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Earnings Management and Derivative Hedging with Fair Valuation: Evidence from the Effects of FAS 133

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ABSTRACT: Barton (2001) and Pincus and Rajgopal (2002) show that earnings management through discretionary accruals and derivative hedging are partial substitutes in smoothing earnings before 1999. In this study, we investigate whether Financial Accounting Standard (FAS) 133 regarding hedge accounting in 2000 has influenced the relative merit of the two earnings-smoothing methods. Based on a sample of S&P 500 nonfinancial firms during 1996–2006, we find that the substitution relation between derivative hedging and discretionary accrual is significantly attenuated after FAS 133 implementation. We also document a significant increase in earnings volatility associated with derivative hedging post-FAS 133. These results are robust to the use of various model and method specifications, as well as controlling for contemporaneous macroeconomic and regulatory shocks. Overall, our results suggest that a material change in an accounting rule regarding derivatives can influence the level and volatility of reported earnings, as well as the method of income smoothing.

Keywords: *discretionary accrual; FAS 133; fair value accounting; derivative hedging; income smoothing; corporate risk management; earnings management*.

JEL Classifications: *G32; M41; M48*.

I. INTRODUCTION

It is commonly accepted in the accounting and finance literature that corporate managers have incentives to smooth earnings in the presence of market imperfections such as taxes, distress costs, or information asymmetry (Smith and Stulz 1985; Trueman and Titman 1988; Goel and

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Thakor 2003). On the other hand, Lev and Kunitzky (1974), Kamin and Ronen (1978), and Petersen and Thiagarajan (2000) argue that there are two methods of smoothing income: an "artificial smoothing" through accounting techniques such as discretionary accruals to shift revenues and costs from one period to another, or a "real smoothing" through contractual transactions such as derivatives to smooth income by reducing cash flow volatility.[1] Given the availability of alternative methods of achieving the same objective, one should expect empirical work to reveal a substitution relation between discretionary accruals and derivative hedging, assuming no cross-sectional or time-series variation in incentives for income smoothing.

Barton (2001) finds a negative and significant association between notional amounts of foreign exchange and interest rate derivatives and discretionary accruals for Fortune 500 firms for the 1994–1996 period, indicating a substitution relation between the two. Using data for oil and gas firms for 1993–1996, Pincus and Rajgopal (2002) show that oil and gas firms manage earnings volatility by trading off abnormal accruals and commodity price derivative hedging. However, these two studies cover the period before 1999, when there was no uniform standard of derivatives accounting. Managers can use deferral and accrual methods to account for derivatives at their discretion. In 1998, the Financial Accounting Standards Board (FASB) issued Statement 133, *Accounting for Derivative Instruments and Hedging Activities* (FAS 133). FAS 133, which became effective on June 15, 2000, requires firms to record all derivatives at their fair values on the balance sheet and to recognize portions of unrealized gains or losses due to valuation changes in the income statement.[2]

In this study, we examine whether and how the adoption of the fair value derivative accounting rule under FAS 133 has altered the relation between derivative hedging and accrual management for nonfinancial firms. As conjectured by practitioners and policymakers, it is conceivable *ex ante* that FAS 133 might have affected the cost and effectiveness of using derivatives to smooth earnings, thereby altering the relation between the two income-smoothing methods.[3] We use firm-specific accounting, financial, and derivatives data for nonfinancial firms in the S&P 500 index for the 1996–2006 period, which roughly evenly encompasses the pre- and post-FAS 133 eras. We find that the relation between financial derivative use and discretionary accruals is negative before FAS 133, confirming the results in Barton (2001) and Pincus and Rajgopal (2002), but the substitution relation is significantly attenuated after FAS 133 implementation. This finding is consistent with the argument that financial derivatives became less effective in smoothing earnings due to the mandated fair value derivative accounting rule under FAS 133. Our results are robust to the use of alternative measures of derivative hedging and discretionary accruals.

We further show that our findings are not driven by the effect of contemporaneous events, including the Sarbanes-Oxley Act (SOX) of 2002, changes in accounting quality, the dot-com bubble and bust around 2000, and macroeconomic shocks in interest rates and foreign exchange rates during the sample period. Finally, consistent with the practitioners' concerns (e.g., FASB comment letters;[4] PricewaterhouseCoopers 2009), we find that there is a significant increase in earnings volatility associated with derivative hedging after FAS 133 implementation. It is

[1] Additional real earnings-smoothing methods include changes in sales by price discount, production changes to alter cost of goods sold, and changes in discretionary expenditures (Roychowdhury 2006).

[2] The original statement issued by the FASB in June 1998 indicated that FAS 133 would be effective June 15, 1999. However, the implementation was delayed until June 2000 since firms needed more time to adapt to the extensive changes. The delay was caused by the lack of details on how to operationalize the extensive changes in FAS 133.

[3] Alan Greenspan, the chairman of the Federal Reserve Board at the time, argued in a letter to the FASB that "The treatment of cash flow hedges will report an increase in the volatility of comprehensive income and stockholders' equity where no comparable increase in risk has occurred . . . [so the standard] may discourage prudent risk management activities" (MacDonald 1997).

[4] See comment letters at: http://www.fasb.org/jsp/FASB/Page/SectionPage&cid=1218220137090, particularly comments on topics related to accounting for financial instruments, derivatives, and hedging, as well as those on fair value.

noteworthy that significant increases in earnings volatility only exist in derivative users that employ a relatively low level of discretionary accruals, implying that such firms are unable or unwilling to counter the slack in derivative hedging by other means to smooth earnings post-FAS 133.

Our study is related to a contemporaneous article by Kilic, Lobo, Ranasinghe, and Sivaramakrishnan (2013) that examines the effects of FAS 133 on commercial banks. There are two reasons why our study of nonfinancial firms may find different results from those for banks. First, banks have incentives to manage earnings, as well as regulatory capital ratio. Since both loan loss provisions and gains/losses from derivatives that do not qualify for hedge accounting (or the ineffective portion) affect regulatory capital, it is likely that the findings in Kilic et al. (2013) also reflect incentives to maintain a target regulatory capital ratio.[5] An analysis of nonfinancial firms allows us to focus on the impact of FAS 133 on earnings management since regulatory capital ratio is not a concern for these firms. Second, banks are heavier users of derivatives and, therefore, the effect of FAS 133 on banks may be stronger than that on nonfinancial firms. For example, Fitch Ratings (2009) reported that in 2009, five large financial firms accounted for approximately 80 percent of the total derivative assets and liabilities carried on the balance sheets of all companies. Differential impacts of derivative hedging in different industries have been documented in the prior literature.[6] Compared to banks, nonfinancial firms, in effect, are more conservative cases, so a finding of significant impacts of FAS 133 in nonfinancial firms would *ipso facto* be interesting.

Our study contributes to the literature on earnings management and risk management in several ways. First, we reexamine the accruals-derivatives substitution relation raised by Barton (2001) for a time period that spans both pre- and post-FAS 133 regimes. We show that while accrual management and derivative hedging may have been substitutes in the pre-FAS 133 period, such substitution relation is significantly attenuated by FAS 133, which mandated the fair value derivative accounting rule. Second, we provide empirical support for the practitioners' conjecture that FAS 133 may have led to higher volatility in reported earnings. Finally, the implication from the banking literature is that the fair value accounting of derivatives can lead to higher risk and contagion (Allen and Carletti 2008; Plantin, Sapra, and Shin 2008). Our analysis points to an alternative explanation: that reported higher earnings volatility after FAS 133 may have been caused by the differential accounting treatment of effective and ineffective portions of hedging derivatives rather than fair valuation *per se*. It is not so much a question as to whether derivatives are reported by fair or notional values; it is as much a question of whether all derivative-related gains or losses are treated in the same way. In sum, our results suggest that a material change in an accounting standard regarding derivatives can impact earnings volatility, as well as the method of income smoothing.

The rest of the paper is organized as follows. In Section II, we review the derivative accounting rules and develop hypotheses. Section III describes the data and variables used in the empirical work, and the empirical results are in Section IV. Section V concludes.

II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Accounting Rules for Derivative Instruments

Derivative accounting prior to FAS 133 was incomplete and inconsistent. The primary guidelines were FAS 52, *Foreign Currency Translation,* concerning currency forwards and swaps,

[5] Regarding the issues pertaining to regulatory capital ratio, see the report on how FAS 133 affects banks' regulatory capital at: http://www.newyorkfed.org/banking/circulars/11134.html

[6] Allayannis and Weston (2001) find that the Tobin's Q of the U.S. multinational firms using foreign currency derivatives is 5.7 percent higher than that of the non-users during 1990–1995. In contrast, Jin and Jorion (2006, 2007) examine 119 U.S. oil and gas producers during 1998–2001 and 44 North American gold mining firms during 1991–2000, respectively, and document no evidence that financial hedging improves firm value.

and FAS 80, *Accounting for Futures Contracts*. These standards only covered futures and forward exchange contracts and currency swaps.[7] FAS 119 was issued in October 1994 and required that companies disclose their reasons for holding derivative instruments, along with notional amounts, fair values, and gains and losses for positions held for trading, as well as accounting policies related to hedging activities. However, there were many questions and deficiencies in implementation, causing the Securities and Exchange Commission (SEC) to issue Financial Reporting Release No. 48 (FRR 48) in 1997 to remedy these deficiencies. While FAS 119 and FRR 48 had provisions mandating the disclosure of notional or fair values of derivatives used for hedging as well as market risk analysis, it was not until FAS 133 that several significant derivative accounting rules were adopted, along with comprehensive fair valuation.

The first major provision of FAS 133 is that all derivatives—regardless of the purpose of holding—are to be carried at their fair values on the balance sheet either as an asset or as a liability, and marked to market as of the reporting date.

Second, firms will no longer be able to use the deferral and accrual methods to account for derivatives at their discretion. FAS 133 established specific criteria for hedge accounting. To qualify for hedge accounting, the firm must specify the hedged item, identify the hedging strategy and the derivative involved, and document by statistical or other methods the basis for expecting the hedge to be effective in offsetting the designated risk exposure (prospective test). FAS 133 also requires a demonstration, at every reporting period, that the hedge is effective (retrospective test). Three methods of testing hedge effectiveness are recognized: the dollar-offset method, the variability-reduction method, and the regression method. For an effective hedge, the dollar-offset ratio, for instance, should fall within 80 percent to 125 percent.[8] Finnerty and Grant (2002) and Charnes, Koch, and Berkman (2003) show that this method is sensitive to small changes in prices and rejects 36 percent of all hedges even when the variance reduction in these hedges approaches 98 percent. This is problematic because if the variability reduction ratio, for example, is 65 percent, then it may be an effective hedge economically in that it reduces the volatility by 35 percent below the level of the unhedged position. Still, it does not qualify for hedge accounting under FAS 133, meaning that the gains or losses from these derivative transactions must be recognized in current earnings. As we discuss below, this could lead to increased short-term volatilities in earnings and cash flows due to the interim realization of derivative-related gains or losses.

