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ORIGINAL RESEARCH

Evidence that financing decisions contribute to the zero-earnings discontinuity

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Abstract
In this paper we argue that financing decisions contribute to the zero-earnings discontinuity. We find a discontinuity in the distribution of earnings before tax and earnings before special items, but not in the distribution of earnings before interest which suggests that interest expense contributes to the zero-earnings discontinuity. To investigate the role of interest expense in the zero-earnings discontinuity, we further show that there was a discontinuity in the distribution of the level of debt issues around zero earnings contemporaneous with the zero-earnings discontinuity. We also show that the recent disappearance of zero-earnings discontinuity is coincident with the disappearance of the discontinuity in the debt issuance distribution. Overall, our findings suggest that the level of debt contributed to the zero-earnings discontinuity when it existed.

Keywords Earnings distribution · Earnings discontinuity · Earnings management · Financing decisions · Debt issuance

JEL Classification M41

1 Introduction

An earnings discontinuity, where an unusually high frequency of firms report small profits and an unusually low frequency of firms report small losses, has attracted extensive attention from researchers over the past two decades. However, researchers have not reached a conclusion on the reasons why such discontinuities exist. A large and growing body of

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research tends to argue that the discontinuity reflects earnings management (e.g. Hayn 1995; Burgstahler and Dichev 1997; Roychowdhury 2006; Zang 2012; Halaoua et al. 2017; Elleuch Hamza and Kortas 2018; Trimble 2018), while others challenge this view and provide a variety of explanations, such as the effects of deflation and sample selection (e.g. Dechow et al. 2003; Durtschi and Easton 2005, 2009) as well as the asymmetric effects of income taxes and special items on profit and loss firms (Beaver et al. 2007). This paper provides a new explanation for the discontinuity in earnings distribution by investigating how financing decisions affect zero-earnings discontinuity.

Gilliam et al. (2015) marked a turning point in earnings distribution studies by revealing that the discontinuity around zero earnings disappeared with the adoption of the Sarbanes–Oxley Act (SOX) in 2002. Their findings indirectly support the earnings management interpretation of the discontinuity and show that alternative explanations, including scaling, sample selection, tax and special items, fail to explain either the emergence or the disappearance of the discontinuity.

We believe that the disappearance of the zero-earnings discontinuity casts doubt on the existing explanations for the discontinuity and offers an unprecedented opportunity to reinvestigate the reasons behind the discontinuity. For instance, if non-earnings management factors, such as deflation, sample selection or the asymmetric nature of income taxes and special items (e.g. Dechow et al. 2003; Durtschi and Easton 2005, 2009) were identified as drivers of the discontinuity, the discontinuity would not disappear after 2002 as there is no evidence that these drivers have changed after 2002. A better understanding of the factors that affect the discontinuity is, therefore, crucial to avoid spurious conclusions (Beaver et al. 2007).

This study is an attempt to shed light on the factors behind the zero-earnings discontinuity. We argue that the managerial decision to issue debt contributes to the zero-earnings discontinuity. Prior literature has shown that managers' debt issuance decisions are closely related to the earnings level of the firm (Ahn and Choi 2009; Schipper 1989). Pinnuck and Shekhar (2013) argue that the decision to issue external debt is associated with profit versus loss classification of firms and firms reporting a loss are likely to issue lower amounts of debt due to higher cost of debt financing. They report a discontinuity in the level of debt issues around zero earnings, showing that small loss firms issue significantly lower debt than small profit firms. In this paper, we hypothesise that a comparable discontinuity in the distribution of debt issuance is associated with the discontinuity in earnings distribution. We argue that managers' decisions to issue external debt finance, which are influenced by the profit versus loss classification of firms, would in turn affect the level of firms' earnings through interest expense variations. Managers of firms anticipating zero earnings or a marginal loss would be reluctant to issue debt due to the higher cost associated with debt issuance, thereby reporting less interest expenses. On the other hand, firms anticipating a small profit are likely to issue more debt and thus incur higher interest expense, which would push them towards the right of zero earnings. This results in more firms reporting a marginal profit than a marginal loss and hence contributes to the pre-SOX discontinuity around zero earnings.

