TSFAS No. 34 on earnings volatility, this investigation studies the period from one year before the adoption of the measure to one year after—namely, from January 1, 2005 to December 31, 2006—in order to analyse and compare earnings volatility for two groups of sample firms after the adoption of this standard.

II.B Research Hypothesis

TSFAS No. 34, Accounting for Financial Instruments, requires firms holding or issuing financial instruments to apply fair value accounting. The recognition of derivative instruments is changed from off-balance-sheet to on-balance-sheet, and earnings in financial statements fluctuate to reflect market prices. Restated, unrealized gains and losses from derivatives are truly reflected in financial statements. Based on the requirements of TSFAS No. 34, this investigation thus sets out the following research hypotheses:

H_1: Following the adoption of TSFAS No. 34, firms with operational derivatives have greater earnings volatility than those without operational derivatives.

Moreover, this investigation considers the possible influences on hedging as a control variable, and uses prior hedging theory to analyse the relationship of these control variables and of firms using derivatives for hedging. The hypotheses which follow are derived from conventional hedging theories.

In the hedging theory literature focusing on the underinvestment issue, firms with higher growth opportunities have a greater need to employ derivative financial instruments for hedging, in order to mitigate the uncertainty associated with future cash flows. Mian (1996), as well as Gay and Nam (1998), the treat the market-value to book-value ratio and the price-earning ratio as two independent variables for measuring future corporate growth opportunities. Their findings suggest that firms with greater growth opportunities will make greater use of derivatives for hedging. This investigation thus formulates hypotheses H_2 as follows:

H_2: Firms with higher growth opportunities are more likely to use derivatives for hedging, increasing earnings volatility.

As for the firm operating scale factor, larger firms have lower average trading costs than smaller firms because of the increased operation of derivative contracts, and firms of a larger scale are more likely to employ professional financial managers to perform hedging. Block and Gallagher (1986) suggest that from the perspective of information economies of scale, larger firms are better able to use derivatives for hedging, and are more likely to conduct hedging. This study thus proposes hypothesis H_3:

H_3: Larger firms are more likely to use derivatives for hedging, increasing earnings volatility.

Concerning the relation of industrial characters to hedging theory, Geczy et al. (1997) point out that firms with exposure to exchange-rate risk have larger cash flows and accounting earnings volatility, increasing the potential benefits associated with hedging. For firms, the exchange rate risk predominantly comes from export sales. To reduce exchange rates, firms with higher exports are more likely to employ derivatives for hedging to mitigate the appreciation of the New Taiwan Dollar. Thus hypothesis H_4 states that

H_4: Firms with higher export sales ratios are more likely to employ derivatives

II.B Empirical Model and Variable Measurement

After the adoption of TSFAS No. 34, the recognition of derivative financial instruments has changed from off-balance-sheet to on-balance sheet, and accounting earnings in financial statements vary with financial instruments market prices, such that unrealized the gains or losses of financial instruments are reflected in financial statements Firms engaged in frequent derivative hedging, as expected, must therefore assess unrealized gains or losses from the derivatives in a more complicated manner for the final period of financial statements in each quarter; that is, firms affected by TSFAS No. 34 are more likely to display larger earnings volatility. This investigation thus divides the sample into firms using derivatives for hedging, and those which do not do so. This work treats accounting earnings volatility as the dependent variable, and other proxy variables in the constructed hypotheses as the independent variables. According to H_1, after the implementation of TSFAS No. 34, the earnings volatility of the sample firms with operating derivatives should be larger than those of the sample firms without any operating derivatives. In the regression equation, the dummy variable is also the independent variable, set to represent the interaction function term of whether or not firms have hedging activities in the pre- and post-TSFAS No. 34 periods. Under H_2, firms with greater opportunities for business growth are more likely to perform hedging to instigate major earnings changes. This investigation uses the market-value to book-value ratio and the price-earnings ratio as the proxy variables for firm growth prospects. In H_3, larger scale firm have larger scope to operate derivatives for hedging, thus generating larger earnings volatility. This investigation employs the net operating income and total assets as a natural log, representing the proxy variable for firm size. Moreover, according to H_4, firms with higher export sales ratios are more likely to use derivatives for hedging in order to create larger earnings volatility. This investigation uses the ratio of annual exports to annual net sales as a proxy for export sales ratio.

