

Numbers Games? A Natural Experiment Investigating Three (Ir)regularities in Reported Earnings Per Share*

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1. Introduction

This paper conducts a natural experiment to confirm the existence of three irregularities noted in prior research related to reported earnings per share (EPS), arguably the most important performance statistic reported by managers to the market and other stakeholders. Specifically, we test three irregularities documented in the prior literature. First, the unusual pattern in the second digit of reported EPS noted by Thomas (1989) that the second digit of EPS is more likely to be zero and five and less likely to be nine for profit firms while the reverse pattern appears for loss firms. Second, the rounding pattern in third decimals of EPS noted by Das and Zhang (2003) that the one tenth of a cent is more likely between five and nine for profit firms. Third, the threshold irregularity in EPS changes attributed to Degeorge et al (1999) and related to Burgstahler and Dichev (1997), that zero changes and one-cent increases are over-represented and one-cent decreases are underrepresented, relative to expectations. Our study confirms that these patterns exist and enhances confidence in each reported irregularity's validity. We further extend research on EPS reporting irregularities by conducting analysis to discern whether the second digit pattern appears to dominate the threshold irregularity or vice-versa.

We begin our analysis by demonstrating that these previously noted patterns manifest in reported EPS both before and after the mandatory adoption of SFAS 128 (for fiscal years ending after December 15, 1997). Under the previous reporting standard (APB 15), the focal EPS measure was Primary EPS, while under the current standard (SFAS 128) the focal measure is Diluted EPS – we show that the three patterns exist

using these measures in the respective reporting eras.¹ We then exploit the change in reporting EPS under US GAAP to conduct a natural experiment as firms were required to report two measures of annual EPS for an overlap period beginning with fiscal years ending in December 1995 and ending with fiscal years ending in November 1997. For each of these two fiscal years there are two reported EPS metrics – the ‘as reported’ measure (Primary under APB 15) and the ‘as restated’ measure (Diluted under SFAS 128) because upon adoption of SFAS 128, EPS were reported retroactively under SFAS 128 for the two prior years, enabling investors to compare performance on a consistent basis.² Early adoption was proscribed by the standard. If the irregularities are valid, one would expect to see the patterns in the ‘as reported’ Primary EPS, but not in the ‘as restated’ Diluted EPS. In fact, the ‘as restated’ data offer a ‘null hypothesis’ distribution against which to test each peculiar EPS pattern. Finally, we consider whether one irregularity in the distribution of reported EPS is subsumed by another by isolating observations contributing to second-digit patterns and determining whether the change in EPS threshold pattern remains and similarly isolating observations contributing to the change in EPS threshold pattern and determining whether the second digit pattern remains.³

We are able to replicate each irregularity in the pre-SFAS 128 reporting era (using Primary EPS) and under the current reporting regime (using Diluted EPS). That is, using

¹ Thomas (1989) uses Primary EPS from 1966-1986; Das and Zhang (2003) use Primary EPS for fiscal years ending before 12/15/1997 and Basic EPS after. However, most analysts forecast Diluted EPS under the SFAS 128 reporting regime (Hribar et al, 2006); as such, Diluted EPS is the more important performance metric under SFAS 128.

² In conducting this experiment, we hold earnings before extraordinary items constant, though the numerators of the EPS ratio can differ based on the EPS measurement regime.

³ We view the third digit pattern (Das and Zhang, 2003) to be a means to the other two patterns as companies are required to report EPS to two digits (cents).

annual data, like Thomas (1989) we find an over-representation of zeros and fives and an under-representation of nines as the last EPS digit (cents) for positive EPS, implying that managers prefer reporting EPS in round numbers. We extend Thomas (1989) by demonstrating that the pattern *largely* remains under current GAAP. We replicate the third digit pattern of Das and Zhang (2003) – noting an excess of third (tenths of cents) digits in the [0.005 to 0.009] range and a deficiency in the [0.000 to 0.004] range, implying that managers pursue mechanisms to ‘round up’ reported positive EPS. We extend Das and Zhang (2003) by using Diluted EPS under SFAS 128 and by using a more recent sample period. We also confirm the threshold pattern in changes before and after SFAS 128 – that changes of zero and one cent in EPS are over-represented while changes of minus one cent are underrepresented relative to expectations, implying that managers manage earnings upward so as to avoid EPS decreases. With the EPS changes analysis we extend current research by using the focal reported EPS measures before and after adoption of SFAS 128.⁴

Exploiting the natural experiment created by the change in reporting standard, we provide convincing evidence of each irregularity in reported EPS by two means. First, using the tests derived in the original papers (i.e., Thomas, 1989; Das and Zhang, 2003; and Burgstahler and Dichev, 1999), we demonstrate that *in the overlap period* the irregular patterns are statistically significant using the ‘as reported’ (Primary) EPS data

⁴ Burgstahler and Dichev (1997) use earnings scaled by market capitalization to demonstrate a threshold pattern in earnings changes while DeGeorge et al (1999) employ Q-Prime forecasts (1974-1984) matched with COMPUSTAT EPS before extraordinary items and IBES forecasts and reported actual EPS (1985-1996) to demonstrate the threshold pattern in EPS changes. To the extent that the market is less attentive to non-recurring and ‘special’ items which result in differences between Primary or Diluted EPS before extraordinary items reported in COMPUSTAT and IBES-reported EPS actuals, and managers are aware of, and care about, the measure upon which the market focuses, our tests are biased against finding patterns in changes relative to DeGeorge et al.

but are not consistently evident in the ‘as restated’ (Diluted) EPS data. Second, we compare manifestations of the irregularities in the ‘as reported’ data to the ‘null’ of the ‘as restated’ data and generally find that the patterns of irregularity are different. For example, using the percentage of [0.005, 0.009] third digits with ‘as restated’ data as the null, we find a higher ‘as reported’ percentage that is significantly different from the null. Our research design is similar to Berger and Hahn (2003) and Botosan and Stanford (2005) in that the mandated reporting change offers a natural experiment because the underlying transactions are held fixed for this sample.

Exploring whether EPS reporting irregularities are distinct, we find some evidence that both the second digit pattern (Thomas, 1989) and the threshold pattern in changes are unique. However, the overall evidence suggests that the changes pattern dominates the second digit pattern, implying that managers care more about avoiding EPS decreases than they do about reporting EPS rounded to the nearest nickel.

Our paper contributes to accounting research related to financial reporting and earnings management in the following ways. Prior studies provide evidence of the irregular patterns in EPS reporting predominately using APB 15 EPS measures. We extend results providing evidence of EPS management related to each of the three irregular patterns to the current measure of EPS calculated under SFAS 128. We also provide a stronger research design, using the overlap period when multiple EPS measures are reported, enhancing confidence in the validity of the irregular patterns. Our results provide additional convincing evidence consistent with unusual patterns in reported EPS arise from earnings management.

Our paper is organized as follows. Section 2 summarizes prior research and describes our research questions. Section 3 describes the data and research design and Section 4 reports our results and interpretations thereof. Finally, Section 5 concludes.