We suggest that the zero-earnings discontinuity does not exist after the passage of SOX in 2002 due to a shift in financing behaviour of firms. Carter (2013) examines the impact of SOX on capital structure and finds that long-term debt increased after the passage of the Act because of a reduction in information asymmetry. In the same vein, Andrade et al. (2014) indicate that the cost of debt declined after adopting SOX due to more stringent corporate governance and enhanced transparency. We argue that, before 2002, the zero-earnings discontinuity existed as firms with non-positive earnings were

reluctant to raise debt compared with firms with positive earnings because of the higher cost of debt. However, due to reduction in information asymmetry, the gap between small loss firms and small profit firms in terms of debt issues, and consequently in terms of interest expense, vanished after 2002. This leads to the disappearance of the zero-earnings discontinuity.

Our empirical findings support the above predictions. Based on data from U.S. public firms for the period 1976–2015, we plot the distribution of scaled earnings and earnings components to examine changes in the earnings discontinuity over time. We find no discontinuity in earnings before interest for both the pre- and post-2002 periods, while a discontinuity exists pre-2002 for other earnings distributions, including earnings before tax and earnings before special items. These results indicate that interest expense affects the earnings distribution. We also show that the differential impact of financing decisions on the earnings discontinuity in the pre- and post-2002 periods can be explained by a corresponding change in the cost of financing. We then examine the decision to issue debt by small profit and small loss firms for the pre- and post-2002 subsamples. The results indicate that while in the pre-2002 period there is a discontinuity in the distribution of debt issuance, this discontinuity disappears after 2002. Overall, the results suggest that financing decisions, through their impact on interest expense, contribute to the discontinuity around zero earnings.

There is a narrow financial difference between small loss and small profit firms, and their cost of debt is also expected to be comparable. As Pinnuck and Shekhar (2013) point out, in an efficient market small loss and small profit firms should be similar in terms of external financing decisions as there is little or no difference in their economic fundamentals. SOX improved market efficiency (e.g. Chelikani and D'Souza 2011), it is thus expected that, in the post-SOX era, small loss and small profit firms have a closer level of cost of debt and in turn a similar borrowing pattern. In line with this expectation, our findings indicate that the pre-SOX gap between debt/interest expense of small profit and small loss firms declined after the adoption of SOX. Furthermore, we show that, contemporaneous with the disappearance of the zero-earnings discontinuity, a counterpart discontinuity in the distribution of the level of debt issues observed pre-SOX also vanished during the post-SOX period. Our findings suggest that external financing decisions explain the pre-SOX discontinuity around zero earnings and its subsequent disappearance.

This study makes the following important contributions. First, it strengthens our understanding of the zero-earnings discontinuity and its disappearance after 2002. Since Hayn (1995) identified a discontinuity in the distribution of earnings at zero, various explanations have been suggested by the literature. The earnings management interpretation (Burgstahler and Dichev 1997; Hayn 1995) appears to be widely accepted, while alternative explanations are put forward showing that non-earnings management factors, such as scaling and sample selection (Durtschi and Easton 2005, 2009; Dechow et al. 2003) as well as income taxes and special items (Beaver et al. 2007), could explain the zero-earnings discontinuity. However, those explanations may not be valid enough due to weaknesses in research design. Our study provides a new explanation of zero-earnings discontinuity and shows potential reasons why the current explanations are not adequate in explaining the existence and subsequent disappearance of the discontinuity. We show that managers' financing decisions contribute to the discontinuity. Compared with prior studies on earnings discontinuities that focused only on operating activities, this study is, to the best of our knowledge, the first attempt to provide evidence on the impact of non-operating activities on the distribution of earnings.