Third, FAS 133 stipulates that the method of reporting gains or losses from derivative holdings depends on whether there exist identifiable underlying risk exposures being hedged. FAS 133 recognizes three types of hedges—fair value hedge, cash flow hedge, and hedge of the foreign currency exposure—and differentiates these from non-hedge derivative transactions.[9] Important for our purpose is the provision concerning a cash flow hedge, which may not have a hedged item as readily identifiable on the balance sheet as a fair value hedge does.[10] FAS 133 requires that gains or

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[7] There was no formal guidance for a large number of derivative contracts, such as options, interest rate swaps, or commodity derivatives. In practice, the accounting treatment of these derivative instruments was determined by analogies to FAS 52 and FAS 80 and related consensus positions of the FASB's Emerging Issues Task Force.

[8] The dollar-offset ratio is calculated as the cumulative change in the value of derivative positions divided by the cumulative change in the value of the hedged item.

[9] A *fair value hedge* hedges an exposure to changes in the fair value of a recognized asset, liability, or firm commitment. A *cash flow hedge* hedges an exposure to variability in anticipated future cash flows. This implies that a cash flow hedge may not have a hedged item as readily identifiable on the balance sheet as a fair value hedge does. Finally, a *foreign currency hedge* includes a foreign currency fair value hedge for a security or firm commitment, a foreign currency cash flow hedge for a foreign currency-denominated transaction, or a hedge of a foreign currency exposure of a net investment in foreign operations.

[10] An example of a cash flow hedge is firms in the airline industry using derivatives to hedge their exposures to adverse changes in cash flows related to jet fuel costs. Another example is a company entering into a pay-fixed interest rate swap to hedge the interest rate risk from its outstanding floating rate debt obligations.

losses accrued from an "effective portion" of a cash flow hedge are held in other comprehensive income (OCI), a component of shareholders' equity, until the underlying transaction is closed. At the time of closing, gains or losses from cash flow hedges are offset with losses or gains from underlying transactions. On the other hand, the "ineffective" portions of derivative gains or losses are recognized immediately in current earnings even when the losses and gains from the underlying transaction have not yet occurred. Ineffectiveness can be measured as an excess cumulative change in fair values of the derivative positions beyond the cumulative change in fair values of the hypothetical derivative. In Appendix A, we present a numerical example that illustrates how differential accounting treatment of effective versus ineffective portions of cash flow hedges under FAS 133 can lead to increased volatility in reported earnings.[11]

Hypotheses Development

Researchers such as Petersen and Thiagarajan (2000) and Asdrubali and Kim (2008) indicate that income smoothing can be achieved through "artificial smoothing" (e.g., abnormal accruals) or "real smoothing" (e.g., derivatives). Using financial derivatives is one of the real smoothing methods (Barton 2001). Roychowdhury (2006) argues that real earnings management could be costly to firms in the long term, while accruals-based earnings management could cost managers in the short term. Firms can use a combination of real and accruals-based earnings-smoothing techniques, but regulations can alter the cost benefit of the combination (Cohen, Dey, and Lys 2008). Several studies examine the impacts of FAS 133 on corporate risk management, especially for banks (Kilic et al. 2013; Zhou 2009; Zhang 2009). In this study, we examine whether and how the adoption of the fair value derivative accounting rule under FAS 133 has altered the relation between derivative hedging and accrual management, which constitute two alternative income-smoothing methods.

There are at least two channels by which FAS 133 will make derivative hedging less effective in smoothing earnings. First, FAS 133 instituted strict rules requiring firms to document their risk management strategy, hedging relation at inception, and method of evaluating hedge effectiveness that reduces the flexibility and discretion that managers had prior to FAS 133. For example, FAS 133 imposes a rigid 80–125 rule for the dollar-offset ratio, which is a difficult hurdle to pass, especially when the available hedging instruments display low correlation with underlying exposures. As a result, some economically sound hedging programs may not qualify for hedge accounting under FAS 133, forcing the gains and losses from derivatives to be reflected in earnings. As such, managers have much less discretion in the timing and the recognition of derivative gains and losses than they used to have prior to FAS 133 (Gastineau, Smith, and Todd 2001). The implication is that derivatives may have become a less effective earnings-smoothing device under FAS 133.

Second, under prior accounting standards, the earnings effects of the ineffective portions of hedges were generally disregarded (Ryan 2007), enabling firms to categorize ineffective (non-offsetting) derivatives as accounting hedges and to time the recognition of gains and losses with discretion to reduce earnings volatility. Under FAS 133, even if a derivative transaction qualifies for hedge accounting, firms are required to conduct an additional assessment of "ineffectiveness" to determine what portions of the accumulated OCI balance are to be recognized in earnings or deferred.[12] One result of this rule on the immediate recognition of the ineffective portions in current

[11] We greatly appreciate Travis Quast, Vice President and Director of Hedge Accounting Services at DerivActiv, for sharing his practical insight and expertise in hedge accounting.

[12] The ineffectiveness is measured as the excess cumulative change in the fair values of the derivative positions beyond the cumulative change in the fair values of the hypothetical derivative that is perfectly correlated with the underlying cash flow being hedged.

earnings is that hedging ineffectiveness becomes more apparent. This, in turn, reduces the extent to which hedging derivatives can smooth earnings, and will result in increases in short-term volatility in cash flows and earnings. This effect is particularly pronounced in the case of the cash flow hedge, because the hedged underlying item in the cash flow hedge is not easily identifiable on the balance sheet, and because losses or gains for the ineffective portion of the derivative transaction cannot be immediately offset by the gains or losses of the hedged item.[13]

In sum, under FAS 133, some economically effective hedges may not qualify for hedge accounting, and even if the hedge is qualified, some portion may be categorized as "ineffective" and recognized in current earnings. This may reduce the effectiveness of derivatives as a tool of risk management, such as smoothing reported income. Barton (2001) assumes that derivatives are effective in reducing earnings volatility; therefore, derivative hedging could have a substitution relation with another income-smoothing method, such as discretionary accruals. However, FAS 133 reduces the extent to which hedging derivatives can smooth earnings; therefore, the substitution relation between derivative hedging and discretionary accruals as two alternative means of earnings smoothing may have been attenuated after the adoption of FAS 133:

H1: The substitution relation between derivatives hedging and discretionary accruals is attenuated after the adoption of FAS 133.

Some practitioners express concerns that the differential treatment of derivative transactions, coupled with the fair value rule, could induce volatility in reported earnings (FASB comment letters;[14] PricewaterhouseCoopers 2009; Barton 2001; Finnerty and Grant 2002). On one hand, it is possible that managers will respond to the change in the derivatives accounting rule by more aggressive use of discretionary accruals to make up for the reduced effectiveness of some derivative transactions in smoothing earnings. If so, then FAS 133 may not lead to an increase in earnings volatility.

On the other hand, firms might not be able to substantially increase their use of discretionary accruals to fully make up for the inefficacy of derivatives in smoothing earnings. The survey results by Graham, Harvey, and Rajgopal (2005) indicate that financial executives tend to display less willingness to manipulate earnings by accruals rather than through real activities including derivatives. This is because accrual management is more likely to draw scrutiny from auditors or regulators than real decisions about pricing, contracting, and operations. Managers might be particularly concerned about accrual management after the passage of SOX in 2002 due to increased scrutiny from regulators. As a result, one expects that the difficulty in qualifying for hedge accounting, as well as having to record an ineffective portion of derivative gains and losses in earnings at each interim period, may have induced higher volatility in reported earnings after FAS 133, compared to the pre-FAS 133 era. Overall, the net impact of FAS 133 on earnings volatility is an open empirical question, yielding the following hypothesis to be tested:

H2: Earnings volatility increases with derivative hedging after the adoption of FAS 133.

The implication is that an increase in earnings volatility is likely to occur in firms that are unable or unwilling to manage accruals to a great extent.

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[13] Losses or gains on fair value hedges are recognized in earnings immediately, which will be offset by the gains or losses from the hedged item that are identifiable and booked in the income statement.

[14] See http://www.fasb.org/jsp/FASB/Page/SectionPage&cid=1218220137090 on "Accounting for Financial Instruments."

III. DATA AND VARIABLE CONSTRUCTION

Data and Sample Selection

Our sample consists of firms included in the S&P 500 index at the fiscal year-end of 2000. We exclude financial firms (SIC codes between 6000 and 6999) due to potential regulatory impacts and because these firms often act as dealers of financial derivative trading rather than as end-users, as most nonfinancial firms do. We further restrict the sample to those covered by the ExecuComp database since we use CEO compensation as control variables (Barton 2001).

To identify the use of financial derivatives by our sample firms, we hand-collected derivative information for S&P 500 nonfinancial firms from corporate 10-K reports, as well as the footnotes of their annual reports. To make data collection manageable, we collected derivative data for even years during the period of 1996–2006, i.e., 1996, 1998, 2000, 2002, 2004, and 2006. Our initial sample includes 2,244 firm-year observations. We collected both notional and fair values of derivatives, whenever available, of all types, including futures, forwards, options, and swaps for interest rate derivatives, foreign exchange derivatives, and commodity derivatives.

The variables for firm characteristics are from the Compustat annual industrial database. We lost 216 firm-year observations due to missing values for necessary firm-specific variables. Industrial segment data are from the Segment files of the Compustat database, and we lost another 104 firm-year observations due to missing values. Stock return data are from the CRSP database; missing values in CRSP data further reduce our sample by 143. Data on analyst coverage are from the I/E/B/S database. Missing values in analyst coverage causes another reduction of our sample size by 127. Our final sample consists of 404 firms and 1,654 firm-year observations. In Appendix B, we summarize the sample selection process.

Discretionary Accruals

We constructed three measures of discretionary accruals. Following Jones (1991), we estimate the following model:

$$Accruals_{i,t}/Assets_{i,t-1} = \alpha*(1/Assets_{i,t-1}) + \beta_1*(\Delta Sales_{i,t}/Assets_{i,t-1}) + \beta_2*(PPE_{i,t}/Assets_{i,t-1}) + \varepsilon_{i,t}, \quad (1)$$

where total accruals of firm i and at time t, $TA_{i,t} = Accruals_{i,t}/Accruals_{i,t-1}$, is income before extraordinary items minus operating cash flows, scaled by lagged total assets. $TA_{i,t}$ is regressed on a constant, change in sales ($\Delta Sales_{i,t}$), and plant and equipment ($PPE_{i,t}$), all scaled by lagged assets ($Assets_{i,t}$) to mitigate the effect of heteroscedasticity. Discretionary total accruals are residuals from the regression model, labeled as *DTACC*.

