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The Effects of Ex Post Disclosures of Prior-Period Estimation Errors on Investors' and Managers' Behavior - Evidence from Product Warranty Liabilities

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Abstract

This paper investigates whether ex post disclosures of prior-period estimation errors in accounting accruals provide value-relevant information to investors and whether such disclosures discourage opportunistic reporting by managers. Several researchers argue that by requiring managers to disclose past estimation errors, the financial reporting system can increase the reliability of estimates and at the same time preserve the relevance of reported earnings. There is, however, litter empirical evidence on the validity of this argument. Using the mandated disclosures of prior-period estimation errors in product warranty liabilities required by FIN 45, I find that investors attach a smaller valuation multiple to unexpected earnings for firm-quarters with more variable past estimation errors in product warranty liabilities (i.e., less precise past earnings), suggesting that investors consider ex post disclosures of past estimation errors decision-relevant. The differential valuation multiples are observed only after but not before the information about past estimation precision becomes available to the market. Moreover, there is an association between current period estimation errors in product warranty liabilities and proxies for the occurrence of earnings management in the current period. Such an association becomes less pronounced after the implementation of FIN 45, implying that the ex post disclosures of prior-period estimation errors curb accrual management through product warranty liabilities.

Keywords: *Accounting estimates, Disclosures, Opportunistic financial reporting, Product warranty liabilities.*

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事後揭露前期應計項目估計錯誤對投資人與經理人行為影響之研究－以產品保證負債為例

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摘要

本文旨在研究應計項目前期估計錯誤數的揭露是否能為投資人提供具決策攸關性的資訊，並檢視經理人投機性財務報導的行為是否受到此項揭露所影響。本文的研究動機係著眼於會計資訊攸關性與可靠性之取捨。會計學者認為，要求公司揭露應計項目前期估計錯誤數可增加會計估計的可靠性且不犧牲盈餘數字的攸關性。然而現有文獻並未對此一見解提出相關證據。

本文使用美國財務會計準則委員會第45號解釋函所要求的產品保證負債揭露來檢視事後揭露前期應計項目估計錯誤的影響。主要發現為：投資人對於過去應計項目估計錯誤波動較大的公司（亦即較不精確的過去盈餘數字），會給予未預期盈餘較低的評價，顯示投資人認為前期估計錯誤數的揭露具決策攸關性，而此差異評價之情形僅出現於投資人取得估計精確性的資料之後。此外，當期產品保證負債估計錯誤數與當期盈餘操縱的發生呈正向相關，且此一相關性於第45號解釋函發佈後變得較不顯著，顯示事後揭露前期應計項目估計錯誤數有助於減少透過產品保證負債估計所進行的盈餘管理。

關鍵詞：會計估計、揭露、投機性財務報導、產品保證負債

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1. INTRODUCTION

This paper investigates whether requiring managers to disclose estimation errors in previous accounting accruals affects managers' financial reporting and investors' equity valuation decisions. Many accounting items in financial statements cannot be measured with precision but have to be estimated based on the best information available to managers because of the uncertainties inherent in business activities. Under current U.S. Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS), corrections to previous estimation errors are accounted for in current earnings (and future earnings if the change in estimates affects both).[1] The magnitude and sign of these corrections generally are not revealed to the public.

While accounting estimates necessarily require managerial discretion, the lack of disclosure of previous accounting estimation errors provides managers with incentives to exploit accounting discretion afforded to them. The extant literature has documented that managers exercise their discretion in specific accounts such as bad debt provision (McNichols and Wilson 1988), restructuring charges (Moehrle 2002), and claim loss reserves (Petroni 1992; Beaver, McNichols and Nelson 2003) to achieve desired earnings results. There is, however, little empirical evidence on what reporting mechanisms help to curb opportunistic reporting. To fill this gap in the literature, I examine two related questions in this paper: (1) does information about previous estimation errors provide useful information in assessing the precision of current reported earnings? (2) do ex post disclosures of estimation errors in prior accounting accruals discourage ex ante opportunistic reporting through accrual misestimation?

The exercise of discretion over accruals has long been the subject of considerable concern (Healy and Wahlen 1999). While accruals allow companies to reflect value creation and depletion in a timely manner, they also give managers opportunities to abuse the flexibility built in the accrual-based financial reporting system, resulting in unreliable accounting amounts. To improve the relevance without sacrificing the reliability of financial information, several researchers (e.g., Lundholm 1999; Ryan 1997; Petroni, Ryan and Wahlen 2000) propose a reporting mechanism that requires companies to provide reconciliation of prior years' accrual estimates to their actual realizations in financial reports. By establishing a clear measure of a manager's disclosure credibility, researchers argue that ex post disclosures give managers incentives to report more accurately.

Although the existing literature establishes the value relevance of ex post disclosures of estimation errors in the property-casualty insurance industry (Anthony and Petroni 1997;

[1] Specifically, SFAS 154 and IAS 8 prescribe the accounting for changes in accounting estimates.

Beaver and McNichols 1998), there is surprisingly little research on how the revelation of prior estimation errors alters market participants' incentives and decisions. This is probably because, with the exception of property-casualty insurers' claim loss reserves, disclosures of estimation errors in prior accounting estimates are virtually nonexistent prior to the issuance of the Financial Accounting Standards Board (2002) Interpretation No. 45 (FIN 45). Therefore, FIN 45 provides a unique opportunity to examine the impact of ex post revelation of past estimation errors on information users' and financial statement preparers' behavior.[2]

Under FIN 45, firms must provide a tabular reconciliation of changes in the company's aggregate product warranty liability for each reporting period. This reconciliation should include any estimation errors related to pre-existing warranties if material. Companies adopting FIN 45 generally provide a comparative reconciliation for one or more prior years for which financial statements are presented. This comparative disclosure enables an examination of managers' reporting decisions regarding product warranty liabilities (accruals) both before and after FIN 45's mandatory ex post disclosures. By linking the accrual realizations to their original estimates, managers may pay more attention to the accuracy of their original estimates since investors have the information to evaluate managers' past estimation performance.

Using a sample of 1,986 firm-quarters (177 firms) providing disclosures of prior-period estimation errors in product warranty liabilities during 2002~2006, I find that firm-quarters with more variable estimation errors in previous earnings have smaller earnings response coefficients (*ERCs*), consistent with investors using the information in estimation error disclosures to form valuation decisions. This result holds after controlling for firms' idiosyncratic risk, operating risk, and default risk, but does not hold before FIN 45 disclosures became available, suggesting that the unfavorable effect of past estimation errors on *ERCs* cannot be attributed to the uncertainty of firms' operating environments.

Focusing on the 30 firms (578 firm-quarters) that went back and disclosed estimation errors for at least one pre-FIN 45 quarter, I find that estimation errors disclosed over the subsequent four quarters are positively associated with the magnitude of current discretionary accruals, consistent with product warranty accruals being used in conjunction with other accruals to manage financial performance.[3] In addition, there is a positive

[2] This paper focuses on product warranty liabilities but does not simultaneously incorporate claim loss reserves in the analyses because claim loss reserves are available only for the highly-regulated property-casualty insurance industry. Given that industrial firms do not have claim loss reserves and property-casualty insurers do not incur product warranty liabilities on their financial statements, I am unable to incorporate both of these accruals in my empirical analyses.

[3] A positive future estimation error indicates that the firm under-estimates product warranty expense (and liability) in the current period, thereby increasing future product warranty expense. Therefore, a positive association between future estimation errors and current discretionary accruals indicates that firms

association between pre-managed earnings shortfall relative to analysts' earnings expectations and the proxy of understatement in current product warranty liabilities, consistent with earnings shortfalls providing incentives to understate the current period's product warranty expense /liabilities. The above findings are less pronounced in the post-FIN 45 period than in the pre-FIN 45 period, suggesting that ex post disclosures of prior estimation errors mandated by FIN 45 discourage opportunistic reporting through product warranty accruals.

This paper contributes along three important dimensions. First, this is the first archival study examining how ex post disclosures of accrual estimation errors change managers' accrual reporting behavior. The finding that ex post disclosures of past estimation errors constrain opportunistic reporting provides relevant evidence to regulators and standard setters wishing to curb abusive financial reporting. Second, researchers have long recognized that there is a trade-off between relevance and reliability in accounting information. This paper builds on researchers' attempt to improve the quality of financial reporting and tests a reporting mechanism that allows relevant information to be reported without a corresponding loss of reliability. Third, I provide direct evidence on the usefulness of FIN 45 disclosures. Hirst, Jackson and Koonce (2003) suggest that not all types of ex post disclosures are equally effective in communicating information about estimation accuracy. Given that FIN 45 disclosures provide only the aggregate amount of estimation errors but do not provide details about when these estimation errors arose, it is an empirical question whether FIN 45 disclosures are effective. This study suggests that the ex post disclosures required by FIN 45 not only convey decision-useful information but also mitigate opportunistic reporting by managers. [4]

The rest of the paper proceeds as follows. I review related literature and develop hypotheses in Section 2. Section 3 presents empirical research design. Section 4 describes the sample and presents the univariate analyses. Section 5 reports my main results and Section 6 provides supplemental analyses. Section 7 concludes.

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reporting more income-increasing discretionary accruals are more likely to under-estimate their product warranty liabilities in the same period.

[4] A concurrent paper by Cohen, Darrough, Huang and Zach (2010) finds that managers use warranty accruals to manage earnings opportunistically to meet their earnings targets. This paper differs from Cohen et al. (2010) by demonstrating that the tendency to manage earnings through product warranty accruals diminishes after the implementation of FIN 45.