Given the above empirical model, the earnings volatility can be represented as a function of the determinants as follows

Earnings volatility = f (presence/absence of hedging activity, market-value to book-value ratio, price earnings ratio, firm size, export sales ratio, before or after implementation of TSFS No. 34) (1)

Before transforming the earnings volatility function of equation (1) into the regression estimation equation, one statistic related to sample selection bias must be mentioned. From a theoretical perspective, this investigation can use equation (1) with all sample firms to estimate the effectiveness of each determinant of earnings volatility, and can then estimate the degree to which TSFAS No. 34 affects the earnings volatility. One key determinant of earnings volatility is whether firms use derivatives for hedging purposes, yet as many as 40% of observations used in this investigation do not use derivatives for hedging. However, this occurs partially because the firms have a core business which does not derivative trading for hedging, and also because many firms are small scale, export only a small portion of sales, and have no need for hedging. Such firms invariably have no hedging at all. The sample selection bias problem occurs in situations where these non-hedging firms are mixed with other, hedging, firms in the observations.

To resolve this possible bias arising from the sample selection, this investigation employs the Heckman two-stage estimation model. The first stage uses all the observations with the logit model to estimate which firms would perform hedging and which would not do so, thus obtaining the hedging ($\overset{\frown}{HEDGE}$) function. The second stage then uses estimated coefficients from the logit model to calculate the inverted Mills ratio, which is used in adjusting the estimation equation to measure the influence of each determinant on earnings volatility.

If firms use derivatives for hedging, then we set HEDGE = 1, otherwise setting HEDGE = 0. The logit model which measures whether firms engage in hedging or not can be written as

$$HEDGE = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 D + \upsilon \qquad (2)$$

Where β_1, β_2, β_3, β_4, β_5, and β_6 are regression coefficients; υ is the error term; X_1 represents the year-end firm market value divided by the year-end book value; X_2 represents the ratio of price to earnings; X_3 represents firm size (net operating income presented in natural log form; X_4 represents firm size (total assets expressed as the natural log; X_5 represents the export sales ratio (annual exports divided by annual net sales); D represents the dummy variable for the pre- and post-TSFAS No. 34 periods, taking the value D=0 for the period before TSFAS No. 34, and D=1 for the period following TSFAS No. 34.

Next, this study uses the estimated hedging function ($\overset{\frown}{HEDGE}$) to estimate the corresponding inverted Mills ratio for each observation. The estimation equation is

$$\text{Inverted Mills Ratio} = \frac{\phi(\overset{\frown}{HEDGE})}{\Phi(\overset{\frown}{HEDGE})} \qquad (3)$$

where φ and Φ denote the probability density function (pdf) and the cumulative density function (cdf) of the logistic distributions, respectively.

This study sets the estimated inverted Mills ratio in the regression equation during the second stage to measure the marginal effect of each variable on earnings volatility. The volatility function is then

$$\text{Volatility} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 (\text{HEDGE} \times D + \beta_7 \text{ Mills ratio} + \varepsilon \qquad (4)$$

where β_1, β_2, β_3, β_4, β_5, and β_6, are regression coefficients; ε is the error term; VOLATILITY represents earnings volatility (the standard error in earnings per share for each quarter, divided by the average earnings per share for each quarter); X_1, X_2, X_3 , X_4, X_5, HEDGE, and D have here the same operational definitions as in the logit model of equation (2); HEDGE × D represents the interaction function of both dummy variables, regarding whether firms use derivatives for hedging before and after the TSFAS No. 34 periods.

III. Empirical Results

To effectively analyse the impact of implementing TSFAS No. 34 on the earnings volatility of Taiwanese listed companies, this investigation classifies the examined companies into two groups: the electronics industry and the non-electronics industry. This classification is made primarily for the reason that the electronics industry is export-oriented and uses derivatives for hedging, while the non-electronics industry does not. This study thus anticipates that following the adoption of TSFAS No. 34, the earnings volatility for the electronics industry will be more significant than that of the non-electronics industry.