The second method follows Bergstresser and Philippon (2006) and utilizes discretionary current accruals. The third method uses discretionary working capital accruals, following Teoh, Welch, and Wong (1998). Current accruals (*CACC*) and working capital accruals (*WCACC*) are defined in Equations (2) and (3), respectively:

$$CACC_{i,t} = (\Delta CA_{i,t} - \Delta CL_{i,t} - \Delta CASH_{i,t} + \Delta STD_{i,t} - DEP_{i,t})/Assets_{i,t-1}, \quad (2)$$

$$WCACC_{i,t} = (\Delta CA_{i,t} - \Delta CL_{i,t} - \Delta CASH_{i,t} + \Delta STD_{i,t})/Assets_{i,t-1}, \quad (3)$$

where $\Delta CA_{i,t}$ is the change in the current assets of firm i at time t; $\Delta CL_{i,t}$ is the change in current liabilities; $\Delta CASH_{i,t}$ is the change in cash holdings; and $\Delta STD_{i,t}$ is the change in short-term debt. $DEP_{i,t}$ is the depreciation and amortization expense of the firm; and $Assets_{i,t-1}$ is lagged total assets. These two alternative measures of accruals, $CACC_{i,t}$ and $WCACC_{i,t}$, are then fed into Equation (1), and discretionary current accruals and discretionary working capital accruals are the residuals from

TABLE 1

Descriptive Statistics of Our Sample in the Pre- and Post-FAS 133 Periods

Panel A: Summary Statistics of All Sample Firms

	Pre-FAS 133 (n = 873)			Post-FAS 133 (n = 781)			Difference in Mean	Difference in Median
Variables	**Mean**	**Median**	**Std. Dev.**	**Mean.**	**Median**	**Std. Dev.**	**(p-value)**	**(p-value)**
Firm size ($billion)	9.394	4.310	15.379	15.578	7.079	25.276	0.000	0.000
Foreign sales ratio	0.188	0.000	0.263	0.255	0.124	0.293	0.000	0.014
Nopseg	4.675	3.000	4.194	7.171	6.000	5.835	0.000	0.000
R&D intensity	0.015	0.000	0.034	0.014	0.000	0.027	0.562	0.752
Capital intensity	0.068	0.057	0.045	0.046	0.038	0.033	0.000	0.000
Dividend payout	0.251	0.185	0.454	0.185	0.110	0.380	0.000	0.000
Dividend yield	0.015	0.011	0.017	0.013	0.008	0.015	0.052	0.000
Leverage	0.242	0.243	0.160	0.240	0.229	0.164	0.757	0.784
ROA	0.057	0.058	0.083	0.038	0.051	0.108	0.000	0.002
BM ratio	0.356	0.306	0.255	0.402	0.353	0.287	0.005	0.000
Earnings volatility	0.039	0.026	0.046	0.059	0.032	0.077	0.000	0.000
Tax convexity	0.070	0.000	1.423	0.190	0.000	2.326	0.000	0.762
Distress	−6.088	−6.152	0.973	−6.154	−6.244	1.103	0.688	0.113
LIFO reserve	0.009	0.000	0.019	0.007	0.000	0.019	0.102	0.002
Cash cycle	75.090	69.216	59.972	79.010	66.849	63.813	0.212	0.461
Short-term debt	0.238	0.151	0.255	0.177	0.097	0.223	0.000	0.000
$\|OCF\|$	0.144	0.124	0.100	0.125	0.111	0.080	0.000	0.004
CEO incentive pay	0.579	0.617	0.263	0.661	0.720	0.246	0.000	0.000
CEO cash comp	0.421	0.383	0.263	0.339	0.280	0.246	0.000	0.000
CEO option comp	0.421	0.423	0.295	0.375	0.360	0.280	0.000	0.000
CEO stock comp	0.059	0.000	0.141	0.163	0.022	0.220	0.000	0.000
Flexibility	0.198	0.219	0.482	0.212	0.199	0.467	0.078	0.062
Analysts	15.988	13.000	12.843	14.421	13.000	10.195	0.009	0.078
$\|DTACC\|$	0.202	0.187	0.143	0.296	0.295	0.084	0.000	0.000
$\|DCACC\|$	0.094	0.056	0.116	0.071	0.059	0.056	0.033	0.128
$\|DWCACC\|$	0.068	0.076	0.124	0.055	0.066	0.053	0.046	0.083
Derivative notional value ($ mil)	731.434	24.375	1928.21	882.832	121.353	1963.31	0.000	0.000
Derivative fair value ($ mil)	8.072	0.000	63.528	305.200	126.709	88.292	0.000	0.000
Derivative user dummy	0.604	1.000	0.489	0.725	1.000	0.447	0.000	0.000

(continued on next page)

the regression models, and labeled as $DCACC_{i,t}$ and $DWCACC_{i,t}$, respectively. Equation (1) is estimated cross-sectionally using all Compustat firms that have non-missing values in the relevant variables for each two-digit SIC-coded industry in a sample year.

Descriptive Statistics

Panel A of Table 1 reports the summary statistics of the entire sample during the pre-FAS 133 (873 firm-year observations) and post-FAS 133 periods (781 firm-year observations). An average firm in the sample in the pre-FAS 133 period has approximately $9.39 billion in assets, which is significantly lower than the average assets of $15.58 billion in the post-FAS 133 period. Average

TABLE 1 (continued)

Panel B: Summary Statistics on Derivative Ratio for Derivative Users Only

	Pre-FAS 133			Post-FAS 133			Difference in Mean	Difference in Median
Variables	**Mean**	**Median**	**n**	**Mean**	**Median**	**n**	**(p-value)**	**(p-value)**
Derivative ratio (Notional value)	0.098	0.061	442 (84%)	0.095	0.063	369 (65%)	−0.003 (0.449)	0.002 (0.411)
Derivative ratio (Abs. fair value)	0.006	0.002	347 (66%)	0.007	0.003	521 (92%)	0.001 (0.072)	0.001 (0.770)
Total derivative user			527			566		
Derivative user reports neither notional nor fair derivative values			71 (13%)			29 (5%)		

Panel A presents summary statistics for the entire sample of firms during the pre-FAS (1996, 1998, 2000) and post-FAS 133 (2002, 2004, 2006) periods. Panel B presents summary statistics on derivative ratios for derivative users during the two subsample periods. The derivatives ratio is computed as the notional or fair market value of derivatives divided by total assets. All variables are winsorized at 1 percent and 99 percent.
All variables are as defined in Appendix C.

foreign sales accounted for 18.8 percent of total sales in the pre-FAS 133 period, but it increased to 25.5 percent in the post-FAS 133 period, indicating increased foreign exchange risk exposures during the latter period. We also see some increase in earnings volatility post-FAS 133 versus pre-FAS 133. The mean absolute value of discretionary total accruals scaled by total assets ($|DTACC|$) is 0.202 pre-FAS 133, which is significantly lower than that in the post-FAS 133 period. The mean absolute values of discretionary current accruals ratio ($|DCACC|$) and discretionary working capital accruals ratio ($|DWCACC|$) are 0.094 and 0.068, respectively, before the adoption of FAS 133, and the means of both became smaller post-FAS 133.

With regard to the summary statistics on financial derivatives, about 60 percent of the firms in the sample used derivatives before FAS 133 and 73 percent of the firms after it. The mean notional value of derivatives in Table 1, Panel A is \$731.4 million pre-FAS 133 and \$882.8 million post-FAS 133, with the change statistically different from zero. The median notional values are much smaller, with \$24.4 million and \$121.4 million pre- and post-FAS 133, respectively. The large difference between the mean and median implies that the distribution of notional values is skewed to the right.

We also examine the fair market values of financial derivatives. In Panel A of Table 1, the mean fair market value of net positions of all financial derivatives by sample firms in the pre-FAS 133 period is \$8.07 million, while the median is \$0 million. Post-FAS 133, the mean and median are substantially higher, \$305.2 and \$126.7 million, respectively. However, as we discuss below, we should be cautious in drawing inferences from the substantial difference in derivative fair values before and after FAS 133, since the number of firms reporting derivative fair values has substantially increased due to the reporting requirement in FAS 133.

In Panel B of Table 1 we report the mean and median notional and fair values of derivatives for firms that used financial derivatives, as well as the frequencies of reporting these items in their 10-Ks before and after the adoption of FAS 133. We have 527 and 566 derivative users in our sample in the pre- and post-FAS 133 periods, respectively. Prior to FAS 133, 442 firms (84 percent) disclosed their notional values of derivatives, while 347 firms (66 percent) disclosed fair values of derivatives. Despite the fact that both FAS 119 and FRR 48 required firms to disclose either notional or fair values of derivatives in the pre-FAS 133 period, 71 sample firms (13 percent) disclosed neither. After the implementation of FAS 133, we find a significant increase in the frequency of the reporting of the fair value of derivatives, from 66 percent to 92 percent. At the same time, fewer firms reported notional values post-FAS 133 versus pre-FAS 133 (dropping from 84 percent to 65 percent), since FAS 133 does not require that notional values be reported. The frequency of reporting neither notional nor fair values of derivatives drops from 13 percent pre-FAS 133 to 5 percent post-FAS 133, indicating the tightened disclosure practice after FAS 133.

The average notional derivative ratios (the dollar amount of notional derivatives divided by total assets) in Panel B of Table 1 are 9.8 percent before FAS 133 and 9.5 percent after FAS 133, which are statistically and economically indistinguishable. The mean fair derivative ratio (the absolute fair derivative value divided by total assets) is much smaller compared to the mean notional derivative ratio, and becomes slightly larger after FAS 133 was implemented.

IV. RESULTS

We test our primary hypothesis, H1, concerning the relation between derivative hedging and accrual management, in the context of Barton (2001) for the extended period that encompasses both the pre- and post-FAS 133 eras. We also perform various robustness tests concerning whether the results are driven by an intertemporal shift or from a cross-sectional variability, and whether they are influenced by the possible effects of various contemporaneous events such as SOX, changes in accounting quality, the dot-com bubble and bust, and macroeconomic shocks in interest rates and foreign exchange rates, in particular. Finally, we test H2, concerning whether the implementation of FAS 133 might have led to an increase in earnings volatility associated with derivative hedging.

Simultaneous Equation Estimation of Notional Derivative Ratios and Accruals: Barton (2001) Model for the 1996–2006 Period

We first estimate the Barton (2001) model for the extended time period of 1996–2006. This is to examine whether the substitution effect between derivative hedging and the absolute discretionary accruals documented by Barton (2001) for the pre-FAS 133 period changed after FAS 133. Since firms are required to report the fair values, not notional values, of derivatives after FAS 133, the use of the notional derivative value-to-assets ratio as per Barton (2001) may introduce bias after FAS 133 if the voluntary disclosures of notional values are non-random. Nevertheless, we believe that comparison of our work with Barton (2001) is useful given the seminal status of his work on the topic.

Following Barton (2001), we estimate the following system of simultaneous equations in which both the notional derivative ratio and the absolute value of discretionary total accruals ($|DTACC|$) are endogenously determined:

$$\begin{aligned} \textit{Derivative ratio}_t = \alpha + \beta_1 * |DTACC_t| + \beta_2 * (|DTACC_t| * FAS\ 133) + \beta_3 * FAS\ 133 \\ + \beta_4 * (Controls)_t + \varepsilon_t, \end{aligned} \quad (4)$$

$$\begin{aligned} |DTACC_t| = \alpha + \gamma_1 * \textit{Derivative ratio}_t + \gamma_2 * (\textit{Derivative ratio}_t * FAS\ 133) + \gamma_3 * FAS\ 133 \\ + \gamma_4 * (Controls)_t + \varepsilon_t. \end{aligned} \quad (5)$$

To investigate how the relation between financial derivatives and accrual management changed after FAS 133 versus before, we introduce the FAS 133 indicator variable and an interaction term, $|DTACC| * FAS\ 133$, in Equation (4). The FAS 133 dummy takes a value of 1 if the sample year is 2002, 2004, or 2006, and 0 for the sample years of 1996, 1998, or 2000. Similarly, we include the FAS 133 dummy and an interaction term, *Derivative ratio* $*$ *FAS 133*, in Equation (5) to capture potential changes in the level of discretionary accruals and the substitution relation of the two earnings-smoothing methods around FAS 133.