2. RELEVANT LITERATURE AND HYPOTHESIS DEVELOPMENT

Accrual-basis accounting includes numerous estimations, which are subject to potential estimation errors. These estimations enable reported earnings to reflect economic value changes on a more timely basis but at the same time allow abuse if managers intentionally distort the estimates. Therefore, the use of estimates gives rise to the well-known relevance-reliability tradeoff in accounting. Commentators argue that the traditional financial reporting model, developed during the Industrial Age, is losing relevance in the Information Age (e.g., Boulton, Libert and Samek 2000; Eccles, Herz, Keegan and Phillips 2001) because value-relevant items such as research and development costs, brands, and other intangibles often are expensed or ignored on the grounds that they cannot be measured with sufficient reliability. Investors, however, are concerned about the reliability and integrity of the financial reporting system, especially after recent accounting failures of high-profiled U.S. publicly traded companies, including Enron, Tyco, WorldCom, and Xerox.

A common reaction to earnings manipulation is to blame the flexibility allowed by GAAP. For example, former SEC Chairman Arthur Levitt (1998) expressed concerns that companies use accrual estimates to manage earnings and proposed to reduce the discretion companies have in accounting. While reducing accounting discretion may improve the reliability of accounting estimates, it could also reduce the relevance of financial reports by impairing firms' ability to communicate private information through their accounting choices (Dye and Verrecchia 1995). Several researchers (e.g., Lundholm 1999; Ryan 1997; Petroni et al. 2000) have proposed a reporting mechanism that increases reliability of estimates and at the same time preserves relevance of reported earnings. This mechanism requires companies to provide a reconciliation of prior-year estimates to actual realizations in a footnote to financial statements.

Prior to the issuance of FIN 45, information about past estimation accuracy is limited. The only exception is estimated claim losses (i.e., claim loss reserves) of publicly traded property-casualty insurers. As a result, most of the research on estimation accuracy is conducted in the area of claim loss reserves. Anthony and Petroni (1997) empirically examine whether disclosures on past estimation errors in the claim loss reserves of property-casualty insurers have valuation implications. They show that insurers with more variable estimation errors have lower earnings response coefficients. Beaver and McNichols (1998) find that there is a substantial serial correlation in estimation errors in claim loss reserves and investors incorporate this serial correlation when pricing insurers' common stock.

Ryan (1997) argues that standard setters should consider expanding disclosures with regard to ex post estimation errors beyond property-casualty insurers' claim loss reserves since this type of disclosures better reveals earnings variability and, therefore, allows better risk assessments. While this literature suggests that investors find information about prior estimation errors useful, we know little about how mandated revelation of prior estimation accuracy changes managers' reporting behavior. The implementation of FIN 45, "Guarantor's Accounting and Disclosure Requirements for Guarantees, Including Indirect Guarantees of Indebtedness of Others," offers a unique opportunity to examine the impact of the mandated disclosure of prior estimation errors on managers' and investors' behavior because some firms provide comparative estimation error disclosures during their initial adoption of FIN 45, which makes the analysis of pre- vs. post-FIN 45 estimation accuracy possible.

Many if not most consumer goods are sold subject to some kind of product warranty. As with many other accruals, manufacturers providing product warranties are required to accrue a warranty expense as well as a warranty liability when warranted products are sold. Although managerial judgment and discretion could have a significant impact on current and future warranty expenses, disclosures of product warranty obligations were voluntary until the issuance of FIN 45 in 2002. In FIN 45, the FASB requires companies to provide a tabular reconciliation of the changes in product warranty liabilities for the reporting period, including adjustments related to changes in estimated accruals related to pre-existing warranties, which is referred to as the correction to prior period estimation errors in product warranty liabilities included in current earnings in this paper.[5] Appendix A provides an example of the product warranty disclosures required by FIN 45.

Mandating the disclosure of prior estimation errors, however, does not necessarily curb managers' opportunistic reporting unless investors understand the implications of the mandated disclosures. In an experimental setting, Hirst et al. (2003) show that while reconciling prior-year estimates to actual realizations is effective in conveying information about the accuracy of prior estimates to information users, not all types of disclosure are equally effective. The most effective disclosures explicitly describe how estimation errors affect relevant balance sheet and income statement accounts in each of the previous years when estimation errors arose.

Unlike disclosures of claim loss reserves, FIN 45 disclosures about past estimation errors present only the total correction to past estimation errors that are included in current earnings but do not break down the estimation errors by the years from which the

[5] FIN 45 is effective for financial statements of interim or annual periods ending after December 15, 2002.

estimation errors arose.[6] Without knowing the exact timing these estimation errors took place, it is an empirical question whether the value relevance result of estimation errors from the property-casualty insurance industry pertains to the FIN 45 setting. Consequently, my first research question examines how effective FIN 45 estimation error disclosures communicate the information about past estimation accuracy to equity market investors. Specifically, I investigate whether investors incorporate the information about past estimation errors in their valuation of current earnings.

Anthony and Petroni (1997) adapt Holthausen and Verrecchia's (1988) single information release model and show that earnings response coefficients (*ERCs*) are inversely related to the variance of estimation errors in earnings. Given that the precision of previous estimates is indicative of the precision of current estimates, firms with more variable estimation errors in the past should have lower *ERCs*. Thus, my first hypothesis, stated in alternative form, is as follows:

H1: The market valuation of unexpected earnings is smaller for firms with more variable estimation errors in product warranty liabilities in the past.

Lundholm (1999) argues that the ability of investors to assess, on an ex post basis, the reliability of a company's financial reports would create an incentive for the company to report accurately on an ex ante basis. That is, if companies know that the accuracy and biases of their estimates will be evaluated and incorporated into equity valuation ex post, they will have a greater incentive to estimate more accurately and without bias ex ante. Although it is difficult for investors to distinguish ex post between honest and intentional misestimates, the need to explain to the boards and investors significant discrepancies between estimated and realized numbers will provide managers with strong disincentives to manipulate earnings in the first place. Based on the above discussion, I pose my second hypothesis, stated in alternative form, as follows:

H2: Managers are less likely to manipulate earnings through product warranty liabilities in the post-FIN 45 period.

3. RESEARCH DESIGN

To examine whether disclosures on past estimation errors in product warranty liabilities have valuation implications, I use the standard deviation of previous estimation errors as the ex post measure of the reporting precision for product warranty liabilities. I

[6] In other words, investors know the estimation errors that are corrected (reversed) in the current year but have no idea about the timing when these estimation errors arose.

estimate the following regression model using all firm-quarters with at least three previous estimation errors to compute the standard deviation of product warranty estimation errors:

$$\begin{aligned} RET_{i,t}^{j} = {} & \alpha_0 + \alpha_1 UE_{i,t} + \alpha_2 STDERRORS_{i,t} + \alpha_3 UE_{i,t} \times STDERRORS_{i,t} + \alpha_4 SIZE_{i,t} \\ & + \alpha_5 UE_{i,t} \times SIZE_{i,t} + \alpha_6 BM_{i,t} + \alpha_7 UE_{i,t} \times BM_{i,t} + \alpha_8 BETA_{i,t} + \alpha_9 UE_{i,t} \times BETA_{i,t} \\ & + \alpha_{10} LOSS_{i,t} + \alpha_{11} UE_{i,t} \times LOSS_{i,t} + \alpha_{12} Q4_{i,t} + \alpha_{13} UE_{i,t} \times Q4_{i,t} + QuarterDummies \\ & + YearDummies + IndustryDummies + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where i and t are firm and time indexes, respectively; and

RET ^{j} = Stock return, where the superscript *j* refers to either:

CAR: Size-adjusted cumulative abnormal return over a three-day window starting one day before and ending one day after the quarterly earnings announcement; or

BHRET: Buy-and-hold return over the three-month period ending one month after the quarter end minus the buy-and-hold return for a value-weighted market portfolio over the same period.

UE = Unexpected earnings measured in either one of the two ways:

SURPRISE: if the stock return is measured by *CAR*, *UE* is defined as actual quarterly earnings per share (*EPS*) minus the most recent analysts' forecast prior to the earnings announcement, scaled by the stock price at the beginning of the quarter; or

CHEPS: if the stock return is measured by *BHRET*, *UE* is current basic *EPS* before discontinued operations and extraordinary items and before the corrections to previous estimation errors in product warranty liabilities included in current *EPS* minus the same adjusted *EPS* measure four quarters ago, scaled by the stock price at the beginning of the current quarter. Per share earnings and price data are adjusted for stock splits and stock dividends.

STDERRORS = Standard deviation of scaled estimation errors, calculated using all estimation errors available up to quarter t-1, with a minimum of three prior estimation errors, where scaled estimation errors, denoted *ERRORS*, are defined as the correction for past estimation errors in product warranty liabilities included in current earnings, scaled by beginning total assets.

SIZE = Firm size, measured as the logarithm of the market value of equity at the beginning of the quarter.

BM = Book-to-market ratio, measured as the book value of total assets divided by the sum of the market value of equity and the book value of total liabilities, all measured at the beginning of the quarter. *BM* is used to control for the firm's growth opportunities.

BETA = Market beta, the nearest preceding beta to the beginning of the quarter defined per the *CRSP* decile assignment tape, where *CRSP* provides annual betas computed over all days on which the security was traded, beginning

with the first trading day and ending with the last trading day of the calendar year.

LOSS = Earnings loss, defined as an indicator variable equal to one if the *IBES* actual *EPS* is negative and equal to zero otherwise.

Q4 = Indicator variable taking on the value of one if the observation is from the fourth quarter of the fiscal year, and zero otherwise.