2. Prior Research and Research Questions

Research in earnings management can be grouped into overlapping categories related to incentives to manage various income measures (e.g., compensation, capital market pressures, and other contracting costs) and ‘method’ research intended to help discern whether, in fact, earnings management has taken place (e.g., discretionary accrual models).⁵ The stream of research most closely related to our study is the second category. The papers we replicate and extend provide evidence consistent with earnings management via ex-post observation of distributions of a financial performance metric (i.e., EPS) which depart from expectation, without attributing cause. The evidence is ‘indirect’ in the sense that no proxy for the extent to which earnings are managed is derived, rather the fact that distributions depart from what is considered normal is offered as evidence that earnings management occurs in broad samples.

The first ‘indirect’ evidence of performance reporting management we consider and extend relates to digit management in reported annual EPS, first noted by Thomas (1989). Among other findings related to patterns in reported earnings, Thomas (1989) finds unusual patterns in the second decimal (cent) digit of reported EPS. Specifically, zeros and fives are over-represented, relative to expectations, and nines are under-represented with positive EPS, suggesting that managers prefer to report positive EPS in ‘round’ numbers. For negative EPS, the pattern does not manifest. Thomas suggests that

⁵ Schipper (1989), Healy and Whalen (1999), Dechow and Skinner (2000), and Dechow and Schrand (2004) provide discussions of earnings management literature from different perspectives.

the peculiar patterns may result from managerial reporting incentives related to valuation and contracting. That is, managers may believe that the market values rounded EPS proportionately greater than non-rounded EPS numbers (e.g., apply larger P/E ratios) and/or contractual terms for compensation agreements or lending arrangements may be stipulated in round EPS numbers.

Drawing upon Thomas' findings, we expect that the unusual pattern in reported EPS will continue when reporting of alternative performance is mandated. As such, our first research question is:

RQ1: Does the unusual digit pattern in reported EPS extend to Diluted EPS under SFAS 128?

We further expect that in a reporting period for which multiple metrics are reported, and to the extent the unusual patterns in digits are valid, the patterns should only manifest themselves in the data reported in real time. This leads to our second research question.

RQ2: Does the unusual digit pattern in reported EPS exist in 'as reported' data, but not in 'as restated' data for the period when both performance metrics are available?

The second form of evidence of performance reporting management related to annual EPS that we consider and extend is the third or rounded decimal pattern noted by Das and Zhang (2003). Das and Zhang investigate if, when (in what settings is rounding most likely), and how firms round quarterly EPS. They find that firms generally round up positive quarterly EPS (54.6% of third decimal digits are five and above) and round down negative quarterly EPS (53.4% of third decimal digits are four and below) during their sample period. Das and Zhang do consider alternative 'null' distributions of

performance metrics on a per share basis (i.e., sales, operating income before depreciation, and cash flow from operations per share). Our study differs in that we consider a longer interval post SFAS 128 (their study ends with data from 1998, using approximately two years of SFAS 128 reporting), we consistently use annual data versus quarterly data, and we consider an alternative null distribution – the EPS metric not reported in real time. Our research questions related to EPS rounding are:

RQ3: Does the third-decimal rounding pattern extend to annual data?

RQ4: Does the third-decimal rounding pattern continue under SFAS 128 reporting using Diluted EPS?

RQ5: Does the third-decimal rounding pattern manifest in ‘as reported’ data, but not ‘as restated’ data?

The third distributional irregularity in reported EPS we consider is the discontinuity in reported changes in EPS noted by Degeorge et al (1999) and attributed to earnings management to avoid reporting earnings decreases.⁶ Specifically, the discontinuity relates to an under-representation (or ‘divot’) immediately to the left of zero in EPS changes (i.e., changes of -1¢) and an over-representation, relative to expectations, at zero and at positive one cent. We extend Degeorge et al along a few dimensions. First, their sample period ends in 1996, prior to mandatory adoption of SFAS 128, so we determine if the discontinuity extends to the new reporting metric. Second, consistent with the remainder of our analysis, we consider annual EPS measures, as opposed to quarterly EPS in Degeorge et al. Finally, using the overlap sample, we compare the distributions of ‘as reported’ Primary EPS to ‘as restated’ Diluted EPS, expecting to observe the unusual pattern only in the ‘as reported’ data. Our research questions are:

⁶ Burgstahler and Dichev (1997) note a similar pattern in changes in market-value scaled earnings. We follow Degeorge et al (1999) in conducting our analysis with unscaled EPS data, using Burgstahler and Dichev test statistics, as further described below.

RQ6: Does the distributional pattern in changes in reported EPS extend to SFAS 128 reporting?

RQ7: Does the distributional pattern in changes in reported EPS extend to annual EPS?

RQ8: Does the distributional pattern in changes in reported EPS manifest in ‘as reported’ data, but not ‘as restated’ data?

Finally, we consider whether there is a hierarchy in revealed reporting preferences between the digit management noted by Thomas (1989) and the distribution of EPS changes noted by Degeorge et al (1999). The third decimal rounding noted by Das and Zhang (2003) is a means to both ends since both irregularities are defined with respect to the last cent reported. Our prior is that because rounded five cent increments are less likely to relate directly to a contractual or behavioral threshold per se, the change in EPS irregularity will dominate the digit management irregularity.

RQ9: Do incentives to avoid reporting EPS decreases dominate incentives to report EPS in round numbers or vice-versa?

3. Data and Research Design

We use annual EPS data from the COMPUSTAT Xpressfeed North America database for fiscal years ending from January 1980 to December 2007. The overlap period for which ‘as reported’ Primary EPS and ‘as restated’ Diluted EPS are available extends from fiscal years ending in December 1995 to November 1997. We focus on Primary EPS excluding extraordinary items (data item EPSPX) in the APB 15 reporting era and Diluted EPS excluding extraordinary items (data item EPSFX) in the SFAS 128 reporting era. Similar to Thomas (1989), we constrain our sample to annual reported EPS

measures in the [-\$1.00, \$2.50] range, inclusive.⁷ For the APB 15 reporting era (fiscal years ending from January 1980 to November 1997) there are 103,916 observations. We have 82,088 observations of Diluted EPS reported under SFAS 128 between December 1997 and December 2007. For the overlap period, there are 3,900 observations where both Primary ('as reported') and Diluted ('as restated') EPS measures are available.

Our overall sample is reduced for the analysis regarding changes in EPS because a) we lose one year of levels observations to effect changes, and b) because of non-consecutive firm-year observations in the overall sample. Hence, for our analysis considering whether managers seek to avoid decreases in reported EPS, our sample is reduced to 90,743 observations in the APB 15 reporting era; 75,751 observations in the SFAS 128 reporting era. For the overlap period, the sample of 3,900 observations remains because we use fully-diluted EPS data for fiscal years ending between December 1994 and November 1995 to construct changes in 'as restated' Diluted EPS. Our sample is also reduced for the Das and Zhang (2003) analysis because the number of shares outstanding is missing for many companies. Thus, for our analysis of rounding reported EPS, we use 100,658 observations for the APB 15 period and 80,106 observations for the SFAS 128 period. For the overlap period, the sample is further reduced to 2,359 observations.