Only about 60 percent of our sample firms pre-FAS 133 and 73 percent post-FAS 133 report using derivatives. Thus, we need to correct for the self-selection bias, as each determinant of derivative usage might have a different effect on the amount of the derivatives being used. We follow Barton (2001) and embed in the simultaneous equations a correction for the self-selection of being a derivative user. We first estimate an equation to explain the decision to use derivatives as per:

$$Derivative\ user_t = \alpha + \phi * (Controls)_t + \varepsilon_t. \quad (6)$$

We use a probit regression on the full sample of 1,654 firm-year observations to estimate Equation (6). We then compute the inverse Mills ratio, and include it as an additional control variable to correct for the potential self-selection bias in the simultaneous Equations (4) and (5), where we estimate using only the sample of derivative users that report notional values of derivatives (811 firm-year observations).

The results of the probit model and the system of simultaneous equations regressions using the two-stage least squares (2SLS) procedure are presented in Table 2. We report the results with discretionary total accruals ($|DTACC|$) in Panel A, and the results with discretionary current accruals ($|DCACC|$) and discretionary working capital accruals ($|DWCACC|$) in Panel B. We control for industry fixed effects based on two-digit SIC industry codes in all the equations. All the control variables in these equations are based on Barton (2001), and are defined in Appendix C. The first-stage probit model results, in column (1) of Panel A, are similar to those in Barton (2001). Firms that are financially distressed, more research and development (R&D) intensive, and have higher leverage ratios, greater foreign sales ratios, and longer cash cycles are more likely to use derivatives. This is because such firms are riskier and have greater exposures to foreign exchange risk. We also find that larger firms are more likely to use derivatives than smaller firms, since they have the resources and expertise to implement sophisticated derivative hedging programs.

Columns (2) and (3) of Table 2, Panel A present the simultaneous regression results of Equations (4) and (5). In column (2), where the dependent variable is the notional derivative ratio, we find that the coefficient of discretionary total accrual, $|DTACC|$, is negative and marginally significant at the 10 percent level. We also find that the coefficient of the interaction term $|DTACC| * FAS\ 133$ is positive and statistically significant. In column (3), with $|DTACC|$ as the dependent variable, the coefficient estimate on the *Derivative ratio* (γ_1) is negative and significant at the 5 percent level, suggesting a partial substitution relation between derivative hedging and absolute discretionary total accruals in the pre-FAS 133 period. These results confirm the findings documented in Barton (2001) for the pre-FAS 133 period.

However, the results for post-FAS 133 are different. The coefficient estimate (γ_2) on the interaction term *Derivative ratio * FAS 133,* in column (3) of Table 2, Panel A, is positive and significant at the 1 percent level. This suggests that the substitution effect between derivatives and accruals disappeared after FAS 133 implementation, supporting H1. A joint F-test suggests that the sum of γ_1 and γ_2 is also positive and significant at the 10 percent level (reported at the bottom of Table 2). It is noteworthy that the relation between derivative ratios and discretionary accruals becomes positive and statistically significant after FAS 133, suggesting a complementary relation between the two. Heavy derivative users are likely to be those firms with a strong incentive to smooth earnings. If, as argued above, financial derivatives became less effective in reducing earnings volatility after FAS 133, then such firms may have engaged in more aggressive use of discretionary accruals to smooth earnings to compensate for the reduced effectiveness of derivatives for income smoothing. In addition, we find that the FAS 133 indicator variable itself is positive, but

TABLE 2

Simultaneous Equation Estimation of the Notional Derivative Ratio and Absolute Value of Accruals: Barton (2001) Model for the Period of 1996–2006

Panel A: Discretionary Total Accruals

		Dependent Variable		
	Exp. Sign	***Derivative user* (1)**	***Derivative ratio* (2)**	**$\|DTACC\|$ (3)**
$\|DTACC\|$ (β_1)	−		−0.093*	
			(−1.776)	
$\|DTACC\| * FAS\ 133$ (β_2)	+/−		0.156**	
			(1.978)	
Derivative ratio (γ_1)	−			−0.163**
				(−1.984)
Derivative ratio * *FAS 133* (γ_2)	+/−			0.280***
				(2.868)
FAS 133	+/−	−0.114	0.044	0.032
		(−1.309)	(1.061)	(1.120)
CEO cash comp	+	0.303	0.016	0.035*
		(1.265)	(0.804)	(1.843)
CEO option comp	+/−	−0.022	0.003	−0.003
		(−0.101)	(0.171)	(−0.193)
CEO stock comp	+	−0.125	0.021	0.004
		(−0.459)	(0.936)	(0.170)
Tax convexity	+	−0.001	0.002	0.001
		(−0.036)	(0.808)	(0.623)
Leverage	+	1.198**	0.185***	−0.030
		(2.296)	(4.040)	(−0.545)
Distress	+	0.163**	−0.009	−0.000
		(2.279)	(−1.635)	(−0.012)
R&D intensity	+	7.406**	0.503	−1.044***
		(2.158)	(1.122)	(−3.092)
*R&D * Leverage*	+	25.312**	1.102	1.393*
		(2.235)	(1.315)	(1.747)
Analysts	+	−0.074	0.004	−0.014***
		(−1.388)	(0.898)	(−3.190)
Nopseg	−	−0.036	−0.014	−0.008*
		(−0.705)	(−1.411)	(−1.657)
Foreign sales ratio	+	0.423***	0.036***	0.042
		(2.668)	(2.799)	(1.102)
Firm size	+	0.371***	−0.014	
		(7.615)	(−0.999)	
Dividend yield	+	2.206	−0.024	
		(0.642)	(−0.087)	
Short-term debt	+	0.092	0.033**	
		(0.530)	(2.429)	
Cash cycle	+	0.001***	0.000	
		(2.661)	(0.863)	

(continued on next page)

TABLE 2 (continued)

	Exp. Sign	Dependent Variable: *Derivative user* (1)	*Derivative ratio* (2)	*|DTACC|* (3)
$\|DTACC\|_{t-1}$	+			0.378***
				(9.987)
LIFO reserve	+			0.334**
				(2.213)
Dividend payout	−			−0.116*
				(−1.659)
Flexibility	+			−0.000
				(−0.305)
|OCF|	+			−0.017
				(−0.380)
Inverse Mills ratio	+/−		0.217	−0.160
			(1.501)	(−0.810)
Intercept		Yes	Yes	Yes
Industry fixed effects		Yes	Yes	Yes
NOBS		1,654	811	811
Pseudo Adj. R^2		0.1957	0.1581	0.1869
$(\beta_1 + \beta_2)$ or $(\gamma_1 + \gamma_2)$			0.063	0.117*
p-value for F-test			(0.144)	(0.085)
p-value (Hausman test)			(0.286)	(0.061)

Panel B: Discretionary Current Accruals and Discretionary Working Capital Accruals

	Exp. Sign	Dependent Variable: *Derivative ratio* (1)	*|DCACC|* (2)	*Derivative ratio* (3)	*|DWCACC|* (4)
|Accruals| (β_1)	−	−0.079*		−0.063*	
		(−1.856)		(−1.696)	
*|Accruals| * FAS 133* (β_2)	+/−	0.120***		0.118***	
		(3.702)		(3.729)	
Derivative ratio (γ_1)	−		−0.182*		−0.151**
			(−1.943)		(−2.256)
*Derivative ratio * FAS 133* (γ_2)	+/−		0.252**		0.306***
			(1.966)		(2.878)
FAS 133	+/−	−0.040	0.001	−0.052	0.009
		(−1.583)	(0.031)	(−1.416)	(0.328)
CEO cash comp	+	0.025	−0.017	0.026	−0.026
		(1.262)	(−0.995)	(1.322)	(−1.480)
CEO option comp	+/−	−0.004	0.000	−0.004	−0.003
		(−0.199)	(0.027)	(−0.217)	(−0.213)
CEO stock comp	+	0.027	−0.019	0.029	−0.020
		(1.230)	(−1.028)	(1.304)	(−0.977)
Tax convexity	+	0.001	−0.002	0.001	−0.003
		(0.361)	(−1.392)	(0.450)	(−1.401)
Leverage	+	0.150***	−0.126***	0.147***	−0.140***
		(3.729)	(−3.264)	(3.684)	(−3.412)

(continued on next page)

TABLE 2 (continued)

	Exp. Sign	Dependent Variable: *Derivative ratio* (1)	*|DCACC|* (2)	*Derivative ratio* (3)	*|DWCACC|* (4)
Distress	+	−0.008	0.007	−0.007	0.010*
		(−1.385)	(1.518)	(−1.337)	(1.864)
R&D intensity	+	0.809***	−0.746**	0.807***	−0.900**
		(3.070)	(−2.251)	(3.060)	(−2.548)
*R&D * Leverage*	+	−0.771	0.722	−0.754	0.880
		(−0.914)	(0.994)	(−0.896)	(1.135)
Analysts	+	0.004	0.007*	0.004	0.004
		(0.976)	(1.836)	(1.050)	(0.988)
Nopseg	−	−0.007	−0.002	−0.007*	−0.001
		(−1.567)	(−0.573)	(−1.740)	(−0.193)
Foreign sales ratio	+	0.026**	0.000	0.026**	0.004
		(2.075)	(0.027)	(2.075)	(0.305)
Firm size	+	−0.003		−0.001	
		(−0.797)		(−0.444)	
Dividend yield	+	−0.092		−0.083	
		(−0.344)		(−0.316)	
Short-term debt	+	0.008		0.003	
		(0.663)		(0.220)	
Cash cycle	+	0.000		0.000	
		(0.136)		(0.530)	
$\|Accruals\|_{t-1}$	+		0.315***		0.351***
			(10.725)		(10.637)
LIFO reserve	+		−0.062		−0.075
			(−0.492)		(−0.583)
Dividend payout	−		0.007		0.008
			(0.868)		(1.089)
Flexibility	+		−0.000		−0.000
			(−1.200)		(−1.091)
|OCF|	+		0.076**		0.089***
			(2.282)		(2.634)
Inverse Mills ratio	+/−	0.112	0.055**	0.049	0.172***
		(1.356)	(2.011)	(0.612)	(3.245)
Intercept		Yes	Yes	Yes	Yes
Industry fixed effects		Yes	Yes	Yes	Yes
NOBS		811	811	811	811
Pseudo Adj. R^2		0.1368	0.1689	0.1385	0.1611
$(\beta_1 + \beta_2)$ or $(\gamma_1 + \gamma_2)$		0.041	0.070*	0.055	0.155**
p-value for F-test		(0.225)	(0.082)	(0.181)	(0.036)
p-value (Hausman Test)		(0.177)	(0.061)	(0.331)	(0.087)