This section first illustrates the basic descriptive statistics, and having come to an understanding of the basic properties of the observations, uses this data to conduct a regression analysis. This investigation employs the Heckman two-stage estimation method, the first stage of which measures whether or not the listed firms adopt derivatives for hedging, as represented in equation (2), and using the estimated coefficients to calculate the inverted Mills ratio as the adjusted item for the level of earnings volatility of listed companies, represented in equation (3). Finally, the Mills ratio is plugged into equation (4) in order to estimate the simple ordinary least regression. To compare the changes in the estimated coefficient for samples before and after adjustment, this investigation includes and then excludes the inverted Mills ratio from the estimate, and compares the ratios before and after adjustment.

III.A Basic Statistical Description

Tables I–III represent the basic descriptive statistics on the listed companies for the sample electronics firms, for the sample non-electronics firms, and for all sample firms, respectively. Essentially, this investigation uses the absolute value for the earnings volatility variable to effectively compare the earnings volatility fluctuation of Taiwanese listed companies affected by TSFAS No. 34. The findings shown in Tables I and II indicate that the average earnings volatility for the electronics industry is lower than for the non-electronics industry, but its standard error and maximum value are higher.

Table I. Descriptive statistics for sample listed companies in the electronics industry

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
HEDGE	314	0.85	0.35	0	1
VOLATILITY	314	1.85	5.74	0.06	82.45
X_1	314	1.77	1.27	0.32	9.57
X_2	314	24.45	71.36	-97.92	573.33
X_3	314	15.77	1.64	11.47	20.63
X_4	314	16.06	1.44	13.06	20.17
X_5	314	0.72	0.51	0	7.63
D	314	0.50	0.50	0	1
HEDGE × D	314	0.44	0.49	0	1

Note: HEDGE represents the dummy variable, taking the HEDGE = 1 for those firms which use derivatives for hedging, and HEDGE = 0 for those firms that do not. VOLATILITY represents earnings volatility. X_1 represents the year-end firm market value divided by the year-end book value; X_2 represents the ratio of price to earnings; X_3 represents firm size (net operating income presented in natural log form; X_4 represents firm size (total assets expressed as the natural log; X_5 represents the export sales ratio (annual exports divided by annual net sales); D represents the dummy variable for the pre- and post-TSFAS No. 34 periods, taking the value D=0 for the period before TSFAS No. 34, and D=1 for the period following TSFAS No. 34. HEDGE × D represents the interaction function of both dummy variables, regarding whether firms use derivatives for hedging before and after the TSFAS No. 34 periods.

Table II. Descriptive statistics for sample listed companies in the non-electronics industry

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
HEDGE	251	0.53	0.49	0	1
VOLATILITY	251	2.51	5.57	0.06	48.15
X_1	251	5.05	10.24	0.22	45.45
X_2	251	11.66	108.32	-880	753
X_3	251	15.11	1.35	9.35	19.34
X_4	251	15.55	1.21	13.51	19.67
X_5	251	0.39	0.80	0	12.07
D	251	0.50	0.50	0	1
$HEDGE \times D$	251	0.25	0.43	0	1

Note: The meanings of each variable are the same as Table I.

Table III. Descriptive statistics for sample listed companies involved in both the electronics and non-electronics industries

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
HEDGE	565	0.70	0.45	0	1
VOLATILITY	565	2.14	5.67	0.06	82.45
X_1	565	3.23	7.07	0.22	45.45
X_2	565	18.77	89.82	-880	753
X_3	565	15.48	1.55	9.35	20.63
X_4	565	15.84	1.36	13.06	20.17
X_5	565	0.57	0.68	0	12.07
D	565	0.50	0.50	0	1
$HEDGE \times D$	565	0.48	0.48	0	1

Note: The meanings of each variable are the same as Table I.