To assess the statistical significance of each EPS reporting irregularity we follow the designs from the respective original papers. Thomas (1989) offers two test statistics to make inferences about unusual patterns in reported EPS. The first uses local last cent referents under the null that the distribution should be 'smooth'. For example, the

⁷ Similar to DeGeorge et al (1999), using the [-\$1.00, \$2.50] range of observations enables us to retain more than 80% of unscaled EPS observations from the EPS measurement periods.

expected proportion of \$0.05 observations is the mean of \$0.04 and \$0.06 observations. Thomas then uses the percent deviations from expectations and computes the median value of the deviations for each last digit – EPS ending in 0, 1, 2 ... 9 and conducts a signed rank test on the median values. We follow this first approach.

Das and Zhang (2003) conduct a simple Chi-square test under the null that 50% of reported EPS will be rounded up and 50% are rounded down by chance. Following their hypotheses, they expect that the proportion of rounding up will be greater than 50% for reported positive EPS and less than 50% for reported negative EPS. We follow the same approach in our analysis.

Burgstahler and Dichev (1997) derive a test statistic which indicates departures from ‘smoothness’ of a distribution measured as the difference between the actual number of observations in an interval (or ‘bin’) and the expected number in the interval, divided by the standard deviation of the difference (see Burgstahler and Dichev, footnote 6, p. 103). The expected number of observations in an interval is the mean of two immediately adjacent intervals. The variance of the difference is the sum of the variances of the actual and expectation, similar to the variance of the binomial distribution. We adopt the same test statistic as Burgstahler and Dichev to discern whether there is an unusual pattern in reported EPS changes around zero, consistent with earnings management to avoid reporting EPS decreases. We use the test statistic to confirm the unusual pattern for Primary EPS in the APB 15 reporting era and Diluted EPS in the SFAS 128 reporting era. For the overlap period, we expect the test statistic to be significant with Primary EPS, but not for Diluted EPS.

4. Results

4.1 Digit Management

Table 1, Panel A reports our results replicating Thomas' (1989) findings for a period largely subsequent to Thomas', but similarly using Primary EPS measured under APB 15. We essentially replicate Thomas' results noting statistically significantly more five and zero last cents and statistically significantly fewer four and nine last cents with non-negative Primary EPS than expected using the Spearman rank test. No pattern emerges with negative EPS. Table 1, Panel B demonstrates results extending Thomas' findings to a mandatorily prescribed alternative performance metric, Diluted EPS measured under SFAS 128. Again, an unexpectedly large number of reported EPS end in zero and five cents and an unexpectedly small number of reported EPS end in nine cents for positive EPS, consistent with the results under APB 15, though the result related to last digit of five is marginal ($p=0.073$). As such, the answer to RQ1 is a 'yes' – the pattern continues with second digits of zero, five and nine.

To provide further evidence regarding digit management in EPS reporting, we use the issuance of SFAS 128 as a natural experimental setting for testing for unusual patterns. Under APB 15, all firms reported primary EPS and fully diluted EPS as undiluted and diluted measures of EPS, respectively. Under SFAS 128, all firms report basic EPS and diluted EPS as EPS measures. SFAS 128 had a mandatory implementation date for all firms with fiscal years starting after December 15, 1997 and early adoption was prohibited. This provides us with a unique data period regarding EPS for the last years prior to SFAS 128 adoption because all four EPS measures are disclosed for that period only. First, EPS were reported in real time under APB 15. Second, upon adoption of SFAS 128, EPS were reported retroactively under SFAS 128 for the two

prior years to allow investors to compare performance on a similar basis. Based on Thomas (1989), we predict that managers continued to report unusual patterns in earnings under APB 15 in the years preceding the adoption of SFAS 128. However, we expect that the restated EPS reported retroactively under SFAS 128 for those same years will be less likely to exhibit unusual patterns in earnings.⁸

Table 2 reports results consistent with our hypothesis in that for non-negative earnings, Panel A Primary EPS ('as reported') reflects the pattern in last cents of zero and nine, while Panel B Diluted EPS ('as restated') manifests the pattern only in nines. However, the pattern is not reflected in last cents of five for either Primary 'as reported' EPS or Diluted 'as restated' EPS, so this evidence alone is not overwhelming.

Another approach in conducting the analysis in the overlap period is reflected in Table 3. Specifically, we report a 10 by 10 table with the last digit of 'as reported' Primary EPS for values between \$0.00 and \$2.50 inclusive in the columns and the last digit of 'as restated' Diluted EPS in the rows. We use the distribution of Diluted EPS across digits as a null.⁹ E.g., for the 2,832 observations of non-negative EPS less than or equal to \$2.50 available for both 'as reported' and 'as restated' EPS measures, the expected percentage of zeros is 12.01% (the row margin) under the null. As displayed on Table 3, we find that zeros are over-represented (13.06%) in the 'as reported' EPS numbers relative to the null ($p=0.043$) and nines are under-represented (7.45% versus a null of 8.30%) in the 'as reported' EPS numbers relative to the null of 8.30% ($p = 0.051$).

⁸ Consistent with the evidence presented in Thomas (1989), it is more likely that managers managed earnings as reported for the current period under APB 15. However, it is possible that managers fully anticipated the adoption SFAS 128 and intended to manage EPS trends for subsequent years. This seems unlikely, since FASB issued SFAS 128 in February 1997, so managers might find it difficult to anticipate the exact effect of implementation of SFAS 128 on future reported EPS.

⁹ Consistent with Benford (1938), it is probably not apt to use 10% as an expectation of each last digit, though if we did, stronger results emerge.

However, the expected proportion of EPS ending in five is not statistically different from the ‘as reported’ proportion and, as such, we find no support for unusually digit patterns in fives in the overlap period. Hence, our answer to RQ2 is a qualified ‘yes’ in that Thomas’ (1989) digit pattern largely manifests in the ‘as reported’ data, but not in the ‘as restated’ data and we are able to reject the null that the digit patterns are the same using the ‘as restated’ data as a null distribution for two of the three digit patterns considered.

4.2 Third Digit Management

Table 4 reports our results replicating Das and Zhang (2003) using annual data in both the APB 15 (Primary) and SFAS 128 (Diluted) reporting eras. As indicated in Panel A, we are able to replicate Das and Zhang using annual data as the percentage of third decimals ranging from five to nine (rounded up) for non-negative earnings is significantly greater than 50%. Similarly, the percentage of third decimals ranging from zero to four is greater than 50% at the $p = 0.00$ level, indicating rounding down negative EPS in magnitude.

Table 4, Panel B extends Das and Zhang’s results further into the SFAS 128 reporting era using annual data and the diluted as opposed to basic EPS measure. We find strong evidence that Diluted EPS is rounded up for positive earnings as the third decimals greater than or equal to five are over-represented relative to naïve expectations of 50% (51.28%), though less so than in the prior reporting era. The percentage of EPS with negative earnings reflected in third decimals less than five is greater than 50%, (51.85%) and is statistically significant. We conclude that the answer to RQ3 and RQ4 are both ‘yes’ – the rounding pattern extends to annual data and the pattern continues under SFAS 128 using Diluted EPS as the performance proxy.