(continued on next page)

TABLE 2 (continued)

*, **, *** Denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.
In this table, we follow Barton (2001) and estimate a system of simultaneous equations using 2SLS in which both the notional derivative ratio and the absolute value of discretionary accruals are endogenously determined. Results with absolute value of discretionary total accruals ($|DTACC|$) are reported in Panel A, and results with absolute value of discretionary current accruals ($|DCACC|$) and discretionary working capital accruals ($|DWCACC|$) are reported in Panel B. Column (1) of Panel A reports the results of the probit model explaining the choice of being a derivative user, and the inverse Mills ratio computed from the probit model is included in the system of simultaneous equations to correct for potential self-selection bias. Simultaneous equations results are reported in columns (2)–(3) in Panel A and columns (1)–(4) in Panel B. The sample used for this analysis is from 1996 to 2006. Derivative ratio is the ratio of notional values of financial derivatives to total assets. The FAS 133 dummy takes a value of 1 if the sample year is 2002, 2004, or 2006, and 0 for the sample years of 1996, 1998, and 2000. We control for industry fixed effects based on two-digit SIC industry codes. t-statistics are reported in parentheses below each coefficient estimate.
All explanatory variables are as defined in Appendix C.

statistically insignificant, in column (3), implying that the usage of accruals, on average, did not increase after FAS 133 versus before.[15]

In Table 2, Panel B we use two alternative measures of discretionary accruals, in their absolute values, as dependent variables: the absolute discretionary current accruals ($|DCACC|$) and the absolute discretionary working capital accruals ($|DWCACC|$). In columns (2) and (4) of Panel B we find that the notional derivative ratio is significantly and negatively associated with both absolute discretionary current accruals and discretionary working capital accruals. The coefficient estimates on the interaction term *Derivative ratio* $*$ *FAS 133* are positive and statistically significant in both regressions. The sum of coefficient estimates on *Derivative ratio* and *Derivative ratio* $*$ *FAS 133* is positive and significant. These results are similar to those using discretionary total accruals, ($|DTACC|$), from Panel A.

In sum, like Barton (2001), we find a significant partial substitution relation between financial derivatives and accrual management during the pre-FAS 133 period. However, there is no such substitution effect revealed after FAS 133 became effective. The model we use is exactly the same as that in Barton (2001) except for the time fixed effects. While Barton (2001) includes calendar year dummy variables, we instead include the FAS 133 dummy and its interaction term with *Derivative ratio* to assess the impact of regulation FAS 133. This ensures that any changes we observe, other than those related to FAS 133, are not driven by a different model setting or different control variables.

The Hausman (1978) test for simultaneity (reported at the bottom of Table 2) shows that for the entire sample period, including both periods before and after FAS 133, we can marginally reject the null hypothesis of no simultaneity for the discretionary accruals regressions (p-values less than 10 percent), but not for the *Derivative ratio* regressions (p-values greater than 10 percent).

To test the validity of the instruments in the simultaneous equations, we follow Barton (2001) and estimate rank correlations between the endogenous and control variables. Unreported results show that, in general, the correlations are consistent with our expectations—all variables that capture incentives to derivatives usage are significantly correlated with the derivative user dummy and the notional derivative ratio, but none are significantly correlated with $|DTACC|$. All variables

[15] The results for control variables in Table 2, Panel A are unremarkable. In column (2), we find that leverage, foreign sales ratio, and short-term debt all have positive associations with the derivative value ratio. In column (3), we find that CEO cash compensation is positively associated with the absolute discretionary accruals, suggesting that CEOs with greater cash compensation are more likely to use accruals that might increase their bonuses. We also find positive coefficients on lagged accruals and LIFO reserve, and negative coefficients on R&D intensity, analyst coverage, the number of business segments, and dividend payout ratio.

that capture incentives to manage accruals are significantly correlated with |*DTACC*|, but not with the derivative user dummy and the notional derivative ratio, except a marginally significant correlation between |OCF| and the derivative user dummy. These results offer us confidence that the instruments from Barton (2001) remain valid for our sample period.

Robustness Tests of H1

We conduct several additional tests with respect to our primary finding regarding the intertemporal change in the relation between derivative hedging and accrual management, from a substitution relation pre-FAS 133 to a complementary one post-FAS 133.

Test of H1 Using the Derivative User Dummy

A usual method of estimating the impact of FAS 133 may be the regression with an accounting regulation dummy, but the inconsistency in the reporting of derivative data during our sample period might make such a method inappropriate. Prior to FAS 133, most firms reported *notional* values of derivatives, while most firms report *fair* values post-FAS 133. So neither notional nor fair value derivative data are available consistently for the entire sample period of 1996–2006. To circumvent the bias created by this data-inconsistency problem in the continuous derivative ratio variable, we alternatively use a dummy variable for derivative user and examine its relation with discretionary accruals. This approach mitigates reporting bias since information on whether a firm uses derivatives is uniformly disclosed during the entire sample period.

Again, we undertake a 2SLS simultaneous equation estimation of being a derivative user and discretionary accruals. As with Table 2, we use three alternative measures of discretionary accruals: the absolute discretionary total accruals (|*DTACC*|), the absolute discretionary current accruals (|*DCACC*|), and the absolute discretionary working capital accruals (|*DWCACC*|). The results are reported in columns (1)–(2), (3)–(4), and (5)–(6) of Table 3, respectively. Focusing on columns (2), (4), and (6), we find that derivative user dummies are significantly and negatively associated with absolute discretionary accruals in all three models. The coefficient estimates on the interaction term *Derivative user* ∗ *FAS 133* are positive and statistically significant in all three regressions. The sum of coefficient estimates on *Derivative user* and *Derivative user* ∗ *FAS 133* is positive and statistically significant in all models. These results underscore the earlier point that there existed a significant substitution effect between the use of derivative and discretionary accruals before the adoption of FAS 133, but that the two earnings-smoothing methods became complementary with each other in the post-FAS 133 period. The results again confirm our findings in Table 2, and provide additional support for H1.

The Effects of Contemporaneous Events

Additional issues pertain to the possible effects of several contemporaneous events, including SOX in 2002, changes in accounting quality, and the dot-com bubble and bust around 2000. The adoption of FAS 133 in June 2000 roughly coincides with these events, which could have affected the corporate governance practices of U.S. firms. A concern arises that these events might have also influenced the use of abnormal accruals (Cohen et al. 2008), partly driving our findings on the relation between derivative hedging and discretionary accruals.

Recalling from Table 2 that derivative users are riskier and have greater exposure to foreign exchange risk than non-derivative users, another issue is that there might be other contemporaneous events beyond what we have already controlled for that might differentially impact firms with greater or less exposure to interest rate and foreign exchange risks, which could have led to a

TABLE 3

Simultaneous Equations Estimation of Being a Derivative User and Having Absolute Value of Accruals

		Dependent Variable					
	Exp. Sign	***Derivative user* (1)**	**|*DTACC*| (2)**	***Derivative user* (3)**	**|*DCACC*| (4)**	***Derivative user* (5)**	**|*DWCACC*| (6)**
|*Accruals*| (β_1)	–	−0.028*		−0.023*		−0.029	
		(−1.911)		(−1.738)		(−1.542)	
|*Accruals*| * *FAS 133* (β_2)	+/–	−0.013		0.018		0.044	
		(−1.300)		(1.603)		(1.602)	
Derivative user (γ_1)	–		−0.036**		−0.016*		−0.062**
			(−2.328)		(−1.907)		(−2.228)
Derivative user * *FAS 133* (γ_2)	+/–		0.073***		0.049***		0.113***
			(3.290)		(3.601)		(3.973)
FAS 133	+/–	−0.030	0.003	0.082	−0.041	−0.114	0.123
		(−0.520)	(0.079)	(1.451)	(−0.928)	(−1.617)	(1.532)
Controls (same as Table 2)		Yes	Yes	Yes	Yes	Yes	Yes
Intercept		Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
NOBS		1,654	1,654	1,654	1,654	1,654	1,654
Pseudo Adj. R^2		0.1331	0.2206	0.1288	0.1047	0.1309	0.1109
($\beta_1 + \beta_2$) or ($\gamma_1 + \gamma_2$)		−0.041**	0.037***	−0.005	0.033**	0.015	0.051*
p-value for F-test		(0.030)	(0.000)	(0.786)	(0.042)	(0.412)	(0.066)
p-value (Hausman test)		(0.136)	(0.077)	(0.198)	(0.018)	(0.224)	(0.062)

*, **, *** Denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.
This table reports the estimation results of the systems of simultaneous equations for an endogenous estimation of being a derivative user and absolute discretionary accruals. *Derivative user* is an indicator variable that takes a value of 1 if a firm uses derivatives in a particular year, and 0 otherwise. We use three measures of discretionary accruals: discretionary total accruals |*DTACC*|, discretionary current accruals |*DCACC*|, and discretionary working capital accruals |*DWCACC*|. The results are reported in columns (1)–(2), (3)–(4), and (5)–(6), respectively. The FAS 133 dummy takes a value of 1 if the sample year is 2002, 2004, or 2006, and 0 for the sample years of 1996, 1998, and 2000. We control for industry fixed effects based on two-digit SIC industry codes. t-statistics are reported in parentheses below each coefficient estimate. The same control variables as those in Table 2 are included in all regressions; however, they are subsumed in this table for the sake of brevity.

change in the substitution relation between derivative hedging and accruals management.[16] To address this concern, we include in the regression models two additional variables—*Term spread* and *Dollar's strength*—to control for the impacts of a firm's exposure to interest rate and foreign exchange risks. *Term spread* is the difference between the ten-year Treasury constant maturity rate and the two-year Treasury constant maturity rate; and *Dollar's strength* is measured by the Broad U.S. Dollar Index value from the Board of Governors of the Federal Reserve System.

[16] For example, our sample period of 1996 to 2006 embraces a full cycle of strong and weak U.S. dollar periods, which peaked in January 2002. The strong dollar period coincides with emerging market crises starting with the Asian financial crisis (1997–1998) and currency crises in Russia and Brazil (starting in August 1998 and in January 2002, respectively), while the weak dollar period reflects a strong Euro era beginning with the circulation of the Euro in January 2002 and enlargement of the European union in May 2004 and beyond.

To address the concern on the effect of SOX in 2002, we use a subsample analysis to investigate whether our findings are driven by SOX. We borrow an idea from Chhaochharia and Grinstein (2009), who examined the intertemporal shift in executive compensation through the lens of SOX. Specifically, we assess whether our findings on the change in the substitution relation differ in firms being more affected or less affected by SOX. If our results are driven by SOX, then the change in the substitution relation between derivatives hedging and accrual management should be greater in firms that are more affected by SOX than in firms that are less affected. On the other hand, if our findings are indeed driven by the implementation of FAS 133 rather than by extraneous contemporaneous events, then we should find no significant difference in the change of the substitution relation between the two groups of firms.