III.B Measurement of whether listed companies adopt derivatives for hedging

This study treats the question of whether or not the sample firms adopt derivatives for hedging as the independent variable (HEDGE), and the estimated coefficients for the sample electronics firms, sample non-electronics firms, and all sample firms as a whole are listed in Tables IV, V, and VI, respectively. In Table IV, the coefficients of X_1 and X_2 for the electronics sample firms are -0.11 and -0.0002, respectively, indicating that the coefficients are negative and insignificant. This implies that firms with more opportunities for growth are less likely to use derivatives for hedging, which is inconsistent with the expectations of this study. The estimates of X_3 and X_4 are 0.46 and 0.23, respectively significantly positive and insignificantly positive. Larger firms thus are more likely to use derivatives for hedging, consistent with the expectation of this investigation. The coefficient of X_5 is 0.54, and thus is positive and significant, consistent with expectation, demonstrating that firms with larger export sales ratio are more likely to use derivatives for hedging. Furthermore, the estimate of D is 0.38, and thus is positive and significant, consistent with the expectation of this study, and indicating that the adoption of TSFAS No.34 significantly influences companies employing derivatives for hedging purposes.

Table IV. Estimated results for whether electronics sample firms adopt derivatives for hedging

$$HEDGE = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 D + \upsilon$$

regressor	Expected sign	Estimated Coefficient	P value
Constant	?	-9.87**	0.00
X_1	+	-0.11	0.24
X_2	+	-0.0002	0.98
X_3	+	0.46**	0.004
X_4	+	0.23	0.23
X_5	+	0.54*	0.06
D	+	0.38*	0.07

Note: The meanings of each variable are the same as Table I.

In Table V, the coefficients of X_1 and X_2 for the sample non-electronics companies are 0.002 and 0.0007, respectively, both of which are positive and insignificant. Firms with larger opportunities for business growth thus are more likely to use derivatives for hedging, consistent with the expectations of this study. The corresponding estimates of X_3 and X_4 are 0.41 and 0.21, and thus are significantly positive and insignificantly negative, respectively. This finding indicates that larger firms are more likely to use derivatives, consistent with expectation. The coefficient of X_5 is 0.02, which is positive and significant, consistent with expectation. That is, firms with a larger export sales ratio are more likely to use derivatives for hedging. Furthermore, the estimate of D is -0.15, and is thus negative and insignificant, inconsistent with the expectation of this study, and indicating that the adoption of TSFAS No. 34 insignificantly affects firms' use of derivatives for hedging.

Table V. Estimated results for whether the sample non-electronics firms adopt derivatives for hedging

$$HEDGE = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 D + \upsilon$$

Regressor	Expected Sign	Estimated Coefficient	P value
Constant	?	-9.24**	0.00
X_1	+	0.002	0.77
X_2	+	0.0007	0.38
X_3	+	0.41**	0.001
X_4	+	0.21	0.13
X_5	+	0.02	0.77
D	+	-0.15	0.40

Note: The meanings of each variable are the same as Table I.

In Table VI, for all sample firms, the estimated coefficients of X_1 and X_2 are -0.007 and 0.0009, respectively, and thus are insignificantly negative and insignificantly positive. This finding implies that when treating the ratio of market-value to book-value as a proxy for future business growth, firms with better growth prospects are less likely to use derivatives for hedging, a result which is inconsistent with the expectations of this study. The corresponding estimates of X_3 and X_4 are 0.41 and 0.21, and thus are both significantly positive, consistent with the expected sign. The empirical evidence suggests that larger firms are more likely to employ derivative-based hedging strategies, consistent with expectation. The coefficient of X_5 is 0.18, which is positive and significant, consistent with expectation. Restated, firms which are highly involved in exporting are more likely to use derivatives for hedging. Furthermore, the estimate of D is -0.005, and thus is negative and insignificant, which is inconsistent with the study's expectation, meaning that the adoption of TSFAS No. 34 only insignificantly affects firms' use of derivatives for hedging.

Table VI. Estimated results for on whether all sample firms adopt derivatives for hedging

$HEDGE = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 D + \upsilon$

Regressor	Expected Sign	Estimated Coefficient	P value
Constant	?	-9.08**	0.00
X_1	+	-0.007	0.33
X_2	+	0.0009	0.18
X_3	+	0.41**	0.00
X_4	+	0.21**	0.04
X_5	+	0.18**	0.02
D	+	-0.005	0.96

Note: The meanings of each variable are the same as Table I.