Table 5 uses the overlap sample to strengthen our confidence in prior results. First, Panel A uses ‘as reported’ Primary EPS and reports the results of a simple Chi-square test with a null that 50% of third digits will fall in both the [0, 4] and [5, 9] intervals. Note that the sample size is reduced to 1,363 non-negative EPS observations and 1,008 negative EPS observations, or a total of 2,371 observations (versus 2,832 non-negative EPS observations from the second digit management analysis).¹⁰ For non-negative EPS, 52.60% of ‘as reported’ observations were rounded up – this is significantly different from 50% at the $p=0.05$ level. In contrast, Panel B indicates that only 46.52% of non-negative ‘as restated’ EPS observations were rounded up (significantly *less* than 50% at the $p=0.01$ level). Hence, the evidence is consistent with third digit rounding being manifest in the ‘as reported’ data, but not the ‘as restated’ data in answer to RQ5. We further conduct a test to discern if the proportion of rounding up in the ‘as reported’ data is significantly different than the proportion of rounding up in the ‘as restated data’ and find that the difference is significant at the $p < 0.005$ level ($t=3.18$).

4.3 Earnings management to avoid EPS decreases

We begin by replicating prior research. Figure 1, Panel A reflects the distribution of changes in Primary EPS under APB 15 with 90,743 change observations in the interval [-\$0.20, \$0.20]. Of interest is the distribution around zero. Consistent with Degeorge et al (1999), visually, the distribution of annual changes in Primary EPS exhibits a slight trough at -1¢ and a peak at 1¢. Using the Burgstahler and Dichev (1997) test statistic, we reject that the distribution is ‘smooth’ at -1¢ and accept the alternative that a ‘divot’ is to the immediate left of zero change ($t = -12.26$, $p < 0.001$). Moving to the post SFAS 128

¹⁰ The reason for the reduction is that many firms do not provide the number of shares used in the EPS calculation and, as such, it is not possible to determine the third (truncated) decimal.

performance metric, we find a similar pattern in Diluted EPS, as reflected in Panel B of Figure 1. The test statistic for a discontinuity at -1¢ in this case is $t = -8.43$, significant at the $p < 0.001$ level. As such, we answer both RQ6 and RQ7 affirmatively – evidence consistent with managing earnings to avoid reporting losses extends to both annual EPS data and to the post-SFAS 128 reporting era.

We again exploit the natural experiment in reported EPS during the overlap period to discern whether the discontinuity exists in the ‘as reported’ changes in Primary EPS data, but not in the ‘as restated’ changes in Diluted EPS data. Figure 2, Panel A reflects the distribution of changes in Primary EPS in the overlap period. Visually, there is a peak at zero, followed closely by another high point at a one-cent increase, but a trough at one-cent decrease. The null that the distribution is smooth at minus one cent is easily rejected ($t = -3.89$, $p < 0.001$) using the Burgstahler and Dichev (1997) statistic, consistent with managers managing earnings so as to avoid reporting EPS decreases. In contrast, Figure 2, Panel B offers no distinctive pattern in changes in ‘as restated’ EPS around zero – peaks appear at one-cent and four-cent increases in addition to the peak at no change in Diluted EPS. The Burgstahler and Dichev test statistic for smoothness at minus one cent does not reject at conventional levels ($t = -1.45$, $p = 0.147$, two-tailed). As such, we find evidence consistent with earnings management to avoid EPS decreases in the ‘as reported’ data, but not in the ‘as restated’ data, enabling us to answer RQ8 affirmatively.

To determine whether there is a significant difference in the EPS change distributions around zero between ‘as reported’ Primary and ‘as restated’ Diluted, we use the following test statistic based on Burgstahler and Dichev:

$$test_stat = \frac{N(p_i^p - \frac{p_{i-1}^p + p_{i+1}^p}{2}) - N(p_i^d - \frac{p_{i-1}^d + p_{i+1}^d}{2})}{\sqrt{N[p_i^p(1-p_i^p) + \frac{p_{i-1}^p + p_{i+1}^p}{2}(1 - \frac{p_{i-1}^p + p_{i+1}^p}{2})] + N[p_i^d(1-p_i^d) + \frac{p_{i-1}^d + p_{i+1}^d}{2}(1 - \frac{p_{i-1}^d + p_{i+1}^d}{2})]}}$$

where superscripts p and d refer to Primary and Diluted.

The test statistic is approximately distributed standard normal. For this sample, the test statistic is 1.673, which is significant at about the $p = 0.095$ level, two-tailed. As such, we find some evidence that the ‘as reported’ distribution of zero changes in Primary EPS during the overlap period differs from the ‘as restated’ distribution of zero changes in Diluted EPS. This provides us with more confidence that the prior evidence consistent with managers using estimates and taking strategic actions to avoid reporting EPS decreases is valid.

4.4 Hierarchy in EPS Digit Management

Having provided evidence of digit management consistent with Thomas (1989) and earnings management around EPS thresholds consistent with Degeorge et al (1999) and Burgstahler and Dichev (1997), we now report on tests conducted to discern whether incentives to avoid reporting EPS decreases dominate incentives to report EPS in round numbers or vice-versa. We begin by reconsidering Thomas’ digit pattern both in the pre- and post-SFAS 128 reporting eras, restricting the sample to observations that manifest the change in EPS threshold pattern. Our supposition is that the digit management pattern should be evident throughout most of the distribution of EPS changes. If the digit pattern does not appear in the interval most reflective of the threshold pattern, then we have decreased confidence in the digit pattern as a unique irregularity and/or how incented managers are to manage EPS digits relative to avoiding EPS decreases. As such, we

constrain the sample to include only observations related to minus one cent, zero, and plus one cent changes in EPS during each reporting era, then revisit Thomas' tests to ascertain whether the digit pattern remains. Table 6 reports the results of this analysis. Panel A reflects the digit patterns in the pre-SFAS 128 reporting era (Primary EPS). For the most part, Thomas' digit pattern prevails because zero and five last cent observations are over-represented and nine last cent observations are under-represented, relative to local referents using the signed-rank tests.

The Diluted EPS reported in the post-SFAS 128 reporting regime offer less support for a digit pattern remaining when using observations from the threshold interval in changes. Specifically, the proportions of zero, five and nine last cent observations are not statistically exceptional, as reflected in Panel B. Overall, we conclude that the evidence supports that the digit pattern is a distinct anomaly in the pre-SFAS 128 reporting era, but not in the post-SFAS 128 era.

We next revisit Figure 1, which reflects distributions of EPS changes pre- and post-SFAS 128, now using *only* observations where the last cent of EPS for the current year is zero, five, or nine. Our supposition in this case is that the threshold pattern in changes should be evident across all last digit EPS values and to the extent that the pattern prevails in observations most reflective of the digit pattern, we have increased confidence that the irregularities are distinct and that threshold incentives dominate reporting in round number incentives.