Among the provisions aiming at improving corporate governance practices, SOX requires independent audit committees and that the majority of the board are independent directors. We identify firms that were compliant with both of these provisions in 2002, and the rest are considered as non-compliant firms. We then estimate the simultaneous equations using the two subsamples of non-compliant firms (more affected by SOX) and compliant firms (less affected by SOX). The results are reported in Table 4. Columns (1)–(2) present the results for non-compliant firms, and columns (3)–(4) present results for compliant firms.

The overall results in Table 4 are qualitatively similar to those reported in Table 2 even after controlling for firms' exposures to interest rate (*Term spread*) and exchange rate risks (*Dollar's strength*). We again observe in the subsample analysis a significant substitution relation between derivative hedging and discretionary accruals in the pre-FAS 133 period, and the relation becomes complementary after FAS 133 implementation.

Focusing on columns (2) and (4) in Table 4, we see that the coefficient estimates on *Derivative ratio* and *Derivative ratio* $*$ *FAS 133* are similar in magnitude and significance level in both models. We conclude that, regardless of whether it is before or after FAS 133 implementation, there is no significant difference, both economically and statistically, in the relation between notional derivative ratio and accrual management between the firms that are compliant or non-compliant with SOX. Thus, our finding on the attenuation of the substitution relation between derivative hedging and accrual management in the post-FAS 133 period is unlikely to have been driven by SOX.

Next, we address the aforesaid concern of potential intertemporal changes in accounting quality and the dot-come bubble and bust. Using the same logic as above, we again divide the sample into two groups according to whether a firm is audited by one of the Big 4 auditing firms or whether a firm is a dot-com company. Since the dot-com bubble and bust mostly affected technology industries, we define a firm being a dot-com company if it belongs to any of the high-tech industries, and being a non-dot-com company otherwise. Following Kwon and Yin (2006), we identify high-tech industries as those with SIC codes 3570–3577 (computer and office equipment), 3600–3674 (electronic and other electrical equipment and components, except computer equipment), 3812–3845 (measuring, analyzing, and controlling instruments), 7371–7379 (computer programming and data processing), and 8731–8734 (research, development, and testing services). If our findings are indeed driven by the implementation of FAS 133 rather than by extraneous contemporaneous events, then we expect to find no significant difference in the change of the substitution relation between the two groups of firms (firms with non-Big 4 auditor versus firms with Big 4 auditor, or non-dot-com firms versus dot-com firms).

We estimate the simultaneous equations with correction for self-selection bias using the subsamples, and the results are reported in Table 5. Columns (1)–(2) and (3)–(4) present the results for firms with non-Big 4 and Big 4 auditors, respectively. Columns (5)–(6) and (7)–(8) present results for non-dot-com and dot-com firms, respectively. Focusing on columns (2) and (4), the coefficient estimates on *Derivative ratio* and *Derivative ratio* $*$ *FAS 133* are similar in magnitude

TABLE 4

The Effect of the Sarbanes-Oxley Act

		Dependent Variable			
		Non-Compliant with SOX		Compliant with SOX	
	Exp. Sign	*Derivative ratio* (1)	*|DTACC|* (2)	*Derivative ratio* (3)	*|DTACC|* (4)
|DTACC| (β_1)	−	−0.115* (−1.830)		−0.091 (−1.498)	
|DTACC| ∗ FAS 133 (β_2)	+/−	0.223** (2.406)		0.131* (1.912)	
Derivative ratio (γ_1)	−		−0.117* (−1.912)		−0.116* (−1.700)
Derivative ratio ∗ FAS 133 (γ_2)	+/−		0.371** (2.358)		0.258** (2.139)
FAS 133	+/−	0.004 (1.251)	0.007 (1.204)	0.009 (1.277)	0.006 (1.192)
CEO cash comp	+	0.005 (0.173)	−0.004 (−0.141)	0.045 (0.916)	0.001 (0.032)
CEO option comp	+/−	−0.010 (−0.361)	0.018 (0.695)	0.033 (0.740)	−0.019 (−0.687)
CEO stock comp	+	−0.030 (−0.861)	−0.007 (−0.235)	0.094* (1.723)	0.014 (0.405)
Tax convexity	+	0.001 (0.171)	0.003 (0.926)	0.001 (0.449)	0.001 (0.277)
Leverage	+	0.204*** (3.669)	−0.036 (−0.703)	0.265*** (3.237)	0.095* (1.771)
Distress	+	−0.005 (−0.616)	0.004 (0.558)	−0.018 (−1.551)	−0.011 (−1.425)
R&D intensity	+	1.252*** (3.277)	−0.645** (−2.079)	0.566 (0.846)	0.062 (0.163)
R&D ∗ Leverage	+	−1.604 (−1.459)	0.908 (0.901)	−0.736 (−0.445)	−0.154 (−0.147)
Analysts	+	0.000 (0.292)	−0.001 (−1.586)	0.000 (0.245)	0.000 (0.877)
Nopseg	−	0.001 (0.817)	−0.002** (−1.998)	−0.002 (−1.201)	−0.001* (−1.647)
Foreign sales ratio	+	0.028* (1.669)	0.064*** (4.152)	0.027 (1.185)	0.025* (1.673)
Firm size	+	0.018 (1.581)		−0.007 (−0.431)	
Dividend yield	+	−0.599 (−1.586)		−0.081 (−0.154)	
Short-term debt	+	0.010 (0.581)		0.088*** (3.134)	
Cash cycle	+	0.000 (1.028)		0.000 (0.165)	
|DTACC|$_{t-1}$	+		0.383*** (9.073)		0.165*** (3.857)

(continued on next page)

TABLE 4 (continued)

		Dependent Variable			
		Non-Compliant with SOX		Compliant with SOX	
	Exp. Sign	*Derivative ratio* (1)	*|DTACC|* (2)	*Derivative ratio* (3)	*|DTACC|* (4)
LIFO reserve	+		0.061		0.235
			(0.318)		(1.200)
Dividend payout	−		0.004		−0.011
			(0.330)		(−1.387)
Flexibility	+		0.000		−0.000
			(0.041)		(−1.029)
|OCF|	+		0.142***		0.133**
			(2.583)		(2.095)
Term spread	+/−		−0.056**		−0.171**
			(−2.228)		(−2.161)
Dollar's strength	+/−		0.004*		0.026**
			(1.931)		(2.387)
Inverse Mills ratio	+/−	−0.065	0.098	0.188	0.039
		(−0.639)	(1.394)	(1.140)	(0.910)
Intercept		Yes	Yes	Yes	Yes
Industry fixed effects		Yes	Yes	Yes	Yes
NOBS		488	488	323	323
Pseudo Adj. R^2		0.1602	0.3109	0.1667	0.3218
$(\beta_1 + \beta_2)$ or $(\gamma_1 + \gamma_2)$		0.108	0.254**	0.040	0.142*
p-value for F-test		(0.109)	(0.044)	(0.319)	(0.062)
p-value (Hausman test)		(0.226)	(0.125)	(0.131)	(0.172)

*, **, *** Denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.
This table reports the estimation results of the systems of simultaneous equations where notional derivative ratio and absolute discretionary accruals are endogenous in subsamples. Sample firms are divided into two groups: firms that were not compliant (columns (1)–(2)) and those that were compliant (columns (3)–(4)) with the Sarbanes-Oxley Act (SOX) provisions that mandate both board independence and fully independent audit committee as of 2002. Derivative ratio is the ratio of notional values of financial derivatives to total assets. We include the inverse Mills ratio that is computed from the probit model of Equation (6) to correct for potential self-selection bias in the simultaneous equations. We control for industry fixed effects based on two-digit SIC industry codes. t-statistics are reported in parentheses below each coefficient estimate.
All explanatory variables are as defined in Appendix C.

and significance level in both models. Similar coefficient estimates on *Derivative ratio* and *Derivative ratio* ∗ *FAS 133* are also observed in columns (6) and (8). We conclude that there is no significant difference in the relation of derivative ratio and accrual management between firms with non-Big 4 and Big 4 auditors, or between non-dot-com and dot-com firms. Thus, it is unlikely that our finding on the attenuation of the substitution relation between derivative use and accrual management in the post-FAS 133 period was driven by changes in accounting quality or the dot-com bubble and bust.

Additional Robustness Tests

One issue pertains to the possibility that the determinants of derivative use and discretionary accruals may have changed in the post-FAS 133 period, in which case, our regression models of Equations (4) and (5) might be subject to an omitted variables problem. To address this concern, we

TABLE 5

The Effect of Accounting Quality and the Dot-Com Bubble and Bust

	Non-Big 4 Auditor		Big 4 Auditor		Non-Dot-Com Firms		Dot-Com Firms	
	Derivative ratio **(1)**	**|*DTACC*|** **(2)**	***Derivative ratio*** **(3)**	**|*DTACC*|** **(4)**	***Derivative ratio*** **(5)**	**|*DTACC*|** **(6)**	***Derivative ratio*** **(7)**	**|*DTACC*|** **(8)**
|*DTACC*| (β_1)	−0.181**		−0.185**		−0.161***		−0.128*	
	(−2.131)		(−2.139)		(−1.912)		(−1.806)	
|*DTACC*| * *FAS 133* (β_2)	0.270**		0.257**		0.276**		0.230**	
	(2.117)		(2.225)		(2.189)		(2.413)	
Derivative ratio (γ_1)		−0.104*		−0.114*		−0.131*		−0.133*
		(−1.660)		(−1.679)		(−1.802)		(−1.884)
Derivative ratio * *FAS 133* (γ_2)		0.409***		0.392**		0.315**		0.287**
		(2.813)		(2.368)		(2.292)		(2.197)
FAS 133	0.013*	0.011*	−0.001	0.005	0.005	0.008	0.004	−0.003
	(1.733)	(1.667)	(−0.676)	(1.294)	(1.306)	(1.494)	(0.461)	(−0.069)
CEO cash comp	0.017	0.023	−0.106*	0.103	0.009	0.013	0.063	−0.042
	(0.775)	(0.716)	(−2.302)	(1.347)	(0.430)	(0.366)	(0.872)	(−0.783)
CEO option comp	0.010	0.014	0.113**	0.145**	0.006	0.011	0.001	−0.019
	(0.526)	(0.500)	(2.264)	(2.042)	(0.293)	(0.362)	(0.028)	(−0.457)
CEO stock comp	0.028	0.041	0.133**	−0.015	0.012	0.014	0.005	0.010
	(1.212)	(1.179)	(2.174)	(−0.167)	(0.528)	(0.374)	(0.057)	(0.167)
Tax convexity	0.002	0.004	0.001	0.003	0.003	0.006	−0.000	0.006
	(1.066)	(1.296)	(0.206)	(0.363)	(1.441)	(1.548)	(−0.001)	(1.514)
Leverage	0.208***	0.317***	−0.002	0.075	0.193***	0.299***	0.494**	−0.107
	(4.642)	(3.355)	(−0.018)	(0.744)	(4.527)	(3.220)	(2.552)	(−0.883)
Distress	−0.012**	−0.019**	0.055***	−0.021	−0.008	−0.014	−0.017	0.035
	(−2.014)	(−1.997)	(3.477)	(−1.180)	(−1.352)	(−1.457)	(−0.589)	(1.613)
R&D intensity	0.620**	0.749	−0.407	−0.289	0.573**	0.669	3.020*	1.356
	(2.022)	(1.473)	(−0.409)	(−0.376)	(2.001)	(1.306)	(1.717)	(1.302)
R&D * *Leverage*	−0.545	−0.726	2.943	−3.319	−0.793	−1.038	5.456	−6.031
	(−0.599)	(−0.525)	(1.351)	(−1.364)	(−0.961)	(−0.761)	(0.564)	(−0.830)