I estimate equation (1) using both a short-term event study and a long-term association study designs. For the short-term event study, I measure the stock return as the size-adjusted cumulative abnormal return over a three-day window starting one day before and ending one day after the quarterly earnings announcement and measure the unexpected earnings as the earnings surprise, defined as actual quarterly earnings per share (*EPS*) minus the most recent analysts' *EPS* forecast prior to the earnings announcement day, scaled by the stock price at the beginning of the quarter.[7] For the long-term association study, I calculate stock return as the buy-and-hold return over the three-month period ending one month after the quarter end minus the buy-and-hold return for a value-weighted market portfolio over the same period, and I measure *UE* as the current basic *EPS* before discontinued operations and extraordinary items and before the correction to previous warranty estimation errors included in current *EPS* minus the same adjusted *EPS* measure four quarters ago, scaled by the stock price at the beginning of the current quarter. Per share data are adjusted for stock splits and stock dividends.[8]

I expect $\alpha 1$ to be positive because the *ERC* literature demonstrates a positive association between unexpected earnings and abnormal stock returns. $\alpha 3$ is expected to be negative because Anthony and Petroni (1997) show that investors place a smaller weight on less precise earnings numbers. Based on a survey of prior literature on the determinants of the earnings-return relation (e.g., Kormendi and Lipe 1987; Collins and Kothari 1989; Hayn 1995), I control for size (*SIZE*), book-to-market ratio (*BM*), systematic risk (*BETA*),

[7] I do not exclude the correction to past warranty estimation errors included in current earnings from the calculation of the current earnings surprise because FIN 45 disclosures are not publicly available until the firm releases its 10-Q reports, which generally takes place weeks after the earnings announcement. Thus, investors have no knowledge of past estimation errors included in current earnings during the three-day earnings announcement window.

[8] The reason I use a 3-month as opposed to a 12-month window to measure the long-term stock return is because this paper deals with quarterly rather than annual data. The fact that there will be at least three more quarterly product warranty disclosures released before the end of the 12-month window could confound the effect of estimation errors in product warranty liabilities on the valuation multiple assigned by investors. Alternatively speaking, I want to make sure that the abnormal return is measured over the period when *STDERRORS* is the most updated product warranty information available to the market. One could argue for the use of a 12-month return accumulation window after controlling for any additional product warranty estimation errors released prior to the end of the 12-month period. However, since *STDERRORS* is calculated using all available estimation errors prior to the release of current period earnings, *STDERRORS* of adjacent quarters are highly correlated. Including *STDERRORS* of the current and subsequent three quarters along with a 12-month return accumulation window introduces multicollinearity.

and whether the firm reports a loss for the current quarter (*LOSS*) in equation (1). Since interim reports involve more accounting estimates and assumptions and are not audited, I include an indicator variable for the fourth quarter to allow for differential information precision between the interim and fourth quarter earnings (*Q4*).

To test whether FIN 45 mitigates earnings management through product warranty accruals, I examine the association between the misestimation of product warranty liabilities and proxies of earnings management. I use the sum of the estimation errors included in earnings of the subsequent four quarters to capture the misestimation of product warranty liabilities in the current period. The rationale is that when the firm under-reserves product warranty liabilities, the actual settlement of warranty obligations will force the firm to report additional product warranty expense in the future. Therefore, if the firm boosts earnings by underestimating product warranty liabilities, there should be a positive association between proxies of earnings management in the current period and estimation errors included in future earnings.[9]

The two types of earnings management I examine are: (1) whether the firm uses product warranty accruals to smooth earnings;[10] and (2) whether the firm uses product warranty accruals to manage earnings along with other discretionary accruals. In addition, I examine whether firms are less likely to manage earnings through product warranty accruals after they are required to disclose past estimation accuracy of product warranty liabilities after the issuance of FIN 45. Specifically, I estimate the following regression model:

$$\begin{aligned} LEADERRORS_{i,t} = {} & \beta_0 + \beta_1 EM^{k}_{i,t} + \beta_2 POST_{i,t} + \beta_3 EM_{i,t} \times POST_{i,t} \\ & + \beta_4 SIZE_{i,t} + \beta_5 BM_{i,t} + QuarterDummies \\ & + YearDummies + IndustryDummies + \varsigma_{i,t} \end{aligned} \tag{2}$$

Where

LEADERRORS = Sum of *ERROR* over the subsequent four quarters t+1…t+4, scaled by total assets, where *ERROR* is the correction for past estimation errors in product warranty liabilities included in current earnings.

EM^{k} = Proxies of earnings management, where the superscript *k* refers to either:

SHORTFALL: Pre-managed earnings shortfall relative to analysts' earnings expectations, measured as the most recent analysts' earnings forecast prior

[9] In Section 6, I use an alternative proxy for the misestimation of current product warranty liabilities and obtain inferentially similar results to those reported in my primary analyses.

[10] Consistent with Lee, Petroni and Shen (2006), I identify a firm as having the tendency to smooth earnings through product warranty accruals if its pre-managed earnings shortfall is positively associated with the extent of product warranty underestimation, which suggests that when the firm's pre-managed *EPS* falls short of (exceeds) analysts' *EPS* forecasts by a larger margin, the firm is likely to boost earnings by understating the product warranty liability to a greater (lesser) extent.

to the earnings announcement day minus pre-managed earnings. Pre-managed earnings are defined as the *IBES* actual *EPS* minus performance-matched discretionary accruals per share (*PDA*), where *PDA* is as defined below.[11] A positive (negative) *SHORTFALL* indicates that pre-managed earnings fall short of (exceed) analysts' forecasts; or

PDA: Performance-matched discretionary accruals per share, measured as the residual from the cross-sectional version of the modified Jones model estimated by year, quarter, and Fama-French 48 industry membership minus the median *PDA* of a portfolio matched on beginning-of-the-quarter return on assets (*ROA*) and the Fama-French 48 industry membership, where total accruals used in the modified Jones model are defined as income before extraordinary items minus cash flow from operating activities plus the change in product warranty liabilities.

POST = Indicator variable, set equal to one if the quarter ends in or after November 2002, the issuance month of FIN 45, and zero otherwise.

To test whether firms use product warranty accruals to smooth earnings, I examine the relation between the pre-managed earnings shortfall relative to analysts' earnings expectations and future product warranty estimation errors. For firms wishing to maintain a smooth income pattern, they are likely to report a lower (higher) than justifiable product warranty expense when earnings miss (beat) analysts' expectations. As a result, I expect a positive relation between pre-managed earnings shortfalls and current estimation errors included in future earnings because a larger earnings shortfall motivates firms to understate current product warranty expense, resulting in a larger estimation error which increases product warranty expense in the future. The association between the earnings shortfall and future estimation errors should become less positive after the implementation of FIN 45 if ex post disclosures of estimation errors curb income smoothing via product warranty accruals.

To investigate whether companies manage product warranty accruals along with other discretionary accruals, I investigate the association between *LEADERRORS* (a proxy for misestimations of current product warranty liabilities) and current discretionary accruals. Given that the product warranty accrual is one of the many accounting accruals that the firm can choose to misrepresent performance, the under-(over-) estimation of product warranty accruals could be used along with other income-decreasing (-increasing) discretionary accruals to manage earnings. Thus, I expect a positive relationship between *LEADERRORS* and *PDA*.[12] In addition, if FIN 45's disclosure requirement discourages

[11] I do not define pre-managed earnings as actual *EPS* minus estimation errors per share corrected and disclosed in subsequent periods because of the concern that subtracting the dependent variable from actual *EPS* (a component of the right-hand-side variable) will induce a mechanical *positive* association between LEADERRORS and *SHORTFALL* (because *SHORTFALL* is defined as the last analyst's *EPS* forecast -pre-managed *EPS*).

[12] Note that *PDA* and *LEADERRORS* could be correlated because they both are the results of the firm's overall financial (accrual) reporting strategy, suggesting that a simultaneous equations estimation approach might be necessary in this setting. As a practical matter, in order for *PDA* and *LEADERRORS* to be

opportunistic reporting through product warranty liabilities, the coefficient on *PDA×POST* should be negative.

4. SAMPLE AND UNIVARIATE ANALYESE

TABLE 1 summarizes the sample selection procedures. I obtain my sample by performing a keyword search in 10-K wizard.com using the terms "warranty" or "warrant*" to identify firm-quarters that accrued and disclosed product warranty liabilities. To ensure that the product warranty liability/expense is a material item on the sample firm's financial statements, I exclude firms whose product warranty liabilities were never greater than 1% of their non-debt liabilities during my sample period. From this sample, I hand-collect quarterly product warranty disclosures from 10-Q filings. My initial product warranty dataset starts with 2,380 firm-quarters (197 firms) that provide the estimation error disclosures for product warranty liabilities during 2002~2006.[13] I eliminate 348 firm-quarters that are not listed on *IBES*, 25 firm-quarters not listed on *CRSP*, 15 firm-quarters with missing beginning stock price, and 6 firm-quarters not listed on Compustat. The resulting sample is composed of 1,986 firm-quarter (177 firm) observations. The number of observations differs across empirical analyses depending upon additional control variables required by each model.

TABLE 1

Sample Selection

	No. of quarters
Firm-quarters providing disclosures of the estimation error in product warranty liability	2,380
Less: firm-quarters not listed on *IBES*	(348)
Less: firm-quarters not listed on *CRSP*	(25)
Less: firm-quarters missing beginning-of-the-quarter stock price	(15)
Less: firm-quarters not listed on Compustat	(6)
Sample firm-quarters	1,986

identified in the simultaneous equation system, I need at least one variable that is correlated with *PDA* (*LEADERRORS*) but is exogenous in the *LEADERRORS* (*PDA*) equation. However, virtually all variables affecting *PDA* (such as sales, size, growth potential, and firm performance) also affect current over/under-estimation of product warranty liabilities (i.e., *LEADERRORS*). Larcker and Rusticus (2010) and Francis, Lennox and Wang (2010) demonstrate that using instruments that are weakly associated with the endogenous variable in question or are not exogenous in the structural equation will result in more biased coefficient estimates than the ones generated by the *OLS* estimation. Therefore, while the simultaneous equations approach has theoretical merits, it is empirically difficult to implement in my setting.

[13] Because FIN 45 was issued in November 2002, I search all quarterly (10-Q) reports filed with the SEC in or after November 2002.