The results of these tests are reflected in Figure 3. With respect to changes in Primary EPS under APB 15, Panel A demonstrates a pattern consistent with Panel A of Figure 1 – there visually appears to be an abundance of observations at zero and a relative

paucity of observations at minus one cent. The Burgstahler and Dichev (1997) test statistic ($t = -18.20$) provides evidence to reject the null that the distribution is smooth at minus one cent in Primary EPS. Similarly, Panel B of Figure 3, which reflects changes in Diluted EPS after SFAS 128, conveys a pattern similar to Panel B of Figure 1. The Burgstahler and Dichev test statistic remains significant ($t = -14.16$) in testing for a discontinuity at minus one cent in Diluted EPS when considering only zero, five, and nine last cent observations. From this analysis we conclude that the threshold pattern in EPS changes remains after considering observations wherein the second digit pattern in EPS is most evident, both before and after adoption of SFAS 128. Given the marginal evidence of the digit pattern remaining after considering observations that reveal the threshold pattern and stronger counter evidence, we conclude that the evidence is consistent with the threshold pattern in EPS changes dominating the digit pattern. Hence, there appears to be a hierarchy in EPS reporting management such that managers focus first on avoiding EPS decreases, then consider EPS reporting in round cents. Overall, our answer to RQ9 is that it appears that incentives to avoid reporting EPS increases dominate incentives to report EPS in round numbers.

5. Conclusions

We confirm and extend three anomalies related to EPS reporting. First, we replicate Thomas (1989) for annual EPS in the APB 15 reporting era and for the most part find the same irregular reporting pattern in annual EPS under current GAAP. Second, we confirm that the Das and Zhang (2003) irregular rounding pattern in third decimals of EPS is similarly evident in annual EPS data. We also extend the results to post-SFAS 128 data. Third, we replicate and extend the Degeorge et al (1999) findings

related to changes in reported EPS – that distributions provide evidence consistent with managers taking actions to avoid reporting decreases in EPS. Our extensions are to reporting under current GAAP (SFAS 128) and using annual EPS data.

Our paper also exploits a natural experiment created by mandatory implementation of a new standard in calculating EPS which proscribed early adoption. Because firms retroactively report Diluted EPS under SFAS 128 to provide consistency for the two reporting years prior to adoption, two measures of annual EPS are available for an overlap period: Primary (‘as reported’) EPS and Diluted (‘as restated’) EPS. For each unusual pattern in EPS reporting, we find evidence consistent with the irregularity existing in the ‘as reported’ data but not in the ‘as restated’ data, which managers have much less incentive to manage. These tests enhance our confidence in the legitimacy of each reporting anomaly because it is difficult to ascribe the unusual patterns to other factors such as scale in the case of the changes pattern.

We further consider which of two patterns seem to dominate or, alternatively, whether a hierarchy exists in managing EPS reporting. We find evidence consistent with managers being more concerned with avoiding EPS decreases than with reporting EPS in round (nickel-denominated) numbers.

While prior literature offers many motivations for managers to engage in earnings management, including compensation and a perceived investor focal point, our research design does not allow us to discriminate between these possible incentives managers face that lead them to manage reported EPS. Future research may consider whether there are consequences to not managing EPS such as negative employment outcomes. Future studies might also investigate whether firms with a large dilution factor, i.e., firms where

the numerator makes diluted EPS much higher than undiluted EPS, and expect to find that the unusual EPS patterns are more pronounced in diluted EPS for firms with high dilution factor.

References

- Benford, F. 1938. The Law of Anomalous Numbers. *Proceedings of the American Philosophical Society* 74 (March): 551-572.
- Berger, P., and R. Hahn. 2003. The Impact of SFAS No. 131 on Information and Monitoring. *Journal of Accounting Research* 41 (May): 163–223.
- Botosan, C., and M. Stanford. 2005. Managers' Motives to Withhold Segment Disclosures and the Effect of SFAS No. 131 on Analysts' Information Environment. *The Accounting Review* 80 (July): 751-772.
- Burgstahler, D., and I. Dichev. 1997. Earnings Management to Avoid Earnings Decreases and Losses. *Journal of Accounting and Economics* 24 (December): 99–126.
- Das, S., and H. Zhang. 2003. Rounding-up in Reported EPS, Behavioral Thresholds, and Earnings Management. *Journal of Accounting and Economics* 35 (April): 31–50.
- Dechow, P., and C. Schrand. 2004. Earnings Quality. Research Foundation of CFA Institute. USA.
- Dechow, P., and D. Skinner. 2000. Earnings Management: Reconciling the Views of Accounting Academics, Practitioners, and Regulators. *Accounting Horizons* 14 (June): 235-250.
- Degeorge, F., J. Patel, and R. Zeckhauser. 1999. Earnings Management to Exceed Thresholds. *Journal of Business* 72 (1): 1-33.
- Healy, P., and J. Wahlen. 1999. A Review of the Earnings Management Literature and Its Implications for Standard Setting. *Accounting Horizons* 13 (December): 365-383.
- Hribar, P., N. Jenkins, and W. B. Johnson. 2006. Stock Repurchases as an Earnings Management Device. *Journal of Accounting and Economics* 41 (April): 3-27.
- Schipper, K. 1989. Commentary on Earnings Management. *Accounting Horizons* 3 (December): 91-102.
- Thomas, J. 1989. Unusual Patterns in Reported Earnings. *The Accounting Review* 64 (October): 773-787.

TABLE 1
Distribution of Right Digit for Primary EPS and Diluted EPS

This table provides the results replicating Thomas' (1989) Table 4 for the pre- and post-SFAS 128 periods (fiscal years ending in January 1980 – November 1997 and December 1997 – December 2007, respectively). Panel A reports the distribution of right digit for Primary EPS measured under APB 15, and Panel B reports the distribution of right digit for Diluted EPS measured under SFAS 128. The observed proportion (p) for each EPS value is compared with an expected proportion (p_0) to obtain the percent difference ($= 100 \times (p - p_0)/p_0$). Expected proportions equal the mean of observed proportion for adjacent EPS values. EPS numbers are limited to values between -1.00 and 2.50. The median difference is computed for all EPS values with the same right digit. The p-value refers to a signed rank test of the null hypothesis that the median difference is 0.