Second, our research shows improved research design compared with some previous empirical studies. The closest studies investigating the impact of individual earnings components of earnings distribution are Beaver et al. (2007) and Burgstahler and Chuk (2017), however, they fail to use tax-adjusted accounting items. As prior studies have shown that income tax contributes to the discontinuity, in order to isolate the impact of a certain earnings component on the earnings distribution, tax-adjusted items should be used. The present study seeks to remedy this empirical caveat by investigating the impact of tax-adjusted components of earnings on the zero-earnings discontinuity and finds that interest expense contributes to the discontinuity.

Third, this study provides a possible explanation why prior studies (e.g. Dechow et al. 2003; Siriviriyakul 2014; Makarem et al. 2018) failed to find a difference between small profit and small loss firms in terms of earnings management. We examine firms located in the vicinity of zero and show that the discontinuity is due to non-operating items while earnings management measures mainly capture abnormality in operating performance. In particular, we show that earnings manipulation through financing activities can explain the zero-earnings discontinuity.[1]

It should be noted that the present study assumes that financing decisions by firms around zero-earnings are made to optimise their level of debt. This implies that capital structure matters. This is a deviation from the assumption of irrelevance of capital structure by Modigliani and Miller (1958). The relevance of capital structure is still a controversial issue and it is a caveat of our analysis.

The remainder of this article is structured as follows. Section 2 provides a background of prior studies. Section 3 describes our sample and research design. The results are presented in Sect. 4 and, finally, Sect. 5 concludes the article.

2 Background

Discontinuities in the distribution of earnings have been documented by a large body of academic studies (Burgstahler and Chuk 2017). Hayn (1995) reports a discontinuity around zero earnings with too many firms reporting small profits and too few firms reporting small losses. She interprets the discontinuity as a sign of earnings management, suggesting that firms manipulate their earnings to switch from reporting small negative to small positive earnings. Even though the gap between earnings of small loss and small profit firms could be trivial, as Van Caneghem (2002) suggests, a small positive earnings figure is perceived abnormally higher than a small negative one. According to the prospect theory, earnings targets, such as positive earnings versus negative earnings, are important considerations for market participants when they evaluate financial performance and make economic decisions (Kahneman and Tversky 1979). Therefore, managers have incentives to engage in earnings manipulation to avoid missing earnings targets. Based on this assumption, an earnings target can potentially be used to detect earnings manipulation, that

[1] It should be noted that there is a debate about the economic impact of earning management. While some researchers believe that managers manipulate earnings to achieve certain targets or meet analysts' forecasts (e.g., Burgstahler and Eames 2006; Burgstahler and Chuk 2017), Ball (2013) argues that earnings management explanation is due to limited understanding of the determinants of accounting accruals, terminological issues or inappropriate research design. This paper adopts the former approach which holds that earnings management plays an important role in market prices.

is, an irregularity around the target is expected with 'too many' firms meeting the target and 'too few' firms missing it. This irregularity will create a discontinuity in the earnings distribution.

Earnings management tends to be a widely accepted explanation for the discontinuity in the earnings distribution. Burgstahler and Dichev (1997) test for earnings management to avoid losses. The underlying assumption in their study is that in the absence of earnings management the distribution of earnings is relatively smooth at zero. However, they observe a point of discontinuity in the distribution of earnings and suggest that earnings manipulation to avoid losses is responsible for the discontinuity. Similar discontinuities around zero earnings are reported by Beaver et al. (2003) and Jacob and Jorgensen (2007), who also support the earnings management interpretation of the discontinuity. Kerstein and Rai (2007) further extend the earnings distribution approach to explain the formation of the kink in the distribution of annual earnings. They examine changes in the cumulative earnings distribution from the beginning to the end of the fourth fiscal quarter for firms and show that upward earnings management causes the kink in the earnings distribution around zero.