Panel A of TABLE 2 presents the descriptive statistics on product warranty data. On average, the beginning (ending) product warranty liability is 1.85% (1.84%) of total assets at the beginning of the quarter. The mean (median) product warranty provisions are close to the mean (median) settlements made under product warranty policies, with the mean product warranty provision (settlements) being 0.39% (0.38%) of the total assets at the beginning of the quarter. The average firm reports a correction to prior period estimation errors that increases the current product warranty expense by 0.01% of beginning total assets, suggesting that the average firm understates its product warranty expense (liability) in prior periods. On average, my sample firms accrue a product warranty liability that is about 8.5 times their quarterly payments/settlements made to honor product warranty policies. Alternatively stated, the product warranty accrued by the average firm is large enough to cover 2.125 years (=8.5/4) of warranty payments. The mean estimation errors that will be included in the financial statements over subsequent four quarters are 0.02% of the beginning total assets.

TABLE 2

Descriptive Statistics

Panel A: Descriptive Statistics on Components of Changes in Product Warranty Liability (1,986 firm-quarter observations)

Variable	Mean	Std Dev	25th Pctl	Median	75th Pctl
BEG_BL	0.0185	0.0178	0.0067	0.0117	0.0239
END_BL	0.0184	0.0179	0.0066	0.0114	0.0237
PROVISION	0.0039	0.0045	0.0009	0.0024	0.0053
SETTLEMENTS	0.0038	0.0045	0.0010	0.0024	0.0054
ERRORS	0.0001	0.0034	-0.0004	0.0000	0.0003
DURATION	8.5147	12.9622	8.3082	5.0000	3.4464
LEADERRORS	0.0002	0.0054	-0.0011	-0.0000	0.0010

BEG_BL: Beginning product warranty liability scaled by beginning total assets. *PROVISION*: Provision for product warranty expense for the current quarter scaled by beginning total assets. *SETTLEMENTS*: Settlements made in compliance with the firm's product warranty policies during the current period, scaled by beginning total assets. *ERRORS*: Correction to past estimation errors included in current earnings, scaled by beginning total assets. *END_BL*: Ending product warranty liability scaled by ending total assets. *DURATION*: Ending product warranty liability divided by settlements made during the current quarter. *LEADERRORS*: Sum of *ERROR* over the subsequent four quarters t+1…t+4, scaled by total assets, where *ERROR* is the correction for past estimation errors in product warranty liabilities included in current earnings.

Panel B of TABLE 2 reports the descriptive statistics on selected regression variables. The mean (median) three-day size-adjusted cumulative abnormal return is -0.05% (0.40%). The three-month abnormal buy-and-hold return is 1.91% (0.10%) for the mean (median) sample firm-quarter. The average (median) firm-quarter beats analysts' earnings forecast marginally by only 0.11 (0.06) cents and reports a change in *EPS* of -0.02% (0.08%). The standard deviation of past estimation errors included in current earnings is 0.12% (0.06%) for the average (median) firm. The mean and median values of market beta are both greater

than 1.00, suggesting that most of my sample firm-quarters have systematic risk that is greater than that of the market. About 24% of sample firm-quarters report a loss. The mean and median performance-matched discretionary accruals are both negative. Consistent with discretionary accrual results, the mean and median *DISC_PROV* are both negative, implying that the product warranty expense is understated for the mean (median) firm-quarter in my sample.

TABLE 2

Descriptive Statistics (Continued)

Panel B: Descriptive Statistics on Selected Regression Variables (1,986 firm-quarter observations)

Variable	Mean	Std Dev	25th Pctl	Median	75th Pctl
CAR	-0.0005	0.0912	-0.0471	0.0040	0.0504
BHRET	0.0191	0.2430	-0.1244	0.0010	0.1277
SURPRISE	0.0011	0.0116	-0.0002	0.0006	0.0027
CHEPS	-0.0002	0.0294	-0.0062	0.0008	0.0069
STDERRORS	0.0012	0.0017	0.0003	0.0006	0.0014
SIZE	7.1732	1.6842	5.8992	7.1184	8.3438
BM	0.6067	0.2327	0.4432	0.6065	0.7411
BETA	1.4404	0.6454	1.0000	1.3822	1.8359
LOSS	0.2382	0.4262	0.0000	0.0000	0.0000
SHORTFALL	0.3524	1.2607	-0.1395	0.1264	0.5200
PDA	-0.6949	9.1518	-1.1825	-0.0155	0.5075
SALES	0.2645	0.1371	0.1665	0.2452	0.3380
DISC_PROV	-0.0002	0.0032	-0.0017	-0.0006	0.0009

CAR: Size-adjusted cumulative abnormal return over a three-day window starting one day before and ending one day after the quarterly earnings announcement. *BHRET*: Buy-and-hold return over the three-month period ending one month after the quarter end minus the buy-and-hold return for a value-weighted market portfolio over the same period. *SURPRISE*: Actual quarterly earnings per share (*EPS*) minus the most recent analysts' forecast prior to the earnings announcement, scaled by the stock price at the beginning of the quarter. *CHEPS*: Current basic *EPS* before discontinued operations and extraordinary items excluding the corrections to previous estimation errors in product warranty liabilities included in current *EPS* minus the same adjusted *EPS* measure four quarters ago, and scaled by the stock price at the beginning of the current quarter. Per share earnings and price data are adjusted for stock splits and stock dividends. *STDERRORS*: Standard deviation of scaled estimation errors, calculated using all estimation errors available up to quarter t-1, with a minimum of three prior estimation errors, where scaled estimation errors are defined as the correction for past estimation errors included in current earnings scaled by beginning total assets. *SIZE*: Firm size, measured as the logarithm of the market value of equity at the beginning of the quarter. *BM*: Book-to-market ratio, measured as the book value of total assets divided by the sum of the market value of equity and the book value of total liabilities, all measured at the beginning of the quarter. *BETA*: Market beta, the nearest preceding beta to the beginning of the quarter defined per the *CRSP* decile assignment tape, where *CRSP* provides annual betas computed over all days on which the security was traded, beginning with the first trading day and ending with the last trading day of the calendar year. *LOSS*: Earnings loss, defined as an indicator variable equal to one if the *IBES* actual *EPS* is negative and equal to zero otherwise. *SHORTFALL*: Pre-managed earnings shortfall relative to analysts' earnings expectations, measured as the most recent analysts' earnings forecast prior to the earnings announcement minus pre-managed earnings. Pre-managed earnings are defined as the *IBES* actual *EPS* minus performance-matched discretionary accruals per share (*PDA*). *PDA*: Performance-matched discretionary accruals per share, measured as the residual from the cross-sectional version of the modified Jones model estimated by year, quarter, and Fama-French 48 industry membership minus the median *PDA* of a portfolio matched on beginning-of-the-quarter return on assets (*ROA*) and the Fama-French 48 industry membership, where total accruals used in the modified Jones model are defined as income before extraordinary items minus cash flow from operating activities plus the change in product warranty liabilities. *SALES*: Total sales scaled by beginning total assets. *DISC_PROV* is the residual from the following pooled regression and is used to proxy for the discretionary component of product warranty provision during the quarter:

$$PROVISION_{i,t} = \alpha_0 + \alpha_1 BEG\_BL_{i,t} + \alpha_2 SALES_{i,t} + \alpha_3 SETTLEMENTS_{i,t} + \alpha_4 DURATION_{i,t} + IndustryDummies + YearDummies + QuarterDummies + \varepsilon_{i,t}$$

TABLE 3 presents the correlation matrix on selected regression variables. The Pearson (Spearman) correlation coefficients are reported in the upper (lower) triangle. Consistent with prior literature, unexpected earnings are positively associated with *CAR*. The standard deviation of past estimation errors is negatively associated with firm size and *BM* and positively associated with *LOSS*, suggesting that smaller firms, firms with more growth opportunities, and firms reporting a loss tend to have less precise past estimation errors. *STDERRORS* is positively associated with beta, suggesting that the standard deviation of past estimation errors is correlated with the firm's systematic risk. The discretionary component of the product warranty expense is negatively associated with the correction to estimation errors included in earnings over the next four quarters, suggesting that firms accruing lower than model-predicted product warranty expense report higher corrections for estimation errors in future earnings.

5. EMPIRICAL FINDINGS

TABLE 4 reports the results from estimating equation (1). The dependent variables for models (1) and (2) are *CAR* and *BHRET*, respectively. Consistent with prior literature, the coefficient on *UE* is significantly positive, indicating that earnings surprise is priced by the market. Consistent with H1, the coefficient on *UE×STDERRORS* is significantly negative for both models (1) and (2), suggesting that investors place a smaller valuation multiple on firm-quarters with more volatile past estimation errors. The coefficients on control variables for the earnings-return relation are generally consistent with prior literature.

For completeness, I also include the correction to warranty estimation errors included in current earnings, scaled by beginning total assets, denoted *ERRORS*, and the interaction between *ERRORS* and *STDERRORS* in equation (1).[14] Untabulated results suggest that the coefficients on *UE* and *UE×STDERRORS* continue to be positive and negative, respectively, consistent with model (2) of TABLE 4. The coefficients on *ERRORS* and *ERRORS×STDERRORS* are significantly negative and positive, respectively, suggesting that the market views *ERRORS* as an income-decreasing item and places a negative weight on it. The weight on *ERRORS* becomes less negative when the firm has less precise estimations about past product warranty liabilities.

[14] I do not include *ERRORS* in model (1) of Table 4 because the correction for past estimation errors included in current earnings is disclosed in 10-Q reports published weeks after earnings announcements. Thus, *ERRORS* is not available to investors during the three-day earnings announcement window.