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TABLE 5 (continued)

	Non-Big 4 Auditor		Big 4 Auditor		Non-Dot-Com Firms		Dot-Com Firms	
	Derivative ratio **(1)**	**|*DTACC*|** **(2)**	***Derivative ratio*** **(3)**	**|*DTACC*|** **(4)**	***Derivative ratio*** **(5)**	**|*DTACC*|** **(6)**	***Derivative ratio*** **(7)**	**|*DTACC*|** **(8)**
Analysts	−0.000	−0.000	−0.001	0.001	−0.000	−0.000	0.001	0.001
	(−0.268)	(−0.493)	(−1.398)	(0.921)	(−0.675)	(−1.040)	(0.553)	(0.735)
Nopseg	−0.001	−0.002	−0.009**	0.006	−0.001	−0.002	0.008	0.001
	(−0.737)	(−1.326)	(−2.161)	(1.534)	(−0.749)	(−1.204)	(1.241)	(0.390)
Foreign sales ratio	0.019	0.020	−0.051	−0.009	0.017	0.019	0.057	−0.069
	(1.484)	(0.895)	(−1.001)	(−0.143)	(1.343)	(0.853)	(1.109)	(−1.558)
Firm size	0.004		0.030		0.002		0.114**	
	(0.515)		(0.843)		(0.336)		(2.074)	
Dividend yield	0.090		−1.344*		0.054		−2.364	
	(0.390)		(−1.779)		(0.261)		(−1.126)	
Short-term debt	0.002		0.088***		0.005		0.023	
	(0.181)		(3.040)		(0.467)		(0.514)	
Cash cycle	0.000		0.000*		0.000		−0.000	
	(0.427)		(1.681)		(0.560)		(−1.020)	
$\|DTACC\|_{t-1}$		0.092*		0.361***		0.194*		0.324**
		(1.892)		(3.223)		(1.882)		(1.993)
LIFO reserve		−0.031		−0.052		−0.031		−13.714
		(−0.161)		(−0.156)		(−0.183)		(−0.702)
Dividend payout		−0.003		−0.011		−0.004		0.055
		(−0.282)		(−0.341)		(−0.312)		(1.147)
Flexibility		−0.000		0.000		−0.000		−0.000
		(−0.772)		(0.124)		(−0.422)		(−0.283)
|*OCF*|		−0.039		−0.100		−0.037		0.098
		(−0.735)		(−0.770)		(−0.665)		(0.732)
Term spread		−0.021**		−0.239***		−0.026**		−0.009
		(−2.031)		(−4.226)		(−2.108)		(−0.467)
Dollar's strength		0.002**		−0.000		0.002**		−0.000
		(2.158)		(−0.273)		(2.458)		(−0.198)

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TABLE 5 (continued)

	Non-Big 4 Auditor		Big 4 Auditor		Non-Dot-Com Firms		Dot-Com Firms	
	***Derivative ratio* (1)**	**|*DTACC*| (2)**	***Derivative ratio* (3)**	**|*DTACC*| (4)**	***Derivative ratio* (5)**	**|*DTACC*| (6)**	***Derivative ratio* (7)**	**|*DTACC*| (8)**
Inverse Mills ratio	0.076	0.134*	0.080	0.021	0.085	0.115*	−0.804	0.113
	(1.031)	(1.938)	(0.275)	(0.213)	(1.253)	(1.854)	(−1.598)	(0.782)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NOBS	616	616	195	195	709	709	102	102
Pseudo Adj. R^2	0.1709	0.2013	0.1690	0.2126	0.1653	0.2105	0.1603	0.2082
$(\beta_1 + \beta_2)$ or $(\gamma_1 + \gamma_2)$	0.089	0.305**	0.072	0.278**	0.115	0.184**	0.102	0.154*
p-value for F-test	(0.153)	(0.040)	(0.146)	(0.042)	(0.112)	(0.042)	(0.126)	(0.062)
p-value (Hausman test)	(0.188)	(0.109)	(0.173)	(0.115)	(0.128)	(0.109)	(0.182)	(0.113)

*, **, *** Denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table reports the estimation results of the systems of simultaneous equations where notional derivative ratio and absolute discretionary accruals are endogenous in subsamples. Sample firms are divided into two groups according to their auditors: firms with non-Big 4 auditor (columns (1)–(2)) and those with Big 4 auditor (columns (3)–(4)). We also divide sample firms into two groups based on their industry classifications: non-dot-com firms (columns (5)–(6)) and dot-com firms (columns (7)–(8)). Following Kwon and Yin (2006), we identify dot-com firms as those belonging to the high-tech industries with SIC codes 3570–3577 (computer and office equipment), 3600–3674 (electronic and other electrical equipment and components, except computer equipment), 3812–3845 (measuring, analyzing, and controlling instruments), 7371–7379 (computer programming and data processing), and 8731–8734 (research, development, and testing services). The rest are non-dot-com firms. Notional derivative ratio is the ratio of notional values of financial derivatives to total assets. We include the inverse Mills ratio that is computed from the probit model of Equation (6) to correct for potential self-selection bias in the simultaneous equations. We control for industry fixed effects based on two-digit SIC industry codes. t-statistics are reported in parentheses below each coefficient estimate.

All explanatory variables are as defined in Appendix C.

estimate Equations (4) and (5) with a fully interacted model in which we allow all coefficients (including those of the control variables) to differ across the two periods. Similar to Table 2, we find that the notional derivative ratio is significantly and negatively related to $|DTACC|$ pre-FAS 133. However, the relation between the two becomes positive and significant post-FAS 133. In particular, the magnitudes of the coefficient estimates of γ_1 and γ_2 in the fully interactive model are similar to those reported in Table 2, in support of the robustness of our results (results available upon request).

Another issue is whether the identity of the firms is the same in the two subperiod samples—the before-FAS 133 sample versus the post-FAS 133 sample. As shown in Panel B of Table 1, the frequency of reporting notional values of derivatives dropped from 84 percent of total observations pre-FAS 133 to 65 percent post-FAS 133, since firms were not required to disclose the notional values of derivatives in the post-FAS 133 period. Thus, it is possible that the identity of reporting firms in the pre- versus post-FAS 133 sample might not be the same, which causes the possibility that our result might have come from cross-sectional variations, rather than intertemporal changes. To address this concern, we restrict our sample firms to those firms that disclose notional derivative values both before and after FAS 133, and estimate simultaneous Equations (4) and (5) again. As in Table 2, while the coefficient on the *Derivative ratio* (γ_1) is negative, albeit statistically insignificant in the regression explaining $|DTACC|$, the coefficient on the interaction term (γ_2) is positive and statistically significant (results available upon request). We conclude that the basic notion of an intertemporal weakening of the substitution effect between derivative hedging and accrual management from pre- to post-FAS 133 remains.

FAS 133 and Earnings Volatility

We now address the practitioners' concern that volatility in reported earnings may have increased with the implementation of FAS 133 (e.g., PricewaterhouseCoopers 2009). Both discretionary accruals and derivatives can affect earnings volatility. Therefore, we estimate earnings volatility as a function of *Derivative ratio,* the *FAS 133* dummy, $|DTACC|$, and *Derivative ratio* $*$ *FAS 133,* and firm-specific control variables. We also control for industry fixed effects based on two-digit SIC industry codes.

We choose control variables based on prior studies on income smoothing (DeFond and Park 1997). We include firm size, return on assets (*ROA*), and the book-to-market ratio in the regressions. Tufano (1996) argues that managerial preference for firm risk is dependent on the incentive structure offered to its CEO. Therefore, we also include CEO incentive pay as a control variable. R&D and capital intensities are commonly thought to influence income volatility (Minton and Schrand 1999). Foreign sales ratio and the number of operating segments are used to proxy for uncorrelated alternative sources of revenues that potentially impact a firm's business risk.

It is possible that firms may choose to do more accrual management if derivatives become less effective as an earnings-smoothing device post-FAS 133. However, as discussed above, it is also plausible that firms may not increase their use of discretionary accruals to fully offset the insufficient earnings smoothing by derivatives. This is partly because the post-FAS 133 period overlaps the implementation of SOX, and managers may be prudent in accrual manipulation post-FAS 133 because of the fear of drawing attention from auditors or regulators (Graham et al. 2005). If this argument is valid, then we would expect that an increase in earnings volatility associated with derivative hedging post-FAS 133 will only occur in firms that are unable or unwilling to engage in a substantial level of accrual management.

To sort out the different effects of FAS 133 on earnings volatility for firms that engage in different levels of accrual management, we divide the sample firms into two groups with high and low levels of accruals. High-accruals firms are those with absolute discretionary total accruals above the sample median, and the rest are categorized as low-accruals firms. Regression results using the subsamples with high and low accruals are reported in columns (1) and (2), respectively, of Table 6.

We find that the coefficient estimate on *Derivative ratio* is insignificant in either column, suggesting that derivative ratio is not associated with significant change in earnings volatility pre-FAS 133 regardless of whether firms manage accruals to a great extent. The coefficient estimate on the interaction term *Derivative ratio* $*$ *FAS 133* is insignificant in firms with a high level of accruals (column (1)); however, it is positive and marginally significant in firms with a low level of accruals (column (2)). An F-test of the sum of the coefficient estimates on *Derivative ratio* and *Derivative ratio* $*$ *FAS 133* is positive and statistically significant at the 5 percent level in column (2) (reported at the bottom of Table 6). The results indicate that greater use of financial derivatives is associated with higher earnings volatility after the adoption of FAS 133; however, it is only limited to firms that engage in a relatively low level of accrual management. For firms that manage accruals to a large extent, derivative ratio is not associated with any significant change in earnings volatility post-FAS 133. These results confirm our conjecture that the significant increase in earnings volatility associated with derivative hedging post-FAS 133 is attributable to their inability or unwillingness to manage discretionary accruals to the full extent to compensate for the reduced effectiveness of derivatives. Overall, these results are consistent with H2 and are supportive of the practitioner concern regarding the increased volatility in reported earnings after FAS 133 implementation.[17]

V. CONCLUSION

Barton (2001) shows that the two methods of smoothing earnings—an "artificial smoothing" through abnormal accruals and a "real smoothing" through derivatives hedging—were partial substitutes for Fortune 500 firms during 1994–1996. Pincus and Rajgopal (2002) also showed that oil and gas firms appeared to manage earnings volatility by sequentially trading off derivative hedging and abnormal accruals to smooth income for 1993–1996. The implementation of FAS 133 in June 2000, however, introduced a new uncertainty into the equation. FAS 133 mandated the fair market valuation of derivatives, requiring firms to examine the extent to which derivatives are effective at hedging. It also mandated an immediate recognition of the ineffective portions of cash flow hedges. This led to the practitioner concerns that derivative hedging might have become less effective as a tool of income smoothing, with an implication that volatility of reported earnings may have increased post-FAS 133.