III.C Measurement of Earnings Volatility

When using the estimates from Tables IV–VI to calculate the inverted Mills ratio—treating the estimated value of earnings volatility as the dependent variable—the coefficients of the determinants for company earnings volatility can be further measured, as shown in Tables VII–IX, for the sample electronics firms, for the sample non-electronics firms, and for all sample firms, respectively. In Table VII, the corresponding estimated coefficients of X_1 and X_2 for the sample electronics firms are -0.3 and 0.03, which are thus significantly negative and significantly positive, respectively, inconsistent with the positive sign expected in this study. This implies that using the ratio of market value to book value as a proxy for business growth opportunity indicates that firms with higher future growth are less likely to employ derivatives for hedging. While the price-earnings ratio serves as a proxy for future growth, the fact that the coefficient has a positive value indicates that derivative hedging increases with expected growth, a result consistent with the investigation's expectations. X_3 and X_4 are estimated at -0.09 and 0.09, respectively, and are thus insignificantly negative and insignificantly positive, respectively. That is, using sales as a proxy for firm size indicates that firm size increases as the possibility of using derivative hedging activities decreases, inconsistent with positive sign expected by the study. While total assets serves as a proxy for firm size, the positive coefficient reveals that derivative hedging activities increase with firm size, consistent with the study's expectations. X_5 is estimated at 0.35, and is thus insignificantly positive, consistent with expectations of this study. The empirical analysis suggests that when the share of exports increases, firms become more likely to use derivative hedging. Moreover, the estimate for the interaction term HEDGE× D is -0.46, and is thus insignificant and negative, inconsistent with the expected positive sign. This suggests that the interaction effect of the two dummy variables regarding whether firms use derivatives for hedging following the introduction of TSFAS No. 34 does not determine firms' earnings volatility.

Overall, the estimated coefficient of the inverted Mills ratio is 0.37, which is thus insignificant and positive, and indicates that the estimated earnings volatility exceeds the unadjusted estimates. Restated, the adjusted estimated coefficient of samples differs from the unadjusted estimated coefficient. If unadjusted, the estimated coefficient becomes biased owing to the sample selection problem. To facilitate comparison of adjusted and unadjusted regression equations, the right side of Table VII lists the estimated results for all variables, excluding the inverted Mills ratio variable. The empirical findings demonstrate that the estimated coefficients for including or not including the inverted Mills ratio in the two regression equations will change. The coefficient of X_1 is reduced from -0.30 to -0.41, X_2 from 0.03 to 0.04, X_3 from -0.09 to -0.68, X_4 from 0.09 to 0.53, X_5 from 0.35 to 0.40, and HEDGE×D from -0.46 to -0.94. Thus, the estimated earnings volatility is strongly influenced by significant changes in the coefficients of the determinants.

Table VII. Estimates of earnings volatility for sample electronics firms

Volatility $=\alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6$ (HEDGE× D $+\beta_7$ Mills ratio $+\varepsilon$

Regressor	Expected sign	OLS including Mills ratio Coefficient	t value	OLS excluding Mills ratio Coefficient	t value
Constant	?	1.17	0.43	4.06	1.32
X_1	+	-0.30**	-2.95	-0.41*	-1.92
X_2	+	0.03**	19.51	0.04**	11.07
X_3	+	-0.09	-0.43	-0.68	-1.708
X_4	+	0.09	0.44	0.53	1.15
X_5	+	0.35	1.43	0.40	0.75
HEDGE × D	+	-0.46*	-1.73	-0.94*	-1.70
Mills ratio	+	0.37	0.33		

Note: The meanings of each variable are the same as Table I.