TABLE 3
Correlation Matrix on Selected Regression Variables

	CAR	*SURPRISE*	*STD_ERRORS*	*SIZE*	*BM*	*BETA*	*LOSS*	*PDA*	*SHORT_FALL*	*DISC_PROV*	*LEAD_ERROR*
CAR	1	**0.176**	-0.001	-0.009	-0.013	-0.039	*-0.068*	-0.044	-0.028	0.011	-0.029
SURPRISE	**0.339**	1	0.032	-0.001	**0.075**	-0.011	**-0.134**	-0.002	0.011	0.008	-0.017
STDERRORS	-0.039	0.027	1	**-0.275**	**-0.093**	*0.072*	**0.222**	-0.010	**-0.132**	**-0.191**	0.047
SIZE	0.007	0.036	**-0.323**	1	**-0.218**	0.002	**-0.341**	-0.035	**0.183**	-0.053	-0.046
BM	-0.001	**0.106**	**-0.137**	**-0.209**	1	**0.005**	**0.194**	-0.027	**0.169**	*-0.065*	*0.068*
BETA	-0.019	*0.077*	**0.092**	0.020	-0.008	1	**0.165**	-0.002	**-0.111**	**0.098**	**-0.070**
LOSS	**-0.085**	**-0.146**	**0.208**	**-0.353**	**0.167**	**0.160**	1	-0.015	*-0.097*	-0.020	*-0.087*
PDA	-0.034	0.004	-0.004	*-0.059*	-0.018	0.038	0.03589	1	0.027	*0.058*	0.056
SHORTFALL	-0.043	*-0.099*	**-0.170**	**0.152**	0.071	**-0.108**	**-0.171**	**0.114**	1	-0.058	0.045
DISC_PROV	0.008	0.034	**-0.121**	-0.053	-0.007	**0.161**	0.038	**0.096**	-0.052	1	**-0.083**
LEADERRORS	-0.014	-0.026	0.016	0.039	0.041	-0.039	**-0.143**	0.032	*0.008*	**-0.145**	1

All variables are as defined in Table 2. Pearson (Spearman) correlation coefficients are in the upper (lower) triangle. Bold, italic, and underlined numbers indicate significance at the 0.01, 0.05 and 0.10 levels or better, respectively.

TABLE 4

The Valuation Implication of Past Estimation Errors in Product Warranty Liabilities

Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Model	(1) Short Window (3-Day)	(2) Long Window (3-Month)
***UE* measure**	***SURPRISE***	***CHEPS***
Intercept	0.0556 ***	0.0273
	(2.71)	(0.4060)
UE	13.7594 ***	8.0872 **
	(7.63)	(2.46)
STDERRORS	-0.0028 ***	0.0029
	(-2.88)	(1.1330)
UE×STDERRORS	-0.3498 ***	-0.7684 **
	(-3.17)	(-2.12)
SIZE	-0.0028	-0.0138 ***
	(-1.41)	(-2.65)
UE×SIZE	-0.6870 ***	-0.1391 *
	(-4.71)	(1.96)
BM	-0.0123	0.1214 ***
	(-0.94)	(2.95)
UE×BM	-3.9398 ***	2.7699
	(-4.17)	(1.64)
BETA	-0.0055	0.0116
	(-1.16)	(0.95)
UE×BETA	1.1405 ***	0.1622 ***
	(3.23)	(0.05)
LOSS	0.0040	-0.0467 **
	(0.49)	(-2.14)
UE×LOSS	-4.9115 ***	-3.2314 *
	(-5.24)	(-1.83)
Q4	0.0196 **	0.0273
	(2.39)	(0.41)
UE×Q4	-1.9908 **	0.1232
	(-2. 50)	(0.12)
Quarter dummies	Yes	Yes
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
N	1,089	1,520
Adj. R^2	0.1385	0.0948

*,**,*** significant at the 0.10, 0.05, and 0.01 levels (two-tailed). Industry dummies are indicator variables, one for each 48 Fama-French industry. *UE*: Unexpected earnings measured in one of the following two ways:

(1) *SURPRISE*: If the stock return is measured by *CAR*, *UE* is defined as actual quarterly earnings per share (*EPS*) minus the most recent analysts' forecast prior to the earnings announcement, scaled by the stock price at the beginning of the quarter; or (2) *CHEPS*: If the stock return is measured by *BHRET*, *UE* is measured as the current basic *EPS* before discontinued operations and extraordinary items and before the correction for previous product warranty expense estimation errors included in current *EPS*, minus the same adjusted *EPS* measure four quarters ago, and scaled by the stock price at the beginning of the current quarter. Per share earnings and price data are adjusted for stock splits and stock dividends. *Q4*: Indicator variable taking the value of one if the observation is from the fourth quarter of the fiscal year, and zero otherwise. All other variables are as defined in TABLE 2. Standard errors are calculated based on Petersen's double cluster procedure (Petersen 2009) to allow inter-correlations of residuals across firms or across time. Coefficients on quarter, year, and industry dummies are suppressed for expositional convenience.

Collins and Kothari (1989), among others, suggest that *ERCs* are negatively related to the riskiness of equity. While I have controlled for beta, which is a common proxy used to measure systematic equity risk, in equation (1), it is possible that *STDERRORS* reflects some risk factors other than systematic risk that affect the valuation multiple assigned to unexpected earnings. For example, Dhaliwal and Reynolds (1994) argue that the default risk of debt also captures elements of the riskiness of equity and find that *ERCs* are decreasing in default risk. In addition, estimation errors likely will be greater for firms with more volatile operating environments since managers do not have good information to predict what will happen in the near future. To address potential correlated omitted variable bias, I control for three other risk factors: (1) idiosyncratic risk of the equity, denoted *IDRISK*, measured as the standard deviation of the residual from a rolling 36-month market model regression; (2) operating risk, denoted as *STDROA*, measured as the standard deviation of the firm's return on assets (*ROA*) calculated over the past 20 quarters, where *ROA* is measured as income before extraordinary items and before product warranty expense, scaled by lagged total assets; and (3) Altman's Z score (Altman 1968), denoted Z. Following Ashbaugh-Skaife, Collins and Kinney (2007) and Klein and Zur (2009), Z is measured as:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

where X_1 = working capital/total assets,
X_2 = retained earnings/total assets,
X_3 = earnings before interest and taxes/total assets,
X_4 = market value of equity/book value of total liabilities,
X_5 = sales/total assets, and

Altman's Z score (Altman 1968) is used to capture the firm's default risk. A lower Z score indicates poorer debt service ability and thus a higher risk of default. I augment equation (1) by including *IDRISK*, *STDROA*, *Z*, and the interactions between these additional risk factors and *UE* as follows:

$$\begin{aligned} RET_{i,t}^{j} = {} & \alpha_0 + \alpha_1 UE_{i,t} + \alpha_2 STDERRORS_{i,t} + \alpha_3 UE_{i,t} \times STDERRORS_{i,t} \\ & + \alpha_4 SIZE_{i,t} + \alpha_5 UE_{i,t} \times SIZE_{i,t} + \alpha_6 BM_{i,t} + \alpha_7 UE_{i,t} \times BM_{i,t} \\ & + \alpha_8 BETA_{i,t} + \alpha_9 UE_{i,t} \times BETA_{i,t} + \alpha_{10} LOSS_{i,t} + \alpha_{11} UE_{i,t} \times LOSS_{i,t} \\ & + \alpha_{12} Q4_{i,t} + \alpha_{13} UE_{i,t} \times Q4_{i,t} + \alpha_{14} IDRISK_{i,t} + \alpha_{15} UE_{i,t} \times IDRISK_{i,t} \\ & + \alpha_{16} STDROA_{i,t} + \alpha_{17} UE_{i,t} \times STDROA_{i,t} + \alpha_{18} Z_{i,t} + \alpha_{19} UE_{i,t} \times Z_{i,t} \\ & + QuarterDummies + YearDummies + IndustryDummies + \varepsilon_{i,t} \end{aligned} \quad (1a)$$

Results from estimating equation (1a) are reported in Panel A of TABLE 5. The coefficients on *UE* and *UE×STDERRORS* remain significant in the predicted directions in both short- and long-window market pricing tests, inconsistent with the conjecture that the differential valuation multiples for high and low *STDERRORS* firms are driven by the firm's operating risk or default risk.

TABLE 5

The Valuation Implication of Past Estimation Errors in Product Warranty Liabilities

Panel A: Value Relevance of the Standard Deviation of Past Estimation Errors, Controlling for Risk Factors

Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Model	(1) Short Window (3-Day)	(2) Long Window (3-Month)
***UE* measure**	***SURPRISE***	***CHEPS***
Intercept	-0.0659 **	0.0089
	(-2.15)	(0.10)
UE	11.7311 ***	7.185 **
	(5.33)	(2.27)
STDERRORS	-0.0024 **	0.0035
	(-2.33)	(1.28)
UE×STDERRORS	-0.3382 ***	-0.1825 *
	(-2.81)	(-1.84)
SIZE	-0.0056	-0.0144 **
	(-1.48)	(-2.54)
UE×SIZE	-0.6712 ***	-0.1273 **
	(-4.15)	(-2.06)
BM	-0.0176	0.1121 ***
	(-1.34)	(2.74)
UE×BM	-3.5175 ***	1.7362
	(-3.50)	(1.07)
BETA	-0.0012	0.0107
	(-0.23)	(0.78)
UE×BETA	1.1285 ***	0.0709 **
	(3.50)	(2.15)
LOSS	0.0103	-0.0378 *
	(1.20)	(-1.68)
UE×LOSS	-4.9425 ***	-3.9786 **
	(-4.62)	(-2.40)
Q4	0.0204 **	0.0115
	(2.48)	(0.70)
UE×Q4	-1.5353 *	-0.5695
	(-1.67)	(-0.56)
IDRISK	-0.0201 **	-0.0113
	(-2.24)	(-0.49)
UE×IDRISK	-0.9289	-1.5804
	(-1.38)	(-1.23)
STDROA	-0.0580	0.0004
	(-0.66)	(0.0)
UE×STDROA	-1.0523	2.6690 *
	(-0.17)	(1.73)

TABLE 5

The Valuation Implication of Past Estimation Errors in Product Warranty Liabilities (Continued)

Panel A: Value Relevance of the Standard Deviation of Past Estimation Errors, Controlling for Risk Factors

Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Model	(1) Short Window (3-Day)	(2) Long Window (3-Month)
***UE* measure**	***SURPRISE***	***CHEPS***
Z	0.0000	0.0000
	(0.58)	(1.01)
UE×Z	0.0015	-0.0012
	(1.33)	(-0.63)
Quarter dummies	Yes	Yes
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
N	1,082	1,513
Adj. R^2	0.1471	0.1131

*,**,*** significant at the 0.10, 0.05, and 0.01 levels (two-tailed). Industry dummies are indicator variables, one for each 48 Fama-French industry. (1) *IDRISK*: Idiosyncratic risk of the firm, measured as the standard deviation of the residual from a rolling 36-month market model regression; (2) *STDROA*: Operating risk, measured as the standard deviation of the firm's return on assets (*ROA*) calculated over the past 20 quarters, where *ROA* is measured as income before extraordinary items before product warranty expense scaled by lagged total assets; (3) *Z*: Altman's Z score (Altman 1968), calculated as: $Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$, where X_1 = working capital/total assets; X_2 = retained earnings/total assets; X_3 = earnings before interest and taxes/total assets; X_4 = market value of equity/book value of total liabilities; X_5 = sales/total assets.