Panel A: Primary EPS in the Pre-SFAS 128 Period

Right Digit		0	1	2	3	4	5	6	7	8	9
Non-negative Earnings	Median difference (%)	38.00	-8.83	1.20	0.00	-8.36	11.31	-6.19	-3.15	8.51	-29.03
	p-value	0.000	0.000	0.323	0.408	0.000	0.000	0.001	0.117	0.000	0.000
	N	73,871									
Negative Earnings	Median difference (%)	9.32	-5.76	-4.45	1.27	-2.59	2.98	-2.41	0.48	1.21	-3.83
	p-value	0.055	0.160	0.375	0.232	0.131	0.275	0.160	0.922	0.557	0.322
	N	30,045									

Panel B: Diluted EPS in the Post-SFAS 128 Period

Right Digit		0	1	2	3	4	5	6	7	8	9
Non-negative Earnings	Median difference (%)	11.58	-4.97	0.84	-0.70	-2.13	3.11	2.93	-4.52	8.47	-11.90
	p-value	0.000	0.046	0.666	0.574	0.138	0.073	0.378	0.064	0.007	0.000
	N	52,365									
Negative Earnings	Median difference (%)	-0.63	-2.19	3.60	-3.59	2.87	-1.10	-3.06	-2.08	0.33	-0.40
	p-value	0.652	0.922	0.432	0.084	0.322	0.922	0.695	0.922	0.922	0.846
	N	29,723									

TABLE 2**Distribution of Right Digits for Primary EPS ('as reported') and Diluted EPS ('as restated') upon the Adoption of SFAS 128**

This table provides the distribution of EPS right digit for the two years preceding the adoption of SFAS 128 (fiscal years ending in December 1995 – November 1997). Panel A reports the distribution of right digit for 'as reported' Primary EPS, and Panel B reports the distribution of right digit for 'as restated' Diluted EPS. The observed proportion (p) for each EPS value is compared with an expected proportion (p_0) to obtain the percent difference ($= 100 \times (p - p_0)/p_0$). Expected proportions equal the mean of observed proportion for adjacent EPS values during the pre-SFAS 128 period (fiscal years ending in January 1980 – November 1997). EPS numbers are limited to values between \$-1.00 and \$2.50. The median difference is computed for all EPS values with the same right digit. The p-value refers to a signed rank test of the null hypothesis that the median difference is 0.

Panel A: Primary EPS ('as reported')

Right Digit		0	1	2	3	4	5	6	7	8	9
Non-negative Earnings	Median difference (%)	27.90	-9.29	3.48	-17.17	-4.35	-9.40	-7.83	-12.16	9.50	-41.44
	p-value	0.060	0.154	0.927	0.012	0.454	0.865	0.350	0.556	0.273	0.000
	N	2,832									
Negative Earnings	Median difference (%)	12.90	5.02	9.96	-1.03	-8.93	11.23	16.11	2.44	13.17	1.90
	p-value	0.496	0.557	0.322	0.922	1.000	0.375	0.232	0.625	0.695	0.625
	N	1,068									

Panel B: Diluted EPS ('as restated')

Right Digit		0	1	2	3	4	5	6	7	8	9
Non-negative Earnings	Median difference (%)	5.24	-22.45	-5.21	-25.57	-15.79	-6.51	-9.93	-17.38	-3.69	-35.54
	p-value	0.724	0.082	0.685	0.011	0.179	0.538	0.705	0.064	0.804	0.001
	N	2,832									
Negative Earnings	Median difference (%)	22.16	6.95	12.48	4.12	-7.27	15.29	9.93	1.12	25.31	3.94
	p-value	0.820	0.432	0.375	0.375	0.695	0.275	0.492	0.557	0.064	0.322
	N	1,068									

TABLE 3
Distribution of Last Reported Digits – Primary EPS (‘as reported’) across Columns
and Diluted EPS (‘as restated’) down Rows

The first number in each cell is frequency and the second number is actual proportion. The numbers in parenthesis refer to the cell contributions to the chi-square test of the null hypothesis that the rows and columns are independent.

<u>Right Digit</u>		0	1	2	3	4	5	6	7	8	9	Total
Primary												
Diluted												
0	239	28	12	9	11	16	3	6	3	13	340	
	8.44	0.99	0.42	0.32	0.39	0.56	0.11	0.21	0.11	0.46	12.01	
	(852.32)	(2.94)	(16.55)	(13.41)	(15.22)	(11.12)	(27.05)	(21.06)	(26.34)	(6.00)		
1	16	208	37	16	7	6	5	16	1	9	321	
	0.56	7.34	1.31	0.56	0.25	0.21	0.18	0.56	0.04	0.32	11.33	
	(16.04)	(805.88)	(0.17)	(4.47)	(19.28)	(23.06)	(21.75)	(6.64)	(28.30)	(9.30)		
2	7	18	184	32	15	9	12	3	6	8	294	
	0.25	0.64	6.50	1.13	0.53	0.32	0.42	0.11	0.21	0.28	10.38	
	(25.69)	(7.12)	(732.92)	(2.15)	(6.81)	(15.74)	(9.42)	(21.94)	(17.02)	(8.83)		
3	10	5	11	143	24	16	12	7	7	5	240	
	0.35	0.18	0.39	5.05	0.85	0.56	0.42	0.25	0.25	0.18	8.47	
	(14.55)	(18.20)	(8.53)	(748.03)	(0.00)	(3.49)	(5.36)	(10.72)	(10.79)	(9.28)		
4	8	10	12	8	177	28	11	12	12	7	285	
	0.28	0.35	0.42	0.28	6.25	0.99	0.39	0.42	0.42	0.25	10.06	
	(22.95)	(15.49)	(11.39)	(10.62)	(786.00)	(0.16)	(9.88)	(8.15)	(8.23)	(9.54)		
5	15	11	5	7	14	184	31	14	15	6	302	
	0.53	0.39	0.18	0.25	0.49	6.50	1.09	0.49	0.53	0.21	10.66	
	(15.16)	(15.86)	(23.29)	(13.31)	(8.42)	(722.27)	(0.12)	(7.28)	(6.37)	(12.10)		
6	13	8	17	6	14	11	172	33	13	7	294	
	0.46	0.28	0.60	0.21	0.49	0.39	6.07	1.17	0.46	0.25	10.38	
	(16.81)	(19.34)	(6.79)	(14.16)	(7.81)	(13.03)	(728.20)	(1.05)	(7.82)	(10.14)		
7	14	10	4	5	2	14	12	153	26	15	255	
	0.49	0.35	0.14	0.18	0.07	0.49	0.42	5.40	0.92	0.53	9.00	
	(11.20)	(12.44)	(20.05)	(12.60)	(21.37)	(6.27)	(6.44)	(695.31)	(0.16)	(0.84)		
8	13	11	12	5	8	9	11	13	164	20	266	
	0.46	0.39	0.42	0.18	0.28	0.32	0.39	0.46	5.79	0.71	9.39	
	(13.62)	(12.25)	(9.67)	(13.47)	(12.73)	(13.05)	(8.36)	(5.75)	(769.56)	(0.00)		
9	35	13	11	7	8	7	4	9	20	121	235	
	1.24	0.46	0.39	0.25	0.28	0.25	0.14	0.32	0.71	4.27	8.30	
	(0.60)	(7.04)	(8.09)	(8.23)	(9.99)	(12.86)	(15.36)	(7.74)	(0.21)	(611.72)		
Total	370	322	305	238	280	300	273	266	267	211	2,832	
	13.06	11.37	10.77	8.40	9.89	10.59	9.64	9.39	9.43	7.45	100.00	

TABLE 4
Frequency of Rounding for Primary EPS and Diluted EPS

This table provides the results replicating Das and Zhang's (2003) Table 1 for the pre- and post-SFAS 128 periods (fiscal years ending in January 1980 – November 1997 and December 1997 – December 2007, respectively). Panel A reports the frequency of rounding for Primary EPS measured under APB 15, and Panel B reports the frequency of rounding for Diluted EPS measured under SFAS 128. EPS numbers are limited to values between \$-1.00 and \$2.50. X refers to the first digit immediately right of the decimal of the calculated EPS expressed in cents. The p-value refers to a Chi-square test with the test proportion equal to the expected proportion, which is 50%.