Discontinuity is not just observed around zero earnings but also reported in the distributions of other earnings benchmarks, such as meeting analysts' forecasts (Burgstahler and Chuk 2017). Burgstahler and Eames (2006) report an abnormally high (low) frequency of small positive (negative) earnings surprises in the distributions of earnings surprises and argue that managers avoid missing analysts' forecasts by means of earnings management. Donelson et al. (2013) examine earnings before restatement (managed earnings) and earnings after restatement (unmanaged earnings). They observe a point of discontinuity around last year's earnings and analysts' forecasts before restatement, which disappears when restated earnings are plotted, and a discontinuity around zero earnings both before and after restatement.

The aforementioned discontinuities in earnings distributions are argued to be indicative of earnings management. However, some scholars have cast doubt on the earnings management explanation and provided alternative explanations for the discontinuity. Examining the earnings distribution for the period of 1976–2001, Beaver et al. (2007) show how the asymmetry of certain earnings components, particularly income taxes and special items, creates a discontinuity in the earnings distribution even in the absence of earnings management. They argue that profitable firms pay higher tax which pushes them to the interval to the right of zero, and negative special items push loss firms to more negative territory. This results in a discontinuity around zero earnings regardless of earnings management. Other alternative explanations for the discontinuity include scaling, sample selection and the difference between profit and loss firms (Durtschi and Easton 2005, 2009).

A few studies that directly examined accruals management and real activities manipulation around the zero-earnings discontinuity do not support the earnings management explanation. Comparing firms around zero earnings is based on the idea that small loss firms are less likely to manage their earnings because they would require a little effort to switch from a small loss to a small profit (Burgstahler and Dichev 1997; Kerstein and Rai 2007). Dechow et al. (2003) compare the discretionary accruals of three groups of firms, namely small profit firms, small loss firms and the rest of firms, with the expectation that small profit firms will have higher discretionary accruals than small loss firms if earnings management causes the discontinuity. Their findings, however, are inconsistent with this hypothesis, suggesting that small loss firms exhibit the same level of positive discretionary accruals as small profit firms. Ayers et al. (2006) show that a positive relationship between accruals management and beating earnings targets exists not only at the zero earnings

benchmark but also at other points in the earnings distribution. However, they are unable to conclude that earnings management explains the associations between discretionary accruals and beating benchmarks.

Roychowdhury (2006), on the other hand, provides evidence showing that managers manipulate real activities to avoid reporting annual losses. He finds that small profit firms manipulate their real activities, including sales, production and discretionary expenses, to shift from reporting a small loss to a marginal profit. However, since he does not directly compare small profit and small loss firms, his evidence is not strongly supportive of the earnings management explanation. Siriviriyakul (2014) compares small loss and small profit firms and reports that the two groups are similarly engaged in real activities manipulation. Makarem et al. (2018) find that the small profit and small loss firms are not different in either accruals management or real activities manipulation.

Gilliam et al. (2015) reveal that the discontinuity around zero earnings prior to 2002 is non-existent after the adoption of the Sarbanes–Oxley Act (SOX) in 2002. Examining alternative explanations, including scaling, sample selection, tax and special items, they suggest that these factors explain neither the emergence nor the disappearance of the discontinuity. They interpret their findings as weakly supportive of the earnings management explanation. They, however, note that they are unable to rule out other non-earnings management explanations. Furthermore, there is empirical evidence that while SOX has restricted accruals management, there has been a corresponding increase in real activities manipulation (Cohen et al. 2008) and that firms around the discontinuity (i.e. small loss and small profit firms) are similarly engaged in real activities manipulation post-SOX (Siriviriyakul 2014; Makarem et al. 2018). These are inconsistent with the idea that SOX has reduced overall earnings management sufficiently to eliminate the discontinuity (see Gilliam et al. 2015; Burgstahler and Chuk 2017).