All other variables are as defined in TABLE 2. Standard errors are calculated based on Petersen's double cluster procedure (Petersen 2009) to allow inter-correlations of residuals across firms or across time. Coefficients on quarter, year and industry dummies are suppressed for expositional convenience.

To provide further evidence that the significant coefficient on *UE×STDERRORS* is associated with the FIN 45 disclosure requirement but not with other omitted firm characteristics, I next investigate whether *ERCs* for firms with higher *STDERRORS* are significantly smaller than those with lower *STDERRORS* before *STDERRORS* (FIN 45 disclosures) became available to investors. If *STDERRORS* captures unmodelled firm characteristics but not the precision of past accrual estimates, one would expect *UE×STDERRORS* to be negative even in the pre-FIN 45 period when information about *STDERRORS* was not publicly disclosed. To do so, I create a dummy variable $HIGHSTD_{first}$, coded one (zero) if the firm's first available *STDERRORS*, denoted $STDERRORS_{first}$, is higher (lower) than the sample median *STDERRORS*. I estimate the following equation:

$$\begin{aligned} RET_{i,t}^{j} = {} & \alpha_0 + \alpha_1 UE_{i,t} + \alpha_2 HIGHSTD_{fist_{i,t}} + \alpha_3 UE_{i,t} \times HIGHSTD_{first_{i,t}} \\ & + \alpha_4 POST_{volatility_{i,t}} + \alpha_5 UE_{i,t} \times POST_{volatility_{i,t}} + \alpha_6 POST_{volatility_{i,t}} \times HIGHSTD_{first_{i,t}} \\ & + \alpha_7 UE_{i,t} \times POST_{volatility_{i,t}} \times HIGHSTD_{first_{i,t}} + \alpha_8 SIZE_{i,t} + \alpha_9 UE_{i,t} \times SIZE_{i,t} \\ & + \alpha_{10} BM_{i,t} + \alpha_{11} UE_{i,t} \times BM_{i,t} + \alpha_{12} BETA_{i,t} + \alpha_{13} UE_{i,t} \times BETA_{i,t} + \alpha_{14} LOSS_{i,t} \\ & + \alpha_{15} UE_{i,t} \times LOSS_{i,t} + \alpha_{16} Q4_{i,t} + \alpha_{17} UE_{i,t} \times Q4_{i,t} + QuarterDummies \\ & + YearDummies + IndustryDummies + \varepsilon_{i,t} \end{aligned} \quad (1b)$$

where

$POST_{volatility}$ = Indicator variable taking the value of one if the firm-quarter has at least three prior estimation errors used to estimate *STDERRORS*, and zero otherwise.

$HIGHSTD_{first}$ = Indicator variable coded one (zero) if the firm's first available *STDERRORS*, denoted $STDERRORS_{first}$, is higher (lower) than the sample median *STDERRORS*.[15]

The coefficient on $UE \times POST_{volatility} \times HIGHSTD_{first}$ ($UE \times HIGHSTD_{first}$) indicates the difference in *ERCs* between high and low $STDERRORS_{first}$ firms when investors have (do not have) sufficient prior estimation errors to determine the reporting precision of product warranty accruals. Panel B of TABLE 5 reports the regression results of equation (1b). The coefficient on $UE \times HIGHSTD_{first}$ is not significant at conventional levels, suggesting that equity market participants do not respond differently to unexpected earnings for firms with high and low $STDERRORS_{first}$ in the pre-FIN 45 period. This result holds for both the short- and long-window market pricing tests. The coefficient on $UE \times POST_{volatility} \times HIGHSTD_{first}$ is significantly negative, suggesting that investors place a smaller weight on unexpected earnings for firms with high $STDERRORS_{first}$ only after investors have enough information to determine the reporting precision of product warranty liabilities. This finding lends further support that FIN 45 disclosures convey decision-relevant information used in equity valuation decisions.[16]

TABLE 6 reports the results for earnings management tests. I use the correction for estimation errors in product warranty liabilities included in subsequent four quarters' earnings as the proxy for the misestimation of current product warranty liabilities. Thus, a positive *LEADERRORS* suggests an understatement in the current product warranty expense (liability). The coefficient on *SHORTFALL* is positive, suggesting that firms with greater earnings shortfall relative to analysts' earnings expectations tend to understate current product warranty expense to a greater extent in the pre-FIN 45 period. However, this positive association weakens in the post-FIN 45 period, as evidenced by the negative coefficient on $SHORTFALL \times POST$. The sum of *SHORTFALL* and $SHORTFALL \times POST$ is significantly positive, suggesting that while the FIN 45 disclosure requirement discourages earnings management through the product warranty expense (accrual), it does not completely eliminate opportunistic reporting through this accrual.

[15] I include $STDERROR_{first}$ rather than *STDERROR* in equation (1b) because *STDERRROR* is unavailable for pre-FIN45 firm-quarters. Therefore, I use the first available *STDERROR* ($STDERROR_{first}$) to classify firm-quarters (including those in the pre-FIN 45 period) into high and low estimation error volatility groups. Using the last available *STDERROR* in lieu of $STDERROR_{first}$ yields similar results.

[16] The number of observations in Panel B of TABLE 5 is greater than that in TABLE 4 because TABLE 4 includes only those observations with *ERRORS* information (i.e., from the post-FIN 45 period). TABLE 5, however, includes observations from both the pre- and post-FIN 45 periods. I obtain qualitatively similar results if I replace *STDERRORS* with $STDERRORS_{first}$ only for the pre-FIN 45 observations but leave *STDERRORS* unchanged for the post-FIN 45 observations.

TABLE 5
The Valuation Implication of Past Estimation Errors in Product Warranty Liabilities Before and After FIN 45 (Continued)

Panel B: Value Relevance of the Standard Deviation of Past Estimation Errors, Conditioning on the Availability of *STDERRORS*

Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Model	(1) Short Window (3-Day)	(2) Long Window (3-Month)
***UE* measure**	***SURPRISE***	***CHEPS***
Intercept	0.0373	-0.1050
	(0.9835)	(-0.7819)
UE	6.3409 ***	3.5631 **
	(5.21)	(2.28)
$HIGHSTD_{first}$	-0.0032	0.0032
	(-0.8339)	(1.4530)
$UE \times HIGHSTD_{first}$	1.0865	0.7669
	(1.64)	(1.47)
$POST_{volatility}$	0.0088 *	0.0493 *
	(1.91)	(1.75)
$UE \times POST_{volatility}$	1.9328	1.1910
	(0.76)	(0.91)
$POST_{volatility} \times HIGHSTD_{first}$	0.0004	-0.5338 **
	(0.11)	(-2.07)
$UE \times POST_{volatility} \times HIGHSTD_{first}$	-1.0230 ***	-0.7466 *
	(-2.95)	(-1.82)
SIZE	-0.0008	-0.0154 ***
	(-0.53)	(-3.77)
UE×*SIZE*	-0.4229 ***	-0.2499 *
	(-3.75)	(-1.93)
BM	0.0046	0.1581 ***
	(0.44)	(5.71)
UE×*BM*	-2.4910 ***	2.6945 ***
	(-4.04)	(2.70)
BETA	-0.0041	0.0273 ***
	(-1.10)	(2.78)
UE×*BETA*	0.4784 **	0.2178
	(2.09)	(0.86)
LOSS	0.0033	-0.0334 **
	(0.58)	(-1.98)
UE×*LOSS*	-3.2596 ***	-3.9902 ***
	(-5.81)	(-4.0727)
Q4	0.0135 **	0.0244 *
	(2.15)	(1.65)
UE ×*Q4*	-0.7091	-0.2265
	(-1.45)	(-0.43)
Quarter dummies	Yes	Yes
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
N	1,819	2,015
Adj. R^2	0.1088	0.1244

*,**,*** significant at the 0.10, 0.05, and 0.01 levels (two-tailed). Industry dummies are indicator variables, one for each 48 Fama-French industry. $POST_{volatility}$: Indicator variable taking the value of one if the firm-quarter has at least three prior estimation errors for estimating *STDERRORS*, and zero otherwise. $HIGHSTD_{first}$: Dummy variable coded one (zero) if the firm's first available *STDERRORS* is higher (lower) than the sample median *STDERRORS*, where *STDERRORS* is the standard deviation of all scaled estimation errors available up to quarter t-1, with a minimum of three prior estimation errors. Estimation errors are scaled by total assets at the beginning of the quarter. All other variables are as defined in Table 2. Standard errors are calculated based on Petersen's double cluster procedure (Petersen 2009) to allow inter-correlations of residuals across firms or across time. Coefficients on quarter, year, and industry dummies are suppressed for expositional convenience.