In Table VIII, the corresponding estimated coefficients of X_1 and X_2 for the sample non-electronic firms are 0.005 and 0.01, and thus are insignificantly positive and significantly positive. Firms with better future growth prospects thus are more likely to deploy derivatives for hedging, consistent with the positive sign expected in this study. The estimates of X_3 and X_4 are -0.51 and -0.43, and are thus both insignificant and negative. Restated, derivative hedging activity reduces as firm size increases. The estimate of X_5 is -0.39, insignificantly negative, which is inconsistent with the expectation of this study that it would be positive. This demonstrates that the export sales ratio increases as the likelihood of firms using derivative hedging reduces. Moreover, the interaction term, HEDGE×D, is estimated at 0.81, and is thus insignificant and positive, consistent with the study expectations. This suggests that the interaction function of the two dummy variables for whether firms use derivatives for hedging, and for the periods before and after the introduction of TSFAS No. 34, determines the likelihood of volatility in firms' earnings.

Since the estimated coefficient of the inverted Mills ratio is insignificant and positive, and the obtained estimate is 2.28, the estimated amount of earnings volatility exceeds the unadjusted estimates. Restated, Samples of adjusted estimated coefficients differ from samples of unadjusted estimated coefficients. If unadjusted by the Mills ratio value, the estimates obtained in the regression display a sample selection bias. To facilitate comparisons of the adjusted and unadjusted regression equations, the results of estimation, excluding the inverted Mills ratio variable, are listed on the right hand side of Table VIII. The empirical results indicate that including or excluding the inverted Mills ratio in the estimated coefficients of determinants leads to a relative change. The coefficient of X_1 is reduced from 0.005 to -0.003, X_2 from 0.01 to 0.004, X_3 from -0.51 to -0.06, X_4 from -0.43 to -0.55, X_5 from -0.39 to -0.25, and HEDGE×D from 0.81 to 0.4. The coefficients of these determinants have changed significantly, and thus exert a considerable influence on the estimated earnings volatility.

Table VIII. Estimates of earnings volatility for sample non-electronics firms

Volatility $=\alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6$ (HEDGE× D $+\beta_7$ Mills ratio $+\varepsilon$

Regressor	Expected sign	OLS including Mills ratio Coefficient	t value	OLS excluding Mills ratio Coefficient	t value
Constant	?	18.07	0.71	12.17*	2.56
X_1	+	0.005	0.11	-0.003	-0.09
X_2	+	0.01**	2.73	0.004	-1.23
X_3	+	-0.51	-0.38	-0.06	-0.15
X_4	+	-0.43	-0.53	-0.55	-1.12
X_5	+	-0.39	-0.25	-0.25	-0.59
HEDGE × D	+	0.81	0.72	0.49	0.57
Mills ratio	+	2.28	0.44		

Note: The meanings of each variable are the same as Table I.

In Table IX, the estimated coefficients of X_1 and X_2 for all sample firms are 0.008 and 0.02, respectively, consistent with the study's expected positive sign. The coefficients are insignificantly positive and significantly positive, respectively. This implies that firms with better growth prospects are more likely to employ derivatives for hedging. The estimates of X_3 and X_4 are -0.36 and -0.06, and are thus insignificant and negative, inconsistent with the expectations of this study. That is, larger firms are less likely to adopt derivatives for hedging. Furthermore, the estimate of X_5 is -0.17, and thus is insignificantly negative, inconsistent with the expected positive sign. This situation indicates that the chance of firms using derivative hedging reduces as export sales ratio increases. Moreover, the interaction term, HEDGE× D, is estimated at -0.16, and is thus insignificant and negative, inconsistent with the expectation of this study that it would be positive. This implies that the interaction function of the two dummy variables for whether firms use derivatives for hedging, and for the periods before and after the introduction of TSFAS No. 34, reduces the likelihood of volatility in firms' earnings.

The estimated coefficient of the inverted Mills ratio is 1.26, and is thus insignificant and positive, indicating that the estimated earnings volatility is higher than in the unadjusted estimates. Restated, the samples of adjusted estimated coefficients differ from the samples of unadjusted estimated coefficients. If unadjusted, the obtained estimate is biased by the sample selection problem. In order to compare the adjusted and unadjusted regression equations, the right hand side of Table IX listed the estimated results, excluding the inverted Mills ratio variable. The empirical results indicate that including or excluding the inverted Mills ratio causes the estimated coefficients of the determinants to relatively change. The coefficient of X_1 is reduced from 0.008 to -0.01, X_2 from 0.02 to 0.01, X_3 from -0.36 to -0.44, X_4 from -0.16 to -0.42, X_5 from -0.17 to -0.46, and HEDGE×D from -0.16 to -0.42. Therefore, these coefficients of determinants have considerably changed as a result of significantly influencing the estimated earnings volatility.