The existing literature on discontinuity has not been able to offer a consistent explanation of the phenomenon. The earnings management explanation assumes that "under the null hypothesis of no earnings management, the cross-sectional distribution of earnings changes and earnings levels are relatively smooth" (Burgstahler and Dichev 1997, p. 102). Based on this assumption, the discontinuity around zero earnings is interpreted as a sign of earnings management. Although such an interpretation has been widely accepted, theoretical underpinnings and empirical evidence to support this assumption appear to be weak (Beaver et al. 2007; Hemmer and Labro 2019). For example, in order for earnings management to be responsible for the discontinuity around zero earnings, small profit firms must exhibit more income-increasing earnings management than small loss firms. However, there is evidence, during both the existence and disappearance of the discontinuity, that the two groups actually show similar levels of upward earnings management (Dechow et al. 2003; Siriviriyakul 2014; Makarem et al. 2018).

Some alternative non-earnings management explanations have then been put forward, which argue that the discontinuity in the earnings distribution is due to factors such as scaling, sample selection and difference between profit and loss observations (Durtschi and Easton 2005, 2009). Others dispute these interpretations and criticise the weaknesses in their research designs. For instance, Gilliam et al. (2015) show that these factors explain neither the emergence nor the disappearance of the discontinuity in their study, and Burgstahler and Chuk (2015) and Jorgensen et al. (2014) argue that Durtschi and Easton's (2005, 2009) results are due to their research design rather than scaling or sample selection. Moreover, there is no evidence that those alternative factors are different before and after the adoption of SOX in 2002. Therefore, if the discontinuity were due to the alternative explanations, it should have existed post-SOX while it disappeared.

Motivated by the ongoing debate in the explanation of zero-earnings discontinuity, we propose a new explanation for it. We argue that the inconsistency between earning management explanation and empirical evidence may be due to the fact that the existing studies in the area mainly capture abnormality in operating items, while the zero-earnings discontinuity could be due to non-operating items, such as interest expenses. We hypothesise that managers' financing decisions, which are influenced by the earnings level of the firms, contribute to both the existence and disappearance of the zero-earnings discontinuity. Pinnuck and Shekhar (2013) argue that debt financing decisions are influenced by the profit versus loss classification of firms. Research has shown, theoretically and empirically, that there are additional transaction costs on issuing debt for loss-reporting firms (Jiang 2008). Moreover, for loss-reporting firms, issuing more debt is likely to result in increased asymmetric costs and a ratings downgrade (Pinnuck and Shekhar 2013). As a result, loss firms are expected to issue less debt compared with profit firms. Higher debt of profit firms pushes them towards the right of zero earnings, which in turn affects the patterns of earnings at zero. To test this, we examine the distribution of earnings before and after key earnings components, including interest expense, special items and income tax, to see if these items contribute to the discontinuity.

3 Data and descriptive analysis

Our sample starts with all firms on the Compustat annual database for the period 1976 to 2015. Firm-year observations are required to have net income and opening market value of equity. Following the requirements applied by prior studies, such as Burgstahler and Dichev (1997), Dechow et al. (2003) and Gilliam et al. (2015), we remove firms operating in regulated industries (SIC codes 4400-4999) and financial industries (SIC codes 6000-6499), as well as observations with insufficient data or with zero earnings from our sample. The resulting sample contains 206,342 firm-year observations.[2]

Table 1 presents distribution statistics for annual net income scaled by opening market value of equity as well as the frequency and percentage of small profit and small loss firms during the sample period. Small loss (profit) firms are those whose scaled net income falls in the interval just below (above) zero earnings. Following Gilliam et al. (2015), interval widths are 0.015.[3] As Panel A shows, there is an overall decreasing trend in the scaled net income, which is consistent with prior studies (e.g., Burgstahler and Dichev 1997; Gilliam et al. 2015). Panel B reports that the proportion of firms reporting a small profit or a small loss has been rising over time. Particularly, the percentages of firms reporting small profits and small losses have dramatically increased from 0.56% and 0.95% in 1976 to 3.89% and 4.44% in 2015, respectively.

Table 2 reports descriptive statistics for key financial variables for the entire sample as well as for small loss and small profit firms pre- and post-2002 (presented in Panel A and Panel B, respectively). We consider the year 2002 as a critical point of time because

[2] Total number of firm-year observations varies by each variable due to missing data and trimming the upper and lower 1% of the firm-year observations for each year to address extreme values.