Panel A: Primary EPS in the Pre-SFAS 128 Period

	Non-negative Earnings		Negative Earnings	
	$0 \leq X < 5$	$5 \leq X$	$0 \leq X < 5$	$5 \leq X$
Frequency	33,436	37,834	15,884	14,594
Actual Proportion	46.91	53.09	52.12	47.88
p-value	0.00		0.00	
N	71,270		30,478	

Panel B: Diluted EPS in the Post-SFAS 128 Period

	Non-negative Earnings		Negative Earnings	
	$0 \leq X < 5$	$5 \leq X$	$0 \leq X < 5$	$5 \leq X$
Frequency	24,772	26,076	15,686	14,565
Actual Proportion	48.72	51.28	51.85	48.15
p-value	0.00		0.00	
N	50,848		30,251	

TABLE 5
Frequency of Rounding for Primary EPS ('as reported') and Diluted EPS ('as restated') upon the Adoption of SFAS 128

This table provides the results replicating Das and Zhang's (2003) Table 1 for the two years preceding the adoption of SFAS 128 (fiscal years ending in December 1995 – November 1997). Panel A reports the frequency of rounding for 'as reported' Primary EPS, and Panel B reports the frequency of rounding for 'as restated' Diluted EPS. EPS numbers are limited to values between \$-1.00 and \$2.50. X refers to the first digit immediately right of the decimal of the calculated EPS expressed in cents. The p-value refers to a Chi-square test with the test proportion equal to the expected proportion, which is 50%.

Panel A: Primary EPS ('as reported')

	Non-negative Earnings		Negative Earnings	
	$0 \leq X < 5$	$5 \leq X$	$0 \leq X < 5$	$5 \leq X$
Frequency	646	717	518	490
Actual Proportion	47.40	52.60	51.39	48.61
p-value	0.05		0.38	
N	1,363		1,008	

Panel B: Diluted EPS ('as restated')

	Non-negative Earnings		Negative Earnings	
	$0 \leq X < 5$	$5 \leq X$	$0 \leq X < 5$	$5 \leq X$
Frequency	729	634	515	493
Actual Proportion	53.48	46.52	51.09	48.91
p-value	0.01		0.49	
N	1,363		1,008	

TABLE 6
Distribution of EPS Right Digit When EPS Changes are -1 Cent, 0, or 1 Cent

This table provides the distribution of EPS right digit for the pre- and post-SFAS 128 periods (fiscal years ending in January 1980 – November 1997 and December 1997 – December 2007, respectively) when EPS changes are -1 cent, 0, or 1 cent. Panel A reports the distribution of right digit for Primary EPS measured under APB 15, and Panel B reports the distribution of right digit for Diluted EPS measured under SFAS 128. The observed proportion (p) for each EPS value is compared with an expected proportion (p₀) to obtain the percent difference (= 100 x (p – p₀)/p₀). Expected proportions equal the mean of observed proportion for adjacent EPS values. EPS numbers are limited to values between -1.00 and 2.50. The median difference is computed for all EPS values with the same right digit. The p-value refers to a signed rank test of the null hypothesis that the median difference is 0.

Panel A: Primary EPS in the Pre-SFAS 128 Period

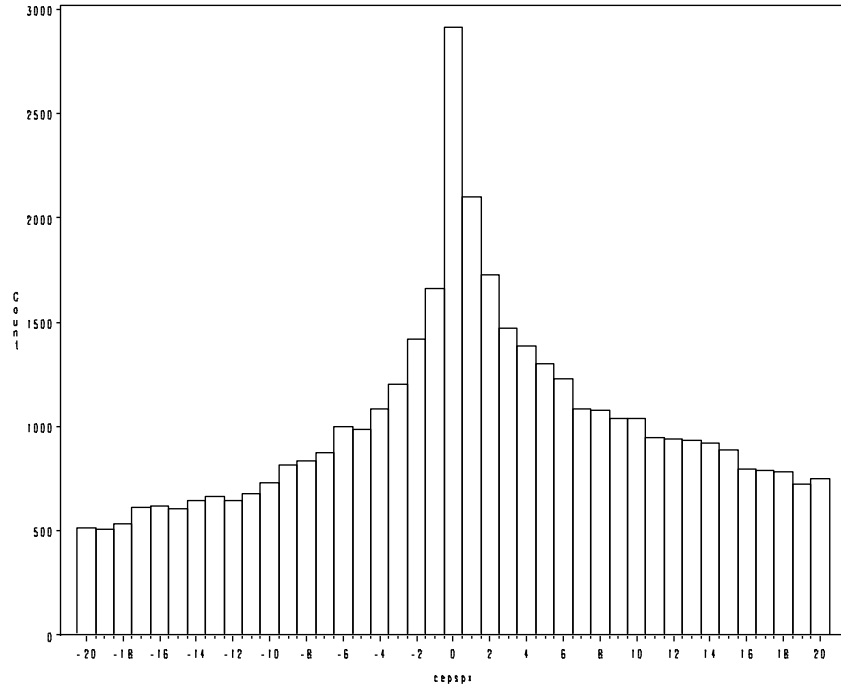
Right Digit		0	1	2	3	4	5	6	7	8	9
Non-negative	Median difference (%)	33.33	-13.04	4.12	4.00	-9.09	11.11	0.00	-15.38	18.88	-33.33
Earnings	p-value	0.009	0.734	0.314	0.834	0.077	0.070	0.417	0.134	0.127	0.000
	N	4,271									

Panel B: Diluted EPS in the Post-SFAS 128 Period

Right Digit		0	1	2	3	4	5	6	7	8	9
Non-negative	Median difference (%)	27.27	0.00	16.67	-33.33	0.00	-5.49	-11.90	-10.00	-9.68	-10.00
Earnings	p-value	0.249	0.935	0.025	0.013	0.449	0.403	1.000	0.647	0.626	0.479
	N	2,736									