TABLE 6

Earnings Management through Product Warranty Accruals Before and After FIN 45

Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Model	(1)	(2)
***EM* measure**	***SHORTFALL***	***PDA***
Intercept	-0.0493	-0.0014
	(0.63)	(-7.88)
EM	0.0304 ***	0.0131 ***
	(3.78)	(6.16)
POST	0.0430	0.0002
	(1.32)	(0.83)
EM×*POST*	-0.0219 **	-0.0127 **
	(-2.55)	(-2.68)
SIZE	-0.0034 *	-0.0001 **
	(-1.65)	(-1.97)
BM	-0.0475	-0.0039
	(-0.86)	(-0.72)
p-value for H_0: $\beta_1+\beta_3=0$	0.071	0.094
Quarter dummies	Yes	Yes
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
N	272	312
Adj. R^2	0.0629	0.0872

*,**,*** significant at the 0.10, 0.05, and 0.01 levels (two-tailed). Industry dummies are indicator variables, one for each 48 Fama-French industry. *LEADERRORS*: Sum of *ERROR* over the subsequent four quarters t+1…t+4, scaled by total assets, where *ERROR* is the correction for past estimation errors in product warranty liabilities included in current earnings. *EM*: Proxies of earnings management, measured in one of the following two ways: (1) *SHORTFALL*: Pre-managed earnings shortfall relative to analysts' earnings expectations, measured as the most recent analysts' earnings forecast prior to the earnings announcement minus pre-managed earnings. Pre-managed earnings are defined as the *IBES* actual EPS minus discretionary accruals per share, where discretionary accruals are obtained from the modified Jones model. A positive (negative) *SHORTFALL* indicates that pre-managed earnings fall short of (exceed) analysts' forecasts; or (2) *PDA*: Performance-matched discretionary accruals excluding product warranty accruals, measured as the residual from the cross-sectional version of the modified Jones model estimated by year, quarter, and Fama-French 48 industry membership minus the median *PDA* of a portfolio matched on beginning-of-the-quarter return on assets (*ROA*) and the Fama-French 48 industry membership, where total accruals used in the modified Jones model are defined as income before extraordinary items minus cash flow from operating activities plus the change in product warranty liabilities. *POST*: Indicator variable, set equal to one if the quarter ends in or after November 2002, the issuance month of FIN 45, and zero otherwise. All other variables are as defined in TABLE 2. Standard errors are calculated based on Petersen's double cluster procedure (Petersen 2009) to allow inter-correlations of residuals across firms or across time. Coefficients on quarter, year, and industry dummies are suppressed for expositional convenience.

Model (2) evaluates the association between the magnitude of estimation errors included in subsequent four quarterly earnings and the level of performance-matched discretionary accruals in the current period. The results from model (2) are inferentially similar to those reported in model (1). The coefficient on *PDA* is significantly positive, suggesting that firms that understate current product warranty expense (liability) also have more income-increasing accruals. The positive association between *PDA* and *LEADERRORS* is less pronounced in the post-FIN 45 period, consistent with FIN 45 curbing earnings management through the product warranty expense (liability). The sum of

PDA and *PDA×POST* is significantly positive, suggesting that FIN 45 disclosures mitigate but do not completely stop earnings management through product warranty liabilities.

6. ADDITIONAL ANALYSES

In my primary analyses, I use one-year ahead realized estimation errors, *LEADERRORS*, to proxy for the misestimation of product warranty expense/liability for the current period. However, if the warranty period lasts longer than one year, *LEADERRORS* will measure the magnitude of current misestimations with error. As an alternative way to measure the degree of over- or under-statement in current warranty liabilities, I estimate the discretionary component of the product warranty expense (provision) as the residual from the pooled time series and cross-section regression model as follows:

$$\begin{aligned} PROVISION_{i,t} = {} & \alpha_0 + \alpha_1 BEG\_BL_{i,t} + \alpha_2 SALES_{i,t} + \alpha_3 SETTLEMENTS_{i,t} \\ & + \alpha_4 DURATION_{i,t} + IndustryDummies + YearDummies \\ & + QuarterDummies + \varepsilon_{i,t} \end{aligned} \quad (3)$$

where *PROVISION* is the product warranty provision for the current period scaled by beginning total assets and *BEG_BL* is the beginning balance of product warranty liability scaled by beginning total assets. I include *BEG_BL* to capture the importance of the firm's obligation under product warranty policies. I expect α1 to be positive, suggesting that firms having more product warranty obligations in the past will accrue a higher level of product warranty expense in the current period. *SALES* is current sales scaled by beginning total assets. I use total sales to proxy for sales from warranted products because companies do not separately disclose sales from warranted and unwarranted products. The coefficient on *SALES* is expected to be positive, indicating that firms selling more warranted products record a larger product warranty provision. *SETTLEMENTS* is the payments made to settle warranty claims during the period, scaled by beginning total assets. If a firm's warranty claims follow a random walk, a higher value of *SETTLEMENTS* indicates that more product warranty provision is needed, suggesting a positive coefficient on *SETTLEMENTS*. *DURATION* is intended to measure the number of quarters the company's ending warrant liabilities (reserves) can cover warranty payments without accruing additional provisions, and is calculated as the ending balance of product warranty liabilities divided by the settlements made during the quarter. *DURATION* can be thought of as a proxy for the period covered by warranty policies. The longer the warranty period is, the more product warranty reserves managers should set aside, which indicates a positive coefficient on *DURATION*.

Panel A of TABLE 7 displays the results from estimating the *PROVISION* model (equation (3)). All of the predictors are significant in the expected directions. The adjusted R-squared is 0.60, suggesting that the *PROVISION* model exhibits reasonable explanatory power. The discretionary component of product warranty provision, denoted *DISC_PROV*, is the residual from equation (3) and is used as a proxy for the current misstatement of the product warranty liabilities. To test whether discretionary product warranty accruals are used as an accrual management tool, I estimate the following equation:

$$\begin{aligned} DISC\_PROV_{i,t} = {} & \delta_0 + \delta_1 EM_{i,t} + \delta_2 POST_{i,t} + \delta_3 EM_{i,t} \times POST_{i,t} \\ & + \delta_4 SIZE_{i,t} + \delta_5 BM_{i,t} + QuarterDummies \\ & + YearDummies + IndustryDummies + \xi_{i,t} \end{aligned} \quad (4)$$

TABLE 7

Earnings Management through Product Warranty Accruals Before and After FIN 45: Alternative Measure of Misestimations of Product Warranty Liabilities

Panel A: Results from Estimating the Product Warranty Model

	Coefficient	t-statistic
Intercept	0.0021 **	2.04
BEG_BL	0.1611 ***	44.23
SALES	0.0101 ***	20.30
SETTLEMENTS	0.0001 **	2.08
DURATION	0.0078 ***	14.44
Industry Dummies	Yes	
Year Dummies	Yes	
Quarter Dummies	Yes	
N	2,374	
Adj. R^2	0.6018	

Standard errors are calculated based on Petersen's double cluster procedure (Petersen 2009) to allow inter-correlations of residuals across firms or across time. *,**,*** significant at the 0.10, 0.05, and 0.01 levels (two-tailed). Industry dummies are indicator variables, one for each 48 Fama-French industry. Coefficients on quarter, year, and industry dummies are suppressed for expositional convenience. All variables are as defined in TABLE 2.

I expect δ1 to be negative because firms are more likely to understate product warranty expenses (i.e., negative *DISC_PROV*) in cases when accrual management is more likely to happen. Higher values of *PDA* and *SHORTFALL* suggest a higher probability of accrual management occurring, implying a negative association between *DISC_PROV* and each of the two earnings management proxies.

Panel B of TABLE 7 presents the regression results of equation (4). As expected, the coefficients on *SHORTFALL* and *PDA* are significantly negative at conventional levels, suggesting that firms missing analysts' earnings expectations by a larger margin or firms reporting a higher value of discretionary accruals tend to record lower than expected product warranty provision. This result is consistent with the notion that firms under-reserve product warranty liabilities more when the pre-managed earnings fall below

analysts' earnings expectations to a greater extent or when firms report more income-increasing accruals. The relation between *EM* and *DISC_PROV* is less negative in the post-FIN 45 period, consistent with FIN 45 mitigating earnings management through product warranty liabilities. However, the sum of *SHORTFALL* and *SHORTFALL×POST* (*PDA* and *PDA×POST*) remains significantly negative, suggesting that FIN 45 deters but does not stop earnings management through product warrant accruals in the post-FIN 45 period.

TABLE 7

Earnings Management through Product Warranty Accruals Before and After FIN 45: Alternative Measure of Misestimations of Product Warranty Liabilities (Continued)

Panel B: The Association between DISC_PROV and Proxies of Accrual Management Before and After FIN 45

Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Model	(1)	(2)
***EM* measure**	***SHORTFALL***	***PDA***
Intercept	-0.0018 **	-0.0017 **
	(-1.86)	(-2.08)
EM	-0.0004 ***	-0.0003 ***
	(-3.82)	(-4.05)
POST	0.0008 *	0.0007 **
	(1.73)	(2.04)
EM×POST	0.0003 **	0.0002 ***
	(2.06)	(3.78)
SIZE	-0.0002 **	-0.0000
	(-1.99)	(-1.01)
BM	0.0005	-0.0003
	(0.70)	(0.78)
p-value for H_0: $\delta_1+\delta_3=0$	0.077	0.083
Quarter dummies	Yes	Yes
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
N	1,115	1,145
Adj. R^2	0.0522	0.0352

Standard errors are calculated based on Petersen's double cluster procedure (Petersen 2009) to allow inter-correlations of residuals across firms or across time. *,**,*** significant at the 0.10, 0.05, and 0.01 levels (two-tailed). *POST*: Indicator variable, set equal to one if the quarter ends in or after November 2002, the issuance month of FIN 45, and zero otherwise. All other variables are as defined in TABLE 2. Industry dummies are indicator variables, one for each 48 Fama-French industry. Coefficients on quarter, year, and industry dummies are suppressed for expositional convenience.

Finally, while the results in TABLE 4 and 5 are consistent with investors placing a smaller valuation multiple on firms with less precise warranty liability estimates, it is possible that the large standard deviation of estimation errors is caused by unanticipated product quality problems, resulting in higher than expected product warranty claims and therefore a more positive estimation error (a larger product warranty expense). Since severe product quality deficiencies affect a firm's future growth potential, investors might

place a lower valuation multiple on firm-quarters with poorer future outlook (Collins and Kothari 1989).[17] Alternatively stated, the unfavorable effect of *STDERRORS* could be driven by bleak future prospects rather than imprecise past warranty estimation.