[3] As Gilliam et al. (2015) observe, interval width could be too wide to hide discontinuities or too narrow to show superficial kinks. Using identical intervals makes it possible to compare our results with those reported by Gilliam et al. (2015). To check the sensitivity of findings to the choice of interval widths, we also replicate the tests using interval widths of 0.01 and 0.02, the results of which indicate similar inferences (we do not report the results considering the length of the paper).

Table 1 Descriptive statistics for scaled earnings and firms around zero earnings

Panel A: Annual net income scaled by lagged market value of equity

Year	N	Mean	Median	SD	Year	N	Mean	Median	SD
1976	3059	0.138	0.163	0.281	1997	6925	−0.043	0.031	0.269
1977	3008	0.124	0.143	0.223	1998	6915	−0.068	0.019	0.293
1978	2919	0.152	0.157	0.192	1999	6815	−0.090	0.025	0.400
1979	3116	0.140	0.155	0.214	2000	6871	−0.094	0.009	0.408
1980	3422	0.096	0.122	0.238	2001	6820	−0.241	−0.030	0.723
1981	3588	0.070	0.091	0.216	2002	6544	−0.228	−0.020	0.781
1982	4112	0.018	0.068	0.282	2003	6267	−0.207	0.010	0.791
1983	4316	0.008	0.069	0.312	2004	6061	−0.085	0.022	0.427
1984	4518	0.009	0.054	0.210	2005	5958	−0.065	0.021	0.313
1985	4555	−0.040	0.047	0.305	2006	5803	−0.070	0.024	0.327
1986	4606	−0.060	0.036	0.325	2007	5794	−0.076	0.015	0.315
1987	4820	−0.020	0.040	0.249	2008	5676	−0.134	−0.010	0.392
1988	4933	−0.030	0.048	0.302	2009	5443	−0.255	−0.010	0.879
1989	4733	−0.050	0.040	0.307	2010	5292	−0.072	0.026	0.372
1990	4652	−0.080	0.030	0.360	2011	5266	−0.065	0.020	0.305
1991	4632	−0.140	0.030	0.563	2012	5233	−0.092	0.012	0.352
1992	4747	−0.070	0.029	0.406	2013	5587	−0.133	−0.010	0.436
1993	4985	−0.040	0.035	0.307	2014	5614	−0.154	−0.010	0.507
1994	5407	−0.010	0.044	0.197	2015	5162	−0.175	−0.020	0.505
1995	5770	−0.020	0.044	0.223					
1996	6398	−0.020	0.040	0.260	Total	206,342	−0.07	0.032	0.432

Panel B: Frequency of small loss and small profit firms by year

Year	Small loss		Small profit		Year	Small loss		Small profit	
	N	%	N	%		N	%	N	%
1976	17	0.56	29	0.95	1996	196	3.06	276	4.31
1977	10	0.33	46	1.53	1997	187	2.70	383	5.53
1978	14	0.48	41	1.40	1998	224	3.24	402	5.81
1979	21	0.67	55	1.77	1999	197	2.89	283	4.15
1980	43	1.26	78	2.28	2000	248	3.61	344	5.01
1981	80	2.23	141	3.93	2001	226	3.31	326	4.78
1982	77	1.87	181	4.40	2002	190	2.90	326	4.98
1983	79	1.83	136	3.15	2003	199	3.18	190	3.03
1984	111	2.46	198	4.38	2004	217	3.58	279	4.6
1985	102	2.24	175	3.84	2005	213	3.58	291	4.88
1986	108	2.34	210	4.56	2006	210	3.62	273	4.7
1987	120	2.49	243	5.04	2007	242	4.18	259	4.47
1988	111	2.25	208	4.22	2008	231	4.07	289	5.09
1989	103	2.18	201	4.25	2009	162	2.98	191	3.51
1990	129	2.77	237	5.09	2010	164	3.10	180	3.40
1991	74	1.60	223	4.81	2011	195	3.70	233	4.42
1992	118	2.49	280	5.90	2012	195	3.73	195	3.73
1993	121	2.43	254	5.10	2013	215	3.85	198	3.54