Table IX. Estimated earnings volatility for all sample firms

Volatility $=\alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6$ (HEDGE× D $+\beta_7$ Mills ratio $+\varepsilon$

Regressor	Expected sign	OLS including Mills ratio Coefficient	t value	OLS excluding Mills ratio Coefficient	t value
Constant	?	8.66	1.44	9.31**	3.39
X_1	+	0.008	0.27	-0.01	-0.45
X_2	+	0.02**	10.24	0.01**	4.65
X_3	+	-0.36	-0.97	-0.44	-1.41
X_4	+	-0.06	-0.21	-0.01	-0.04
X_5	+	-0.17	-0.46	-0.15	-0.45
HEDGE × D	+	-0.16	-0.42	-0.42	-0.84
Mills ratio	+	1.26	-0.74		

Note: The meanings of each variable are the same as Table I.

IV. Conclusion

Tables X and XI summarize the empirical findings for the four hypotheses. In Table X is listed the regressand of HEDGE, and it can be seen that the behaviours of the electronics, the non-electronics, and all sample firms are consistent with the anticipated proposition of H_3 and H_4; that is, larger firms, or those with a high percentage of exports, are more likely to use derivatives for hedging. The sample non-electronics firms exhibit behaviour consistent with the expectation of H_2, demonstrating that firms with higher growth opportunity are more likely to employ derivative hedging. When price earnings ratio is used as a proxy for business growth, all sample firms also exhibit behaviour consistent with H_2. Moreover, only the sample electronics firms exhibit behaviour consistent with H_1, namely that the use of derivatives would increase following the implementation of TSFAS No. 34.

Table X. Results of Hypothesis Testing for the regressand of HEDGE

Regressand HEDGE Regressor	Electronics Sample firms H1	H2	H3	H4	Non-electronics sample firms H1	H2	H3	H4	All sample firms H1	H2	H3	H4
X1		×				✓				×		
X2		×				✓				✓		
X3			✓				✓				✓	
X4			✓				✓				✓	
X5				✓				✓				✓
D	✓				×				×			

Note: The meanings of each variable are the same as Table I.

Table XI shows the regressands of VOLATILITY, and it can be seen that when the price-earnings ratio serves as a proxy for the growth opportunity of a business, then the exhibited attributes for electronics, non-electronics, and all sample firms are consistent with the anticipated proposition of H_2; that is, firms with higher growth opportunities are more likely to employ derivatives for hedging, and are more likely to have high earnings volatility. When the ratio of market value to book value is used as a proxy for business growth, both non-electronics and all sample firms display their characteristics consistent with the anticipated H_2. Moreover, when total assets serve as a proxy for firm size, only the sample electronics firms show characteristics consistent with H_3, demonstrating that operating derivatives and earnings volatility increase with firm size. Only the sample electronics firms exhibit characteristics consistent with H_4, namely that firms with higher export ratios are more likely to employ derivatives for hedging and to have higher earnings volatility. Furthermore, the non-electronics firms exhibit characteristics consistent with H_1, indicating that when the interaction function of the two dummy variables is significan - that is, in the case of firms employing derivatives in the period following the introduction of TSFAS No. 34 - accounting earnings volatility is considerably affected.

Table XI. Hypothesis Test Results for the Regressand of VOLATILITY

Regressand VOLATILITY Regressor	**Electronics sample firms H1**	**H2**	**H3**	**H4**	**Non-electronics sample firms H1**	**H2**	**H3**	**H4**	**All sample firms H1**	**H2**	**H3**	**H4**
X1	×				✓				✓			
X2	✓				✓				✓			
X3		×				×				×		
X4		✓				×				×		
X5			✓				×				×	
HEDGE × *D*	×				✓				×			

Note: The meanings of each variable are the same as Table I.