FIGURE 1
Distribution of Changes in Primary EPS and Diluted EPS

Panel A: Distribution of Changes in Primary EPS under APB 15



Panel B: Distribution of Changes in Diluted EPS under SFAS 128

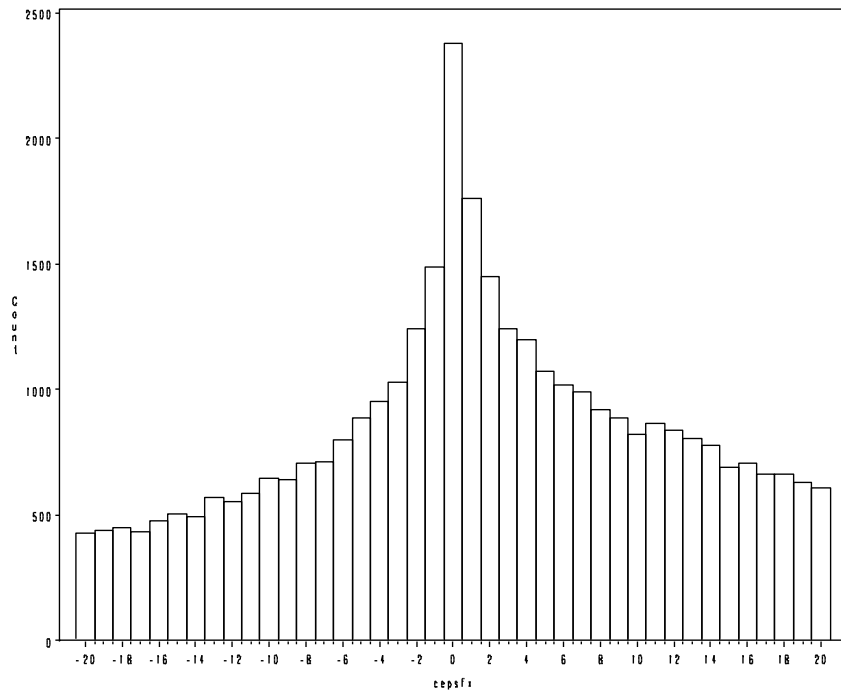
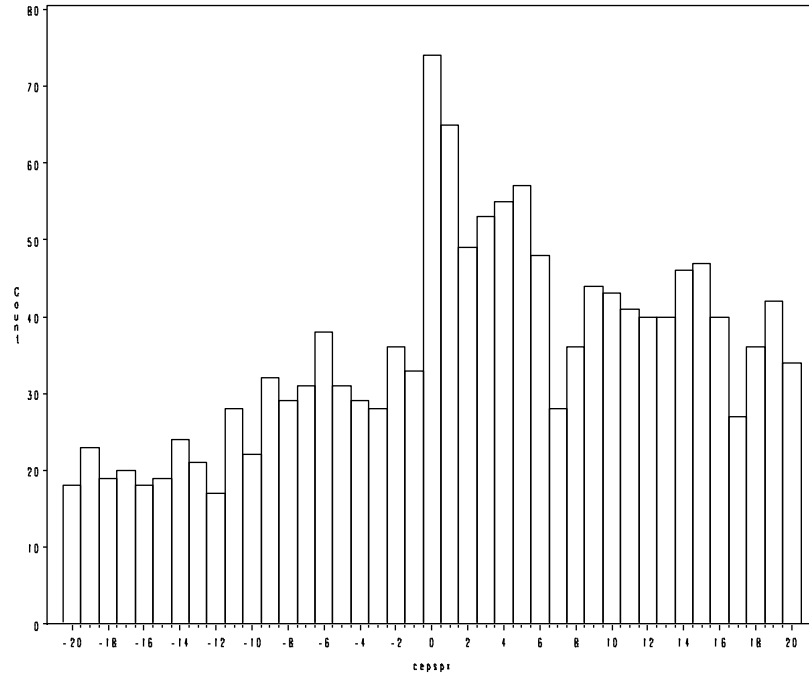


FIGURE 2
Distribution of Changes in Primary EPS ('as reported') and Diluted EPS ('as restated') upon the Adoption of SFAS 128

Panel A: Distribution of Changes in Primary EPS ('as reported')



Panel B: Distribution of Changes in Diluted EPS ('as restated')

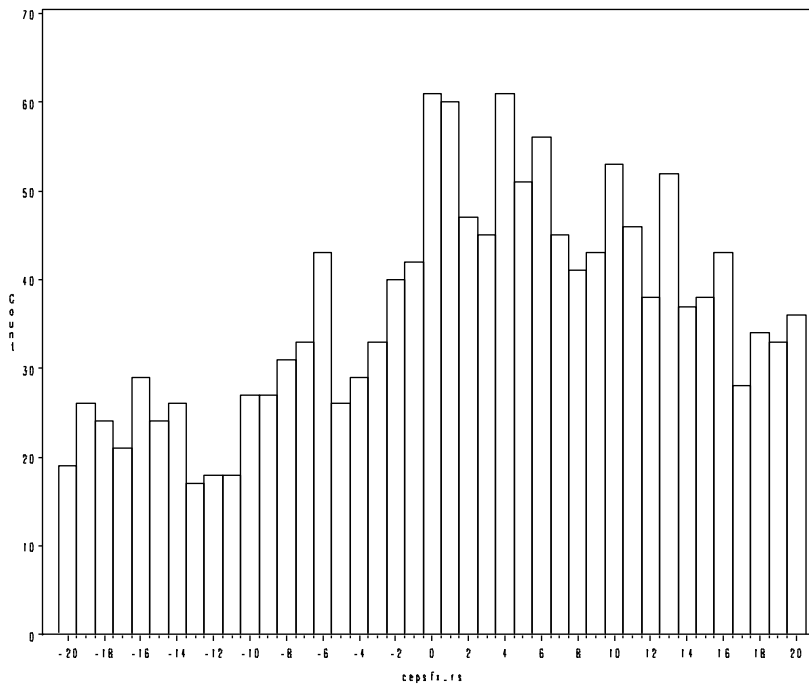
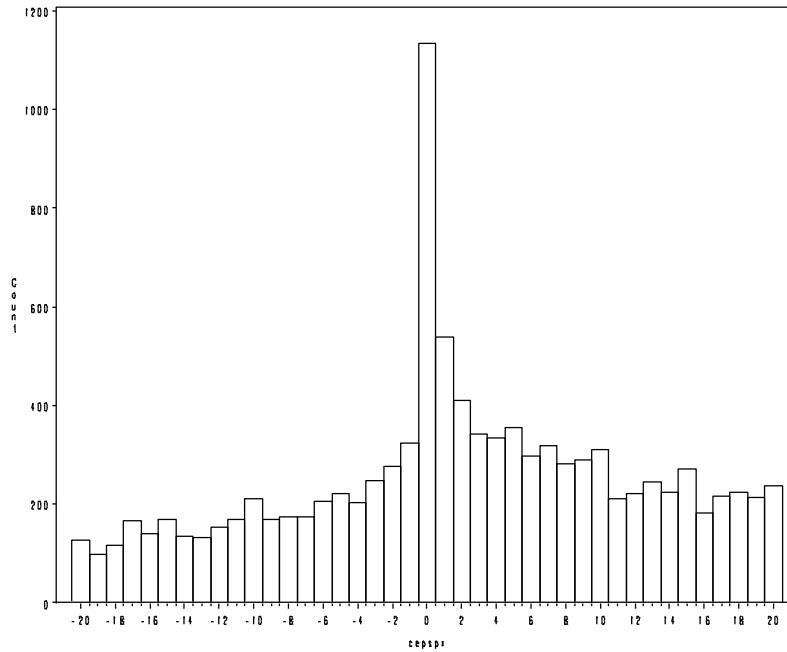


FIGURE 3

Distribution of Changes in EPS Conditioned on the Right Digit of Current EPS

Panel A: Distribution of Changes in Primary EPS under APB 15 When the Right Digit of Current EPS is 0, 5, or 9.



Panel B: Distribution of Changes in Diluted EPS under SFAS 128 When the Right Digit of Current EPS is 0, 5, or 9.