Table 1 (continued)

Panel B: Frequency of small loss and small profit firms by year

Year	Small loss		Small profit		Year	Small loss		Small profit	
	N	%	N	%		N	%	N	%
1994	135	2.50	268	4.96	2014	243	4.33	235	4.19
1995	157	2.72	258	4.47	2015	201	3.89	229	4.44

Panel A presents number of observations (n), mean, median, standard deviation (SD) of net income scaled by lagged market value of equity by year. Panel B presents frequencies and percentages of small loss and small profit firms by year. Small loss (small profit) include firms located in the interval to the immediate left (right) of zero earnings. Interval widths are 0.015. The figures are computed after trimming the upper and lower 1% of the firm-year observations for each year to address extreme values

Gilliam et al. (2015) reveal that the discontinuity around zero earnings disappeared after 2002. It can be seen that small profit firms are larger in absolute terms for total assets, market value of equity and sales than small loss firms in both periods, while the gaps between the two groups in these items are larger and more significant after 2002.

Small loss firms have lower scaled EBIT, pre-tax income, tax expense and net income than small profit firms throughout the sample period. However, the differences between small loss and small profit firms have become less pronounced and less (or not) significant after 2002. Panel A of Table 2 for the pre-2002 period indicates that INT/MV, SPECIAL/MV and TAX/MV are significantly different between small profit and small loss firms, while Panel B shows that their INT/MV and SPECIAL/MV are not significantly different in the post-2002 period. TAX/MV has also become only marginally different and much lower in terms of difference in means post-2002, suggesting that the contribution of tax expense to the discontinuity declined after 2002.

Table 2 provides preliminary evidence that interest expense contributes to the zero-earnings discontinuity. It can be seen that, in the pre-2002 period, small profit firms have scaled interest expense of 0.049, which is on average 1% of market value of equity larger than that of small loss firms. Such a difference between firms around zero earnings could explain the gap between the number of small profit and small loss firms (see Panel A of Fig. 1). On the other hand, in the post-2002 period when there is no discontinuity in the earnings distribution (see Panel B of Fig. 1), small profit and small loss firms show almost the same level of scaled interest expense (both 0.022). Similar observations are noted in the statistics for scaled debt, which show that the level of DEBT/MV for small profit and small loss firms are significantly different in the pre-2002 period, while they are very similar post-2002.

Overall, the descriptive statistics suggest that although the difference between small profit and small loss firms in terms of size (as reflected in total assets and market value of equity) and performance (as reflected in sales and EBIT) has widened after 2002, the differences between the two groups in terms of scaled earnings components have become less pronounced. These results suggest that the change in the distribution of scaled earnings before and after 2002 reported by Gilliam et al. (2015) could be driven by a corresponding change in the components of earnings. Therefore, investigating earnings components for their individual impact on the earnings distribution can reveal if they contribute to the zero-earnings discontinuity. We look more closely into earnings components and their impact on the discontinuity in Sect. 4.

Table 2 Descriptive statistics for key financial variables

Panel A: pre-2002 (1976 to 2001)