References

Ahmed, A. S., Kilic, E. and Lobo, G. J. (2011), "Effects of SFAS 133 on the Risk Relevance of Accounting Measures of Banks' Derivative Exposures", *The Accounting Review*, Vol. 86 No. 3, pp. 769-804.

Ahmed, A.S., Kilic, E. and Lobo, G.J. (2006), "Does Recognition versus Disclosure Matter？ Evidence from Value-Relevance of Banks' Recognized and Disclosed Derivative Financial Instruments", *The Accounting Review*, Vol. 81 No. 3, pp. 567-588.

Beatty, A., Chamberlain, S. and Magliolo, J. (1996), "An empirical analysis of the economic implications of fair value accounting for investments securities", *Journal of Accounting and Economics*, Vol. 22 No. (1-3), pp. 43-77.

Block, S.B. and Gallagher. T. (1986), "The Use of Interest Rate Futures and Options by Corporate Financial Managers", *Financial Management*, Vol. 15 No. 3, pp. 73-78.

Chalmers, K. and Godfrey, J.M. (2004), "Reputation costs: the impetus for voluntary derivative financial instrument reporting", *Accounting, Organizations and Society*, Vol. 29 No. 2, pp. 95-125.

Cheng Agnes, C.S., Hsieh, S.J. and Yip. Y. (2007), "Impact of accounting choices on firm valuation and earnings quality", *Review of Accounting and Finance*, Vol. 6 No. 4, pp. 419-441.

Cornett, M. M., Rezaee, Z. and Tehranian, H. (1996), "An investigation of capital market reactions to pronouncements on fair value accounting", *Journal of Accounting and Economics*, Vol. 22 No. (1-3), pp. 119-154.

Duangploy, O. and Helmi, D.G. (2003), "SFAS No. 133: Effect on 25 Large Banks", *Bank Accounting & Finance*, Vol. 16, pp. 7-13.

Gay, G. D. and Nam, J. (1998), "The Underinvestment Problem and Corporate Derivatives Use", *Financial Management*, Vol. 27 No. 4, pp. 53-69.

Geczy, C., Minton, B. A. and Schrand. C. (1997), "Why Firms Use Currency Derivatives", *Journal of Finance*, Vol. 52 No. 4, pp. 1323-1354.

Hitz, J.M. (2007), "The Decision Usefulness of Fair Value Accounting－ A Theoretical Perspective", *European Accounting Review*, Vol. 16 No. 2, pp. 323-362.

Mian, S.L. (1996), "Evidence on Corporate Hedging Policy", *Journal of Financial and Quantitative Analysis*, Vol. 31 No. 3, pp. 419-439.

Park, J. (2005), "The Economic Consequences of FAS-133 for Bank Holding Companies", *Bank Accounting & Finance*, Vol. 18, 19-48.

Reis, R.F. and Stocken, P.C. (2007), "Strategic Consequences of Historical Cost and Fair Value Measurements", *Contemporary Accounting Research*, Vol. 24 No. 2, pp. 557-584.

Richie, N., Glegg, C. and Gleason, K.C. (2006), "The effects of SFAS 133 on foreign currency exposure of US-based multinational corporations", *Journal of Multinational Financial Management*, Vol.16 No. 4, pp. 424-439.

Supanvanij, J. and Strauss, J. (2006), "The effects of management compensation on firm hedging: Does SFAS 133 matter?", *Journal of Multinational Financial Management*, Vol. 16 No. 5, pp. 475-493.

Wang, L., Alam, P. and Makar, S. (2005), "The Value-Relevance of Derivative Disclosures by Commercial Banks: A Comprehensive Study of Information Content under SFAS Nos. 119 and 133", *Review of Quantitative Finance & Accounting*, Vol. 25 No. 4, pp. 413-427.

Zhang, H. (2009), "Effect of derivative accounting rules on corporate risk-management behavior", *Journal of Accounting & Economics*, Vol. 47 No. 3, pp. 244-264.

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