To explore this possibility, I introduce the total *ERRORS* summed over the estimation period of *STDERRORS*, denoted *LAGERRORS*, and the interaction between *UE* and *LAGERRORS* into equation (1a). If *STDERRORS* simply captures unforeseen product quality problems, one would expect that the coefficient on *UE×STDERRORS* becomes insignificant once *UE×LAGERRORS* is controlled for. Moreover, *ERCs* for firms with more positive estimation errors (i.e., higher unexpected product warranty claims) are expected to be smaller. TABLE 8 reports the results of this supplemental analysis. The coefficient on *UE×LAGERRORS* is not significantly different from zero and the coefficient on *UE×STDERRORS* remains significant at conventional levels in either the three-day or the three-month abnormal stock return model, suggesting that unexpected product warranty claims do not explain the unfavorable effect of *STDERRORS* on the firm's earnings-return relation.[18]

7. CONCLUDING REMARKS

In this paper, I examine whether the mandated disclosures of past estimation errors in product warranty liabilities affect investors' valuation as well as managers' accrual reporting decision. This investigation is motivated by the intensified debate over the trade-off between relevance and reliability of accounting information. To embrace the fair value accounting model, both U.S. GAAP and IFRS have recently introduced substantial accounting estimates into the financial reporting system. While accounting estimates might improve the relevance of accounting information, the discretion exercised over these estimates might render accounting amounts unreliable if managers intentionally distort them. To date, there is little evidence regarding the accuracy of the estimates underlying accounting accruals.

In this paper, I test a reporting mechanism proposed by several researchers, whereby relevant information can be made more reliable by requiring companies to provide a reconciliation of prior-period estimates to subsequent realizations. Lundholm (1999) argues that such a mechanism creates an incentive for management to make the estimates more accurate ex ante because investors will ex post evaluate the accuracy of accounting estimates and punish opportunistic estimators accordingly.

[17] I thank an anonymous reviewer for pointing out this alternative explanation for my TABLE 4 results.

[18] As a sensitivity analysis, I compute two other versions of *LAGERRORS*: (1) the sum of *ERRORS* over the immediate past four quarters; (2) *ERRORS* for the most recent quarter. I obtain virtually identical results as those reported in TABLE 8 regardless of which version of *LAGERRORS* is used in the regression.

Using the quarterly disclosures of past estimation errors in product warranty liabilities from 1,986 firm-quarters (177 firms), I find evidence consistent with investors finding the estimation error data decision-revenant, as evidenced by the smaller valuation multiple investors place on unexpected earnings of firms with more variable past estimation errors (implying less precise earnings numbers). Moreover, I find that the differential valuation multiples between firms with more and less variable past estimation errors are observed only after investors have sufficient FIN 45 disclosures to form their beliefs about warranty estimation precision, providing evidence that the differential valuation multiples are due to differential information precision rather than some unmodelled omitted firm characteristics. Furthermore, I find that managers appear to manage earnings through product warranty accruals in both the pre- and post-FIN 45 periods and the implementation of FIN 45 inhibits but does not completely forestall opportunistic reporting through product warranty accruals.

TABLE 8

The Valuation Implication of Past Estimation Errors in Product Warranty Liabilities

Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Model	(1) Short Window (3-Day)	(2) Long Window (3-Month)
***UE* measure**	***SURPRISE***	***CHEPS***
Intercept	0.0042 **	-0.1242
	(0.08)	(-0.82)
UE	11.5474 ***	0.6946 **
	(4.97)	(4.75)
STDERRORS	-0.0023 **	0.0033
	(-2.02)	(3.09)
UE×STDERRORS	-0.3301 ***	-0.0614 *
	(-4.31)	(-1.73)
LAGERRORS	-0.0306	-0.3496
	(-0.34)	(-1.32)
UE×LAGERRORS	-4.3005	22.5789
	(-0.54)	(0.95)
SIZE	-0.0054 ***	-0.0142 ***
	(-4.01)	(-3.96)
UE×SIZE	-0.6295 ***	-0.0365 **
	(-7.3)	(-2.17)
BM	-0.0213	0.1187 ***
	(-1.91)	(2.22)
UE×BM	-3.4972 *	1.6711
	(-1.67)	(1.57)
BETA	0.0004	0.0105
	(0.1)	(0.59)
UE×BETA	1.0679 ***	-0.0889 **
	(7.86)	(-0.36)
LOSS	-0.0121 *	-0.0344 *
	(-1.67)	(-1.9)
UE×LOSS	-4.7403 ***	-3.9299 **
	(-11.34)	(-2.54)

TABLE 8
The Valuation Implication of Past Estimation Errors in Product Warranty Liabilities (Continued)

Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Model	(1) Short Window (3-Day)	(2) Long Window (3-Month)
***UE* measure**	***SURPRISE***	***CHEPS***
Q4	0.0199 **	0.0231
	(4.23)	(0.72)
UE×Q4	-1.3900 **	-0.6566
	(-2.27)	(-1.15)
IDRISK	-0.0230 ***	-0.0092
	(-3.26)	(-0.27)
UE×IDRISK	-0.8124 **	-1.6889
	(-2.44)	(-1.38)
STDROA	-0.0616	-0.0390
	(-0.68)	(-0.12)
UE×STDROA	-2.5630	32.0056 *
	(-0.25)	(1.95)
Z	-0.0053	0.0232
	(-0.63)	(1.04)
UE×Z	0.0015	-0.0016
	(1.23)	(-0.82)
Quarter dummies	Yes	Yes
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
N	1,082	1,513
Adj. R^2	0.1003	0.0871

*,**,*** significant at the 0.10, 0.05, and 0.01 levels (two-tailed). Industry dummies are indicator variables, one for each 48 Fama-French industry. *LAGERRORS*: Sum of *ERRORS* over the same period *STDERRORS* is estimated. *IDRISK*: Idiosyncratic risk of the firm, measured as the standard deviation of the residual from a rolling 36-month market model regression. *STDROA*: Operating risk, measured as the standard deviation of the firm's return on assets (*ROA*) calculated over the past 20 quarters, where *ROA* is measured as income before extraordinary items before product warranty expense scaled by lagged total assets. *Z*: Altman's Z score (Altman 1968), calculated as: $Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$, where X_1 = working capital/total assets; X_2 = retained earnings/total assets; X_3 = earnings before interest and taxes/total assets; X_4 = market value of equity/book value of total liabilities; X_5 = sales/total assets. All other variables are as defined in TABLE 2. Standard errors are calculated based on Petersen's double cluster procedure (Petersen 2009) to allow inter-correlations of residuals across firms or across time. Coefficients on quarter, year and industry dummies are suppressed for expositional convenience.

One caveat is in order when interpreting the results presented in this paper. My findings do not preclude the possibility that managers use their reporting discretion to signal private information through accruals (Dye and Verrecchia 1995; Subramanyam 1996; Guay, Kothari and Watts 1996).[19] The ex post disclosure required by FIN 45 does not reveal whether estimation errors are opportunistic or genuine. Therefore, estimation errors could arise from good-faith estimates because managers simply do not have very

[19] Subramanyam (1996) finds a positive correlation between stock returns and unexpected accruals, suggesting that discretionary accruals serve as signals of managers' private information. However, Guay et al. (1996) theoretically demonstrate that a positive correlation between returns and discretionary accruals is consistent with both the opportunistic behavior hypothesis and the signaling hypothesis.

good information themselves about the uncertain variable being estimated. But this too is useful information to investors because greater uncertainties surrounding the firm's accounting numbers should motivate investors to place less reliance on the firm's accounting information when making valuation decisions.

This paper makes several contributions to the literature. First, I extend the work in the property-casualty insurance industry where information about prior estimate errors is required to be disclosed. Specifically, the implementation of FIN 45 allows me to investigate the effects of ex post disclosures of estimation errors by focusing on the changes in managers' and investors' behavior before and after such disclosures are mandated. Second, this paper contributes to the long recognized trade-off between the relevance and reliability in accounting. I extend researchers' efforts to improve the financial reporting system and test a reporting mechanism that allows relevant information to be reported while not sacrificing the reliability of accounting estimates. Third, this study provides direct evidence on the effectiveness of FIN 45 disclosures which do not provide detailed information about the timing when estimation errors arose. Evidence from the current study suggests that FIN 45 disclosures not only affect investors' valuation decisions but also help to mitigate opportunistic reporting through product warranty accruals.

APPENDIX

Example of Disclosures of Product Warranty Liabilities

This appendix provides an example of the disclosures about product warranty liabilities required by FIN 45. In the example below, KLA-Tencor decreased (increased) product warranty liabilities/expense by $972,000 ($1,053,000) in the first quarter of 2005 (2004) to reflect the correction for overstatement (understatement) of product warranty liabilities/expense in previous periods.

Guarantees KLA-Tencor provides standard warranty coverage on its systems for twelve months, providing labor and parts necessary to repair the systems during the warranty period. KLA-Tencor accounts for the estimated warranty cost as a charge to cost of revenues when revenue is recognized. The estimated warranty cost is based on historical product performance and field expenses. Utilizing actual service records, KLA-Tencor calculates the average service hours and parts expense per system and applies the actual labor and overhead rates to determine the estimated warranty charge. KLA-Tencor updates these estimated charges every quarter. The actual product performance and/or field expense profiles may differ, and in those cases KLA-Tencor adjusts warranty accruals accordingly.

The following table provides the changes in the product warranty accrual for the three months ended September 30, 2005 and 2004 (in thousands):

	Three months ended September 30	
	2005	**2004**
ginning balance	$ 46,647	$ 38,865
cruals for warranties issued during the period	9,969	13,169
anges in liability related to pre-existing warranties	(972)	1,053
tlements made during the period	(10,798)	(5,266)
ding balance	$ 44,846	$ 47,821

Correction for prior-period estimation errors.

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