Using detailed data on financial derivatives for nonfinancial firms in the S&P 500 index for the period from 1996 to 2006, we find that derivatives and accruals were substitutes in the pre-FAS 133 period, but this relation weakened after the implementation of FAS 133. In fact, we find a complementary relation between derivative hedging and discretionary accruals in the post-FAS 133 period. Our results are robust to the use of alternative measures of derivatives and accrual management. Additional analyses indicate that our findings are not driven by contemporaneous events, including SOX, changes in accounting quality, the dot-com bubble and bust around 2000, and macroeconomic shocks in interest rates and foreign exchange rates during the sample period. Moreover, we document that FAS 133 is associated with an increase in earnings volatility

[17] The signs of the control variables are unremarkable. The negative association between ROA and earnings volatility indicates that more profitable firms are less volatile. Dividend payout ratio is also negatively associated with earnings volatility. CEO incentive pay is positively related to earnings volatility. R&D intensity and the number of business segments are both positively related to earnings volatility, which reflects the risky nature of the R&D projects and operational complexity.

TABLE 6

FAS 133 and Earnings Volatility

		Dependent Variable: *Earnings volatility*	
	Exp. Sign	**High Accruals (1)**	**Low Accruals (2)**
Derivative ratio (β_1)	−	0.346	0.088
		(0.659)	(1.280)
Derivative ratio ∗ *FAS 133* (β_2)	+/−	−0.883	0.631*
		(−1.484)	(1.781)
|*DTACC*|	+/−	0.724	0.381
		(1.232)	(1.251)
FAS 133	+	1.166**	0.347*
		(2.082)	(1.672)
CEO incentive	+	0.468***	0.429***
		(3.347)	(3.455)
Firm size	−	−0.094	−0.023
		(−1.392)	(−0.389)
ROA	−	−1.497**	−2.840***
		(−2.374)	(−6.635)
BM ratio	−	0.104	0.049
		(0.644)	(0.289)
Capital intensity	−	−1.262	−0.144
		(−1.166)	(−0.146)
R&D intensity	+	4.535**	4.826***
		(2.452)	(3.466)
Leverage	+	0.022	−0.396
		(0.065)	(−1.396)
Dividend payout ratio	−	−2.592	−5.285*
		(−0.948)	(−1.648)
Foreign sales ratio	+/−	−0.016	0.071
		(−0.130)	(0.483)
Nopseg	+/−	0.008	0.023**
		(0.854)	(2.421)
Inverse Mills ratio	+/−	−0.825	−0.066
		(−1.241)	(−1.031)
Intercept		Yes	Yes
Industry fixed effects		Yes	Yes
NOBS		405	406
Adj. R^2		0.3292	0.4127
$\beta_1 + \beta_2$		−0.537	0.719**
p-value for F-test		(0.197)	(0.044)

*, **, *** Denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table reports the regression results of the impact of FAS 133 on earnings volatility conditional on a firm's notional derivative ratio and whether the firm engages in a high or low level of accrual management. We divide the sample into two groups: high-accruals and low-accruals firms. High-accruals firms are those with the absolute discretionary total accruals above the sample median, and the rest are categorized as low-accruals firms. Regression results of the high-accruals and low-accruals firms are reported in columns (1) and (2), respectively. Derivative ratio is the ratio of notional values of financial derivatives to total assets. We include the inverse Mills ratio that is computed from the probit model of Equation (6) to correct for potential self-selection bias in the simultaneous equations. We control for industry fixed effects based on two-digit SIC industry codes. t-statistics are reported in parentheses below each coefficient estimate. All variables are as defined in Appendix C.

associated with derivative usage, but this is present only in firms that engage in a relatively low level of accrual management.

A survey of CFOs from 36 countries by Lins, Servaes, and Tamayo (2011) indicates that these rules on fair valuation and hedge accounting have substantially reduced foreign exchange hedging, as well as the use of nonlinear hedging instruments. Nevertheless, FAS 133 might have changed firms' risk management behavior by pushing them to hedge more effectively. Although we do not observe any significant change in the median notional derivative ratio (notional derivatives scaled by total assets) before versus after FAS 133 implementation, it is possible that firms alter their risk management strategy by employing a greater portion of derivatives that qualify for an effective hedge under FAS 133. A potentially fruitful venue for future research includes the investigation of whether and to what extent FAS 133 has influenced hedging effectiveness and corporate risk management strategies, and how this varies for firms with different operational, managerial, and governance profiles.

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APPENDIX A

An Example of a Cash Flow Hedge under FAS 133

This appendix illustrates how an ineffective portion of the cash flow hedge is booked under FAS 133, which, in turn, leads to higher volatility in reported earnings and cash flow.

Suppose that a company issues floating rate debt that resets on the first day of each month at the one-month Federal Funds rate. In order to hedge its interest rate risk, the company enters into a pay-fixed interest rate swap in which it will pay a fixed rate and receive one-month LIBOR (London Inter-Bank Offered Rate). In this case, the company would have some hedging ineffectiveness since the one-month Federal Funds rate and one-month LIBOR are not perfectly correlated. To measure this ineffectiveness due to basis difference, suppose the company can create a "perfect hedge" by creating a hypothetical derivative position structured as a pay-fixed, receive one-month Federal Funds rate. Hedging ineffectiveness is measured as the excess cumulative change in fair value of the derivative beyond the cumulative change in fair value of the hypothetical derivative.

Assume that the LIBOR rate swap is entered into at market (i.e., the trade date value of the derivatives is $0). Now assume that at the end of the first reporting period, the LIBOR rate swap value is −$100 and the value of the hypothetical derivative (pay-fixed, receive one-month Fed Funds rate) is −$90. Because the absolute cumulative change of the swap ($100) is greater than the absolute cumulative change of the hypothetical derivative ($90), there is ineffectiveness as shown below:

Other comprehensive income (OCI)	$90
Interest expenses (ineffectiveness)	$10
Interest rate swaps	($100)
Balance of swaps	($100)
Balance of OCI	$90
Cumulative interest expenses (ineffectiveness)	$10

At the end of the second reporting period, the swap value is −$250 and the hypothetical derivative's value is −$200. Then we have:

Other comprehensive income (OCI)	$110
Interest expenses (ineffectiveness)	$40
Interest rate swaps	($150)
Balance of swaps	($250)
Balance of OCI	$200
Cumulative interest expenses (ineffectiveness)	$50

At the end of the third period, the swap value is −$50, but the hypothetical derivative's value is −$30; we would then have:

Other comprehensive income (OCI)	($170)
Interest expenses (ineffectiveness)	($30)
Interest rate swaps	$200
Balance of swaps	($50)
Balance of OCI	$30
Cumulative interest expenses (ineffectiveness)	$20

Therefore, the ineffective portion of the cash flow hedge results in interest expenses of $10, $40, and −$30 at the end of the first, second, and third period, respectively, and these amounts are booked in current earnings under FAS 133. This leads to additional short-term earnings volatility compared to the pre-FAS 133 era, where there is no measuring of ineffectiveness and all gains or losses of hedge derivatives are deferred until the closing of the hedge strategy.

APPENDIX B

Sample Selection Process

	Number of Firm-Year Observations
Initial Sample Size: (Nonfinancial S&P 500 firms in 1996, 1998, 2000, 2002, 2004, and 2006 that are covered by the ExecuComp database)	2,244
Less: Observations without Compustat annual industrial information	−216
Less: Observations without Compustat segment information	−104
Less: Observations without CRSP information	−143
Less: Observations without I/B/E/S information	−127
Final Sample Size	1,654

APPENDIX C

Variable Definitions

Variable	Description
Derivative user	A dummy that is equal to 1 if a firm uses financial derivatives, and 0 otherwise.
Derivative notional value	Sum of the notional values of all derivative positions.
Derivative fair value	Sum of the fair market values of all derivative positions.
Absolute derivative fair value	Sum of the absolute values of the fair market value of all derivative positions.
Notional derivative ratio	Ratio of notional values of derivatives to total assets.
DTACC	Discretionary total accrual.
DCACC	Discretionary current accrual.
DWCACC	Discretionary working capital accrual.
CEO cash comp	Sum of CEO salary and bonus divided by total compensation (salary + bonus + other annual comp. + restricted stock grants + long-term incentive payouts + all other comp. + value of option grants).
CEO option comp	CEO option compensation divided by total compensation.
CEO stock comp	CEO stock compensation divided by total compensation.
CEO incentive pay	1 minus the ratio of CEO salary to total compensation.
Tax convexity	Marginal tax rate minus average tax rate, where the marginal tax rate is calculated according to Graham (1996).
Leverage	Total debt divided by total assets {(data9 + data34)/data6}.
Distress	Probability of bankruptcy calculated using Ohlson's (1980) model.
R&D intensity	Research and development expenses divided by total assets (data46/data6).
Analysts	Number of analysts following the firm in the fourth quarter of a calendar year.
Nopseg	Number of operating segments.
Foreign sales ratio	Sales from all foreign divisions divided by total sales.

(continued on next page)

APPENDIX C (continued)

Variable	Description
Firm size	Natural logarithm of total assets, or {Ln(data6)}.
Dividend yield	Cash dividend divided by market value of equity, or {data127/(data199 $*$ data25)}.
Short-term debt	Short-term debt divided by total debt, or {data34/(data9 + data34)}.
Cash cycle	Cash conversion cycle in number of days = 360 $*$ {(Inventories/COGS) + (receivables − payables)/sales}, or {(360 $*$ (data3/data41) + (data2 − data70)/data12)}.
LIFO reserve	Last-in-first-out reserve divided by lagged total assets, or $(\text{data240})_t/(\text{data6})_{t-1}$.
Dividend payout	Cash dividend divided by net income, or data127/data172.
Flexibility	Root mean squared error of total accrual regression using Equation (1).
$\lvert OCF \rvert$	Absolute value of the ratio of operating cash flow to lagged total assets, or $\lvert(\text{data308})_t/(\text{data6})_{t-1}\rvert$.
Earnings volatility	Standard deviation of earnings before extraordinary items (data123) during the previous five years, scaled by average total assets (data6) during the same period.
ROA	Net income divided by total assets, or (data172/data6).
BM ratio	Book value of equity divided by market value of equity {data60/(data199 $*$ data25)}.
Capital intensity	Capital expenditures divided by total assets, or (data128/data6).
Term spread	Difference between the ten-year Treasury constant maturity rate and the two-year Treasury constant maturity rate.
Dollar's strength	Measured by the Broad U.S. Dollar Index value from the Board of Governors of the Federal Reserve System.