Variables	Small loss (n = 3008)			Small profit (n = 5476)			Whole sample (n = 126,642)			Dif. in means
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	
TA	748.10	42.82	4566.63	939.52	61.32	5063.66	950.44	66.53	6335.33	**1.72***
MV	1075.71	60.89	9911.34	1402.1	63.67	11,567.58	830.75	47.73	6534.87	1.31
S	621.21	27.74	3663.66	820.85	52.46	4143.86	958.98	68.93	5246.24	**2.21***
EBIT	26.77	−0.019	141.93	47.23	1.26	243.61	80.27	3.60	508.07	**4.23****
INT	17.82	0.39	86.05	19.58	0.81	86.16	23.30	1.15	180.59	0.87
SPECIAL	−18.07	0	120.11	−13.07	0	84.11	−7.56	0	197.90	**2.20***
EXT	−1.63	0	23.43	−1.55	0	26.09	−0.73	0	73.50	0.14
PRETAX	−0.62	−0.29	63.80	24.49	0.55	163.37	63.24	2.18	506.75	**8.10****
TAX	2.94	0	37.83	11.71	0.13	77.19	26.36	0.64	180.41	**5.85****
NI	−6.59	−0.41	38.40	10.18	0.362	86.31	35.03	1.40	364.97	**10.12****
EPS	−0.12	−0.05	0.25	0.19	0.05	7.05	0.89	0.33	92.32	**2.39***
DEBT/MV	0.2866	0.0115	0.9109	0.3671	0.0508	0.9677	0.6155	0.1627	2.8823	**1.91***
S/MV	1.2851	0.4421	2.9014	1.7492	0.7983	3.2863	2.9881	1.3975	6.6121	**6.48****
EBIT/MV	0.0256	−0.0014	0.1167	0.0502	0.0243	0.1158	0.0877	0.0917	0.6050	**9.31****
INT/MV	0.0394	0.0092	0.1077	0.0491	0.0167	0.0992	0.0926	0.0278	0.5495	**4.03****
SPECIAL/MV	−0.0089	0	0.0362	−0.0065	0	0.0484	−0.0220	0	0.1946	**2.34***
EXT/MV	0.0002	0	0.0254	0.0005	0	0.0187	0.0062	0	0.1461	0.57
PRETAX/MV	−0.0061	−0.0079	0.0445	0.0156	0.0112	0.0461	0.0053	0.0684	0.4130	**21.03****
TAX/MV	0.0007	0	0.0225	0.0064	0.0033	0.0259	0.0371	0.0191	0.1043	**10.11****
NI/MV	−0.0079	−0.0080	0.0042	0.0074	0.0074	0.0044	−0.0320	0.0458	0.3565	**60****

Panel B: post-2002 (2003 to 2015)

Variables	Small loss (n = 2877)			Small profit (n = 3042)			Whole sample (n = 73,156)			Dif. in means
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	
TA	1295.76	147.08	4854.48	2287.41	262.86	11,610.47	3389.96	160.83	19,000.48	**4.12****

Table 2 (continued)

Panel B: post-2002 (2003 to 2015)

Variables	Small loss (n = 2877)			Small profit (n = 3042)			Whole sample (n = 73,156)			Dif. in means
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	
MV	1287.55	214.18	5435.51	2255.84	344.09	9780.56	3171.72	161.53	15,978.53	**4.55****
S	912.85	71.05	4841.87	1605.05	167.82	8435.74	2811.47	106.44	15,463.17	**3.74****
EBIT	36.47	−0.06	197.65	92.98	4.95	544.01	294.38	2.66	1795.42	**5.09****
INT	23.69	0.45	91.68	35.47	1.11	151.72	46.19	1.15	312.21	**3.36****
SPECIAL	−23.44	0	135.91	−27.60	0	218.50	−27.55	0	358.85	−0.085
EXTRA	−0.10	0	9.64	−0.06	0	1.84	−0.09	0	9.46	**−1.75***
PRETAX	−3.89	−0.7	94.39	40.68	2.67	306.43	254.28	0.641	1898.59	**7.24****
TAX	4.15	0	55.03	17.56	0.46	204.79	82.24	0.19	702.88	**3.29****
NI	−8.64	−1.24	32.80	18.80	2.08	93.32	169.84	0.47	1297.70	**14.47****
EPS	−0.11	−0.04	0.47	0.17	0.06	1.66	0.74	0.02	45.86	**8.50****
DEBT/MV	0.3105	0.0179	0.9338	0.3168	0.0592	0.7309	0.4055	0.0402	2.7398	0.22
S/MV	0.9484	0.3195	2.5912	1.0404	0.4764	1.8839	1.6570	0.5975	5.3780	1.55
EBIT/MV	0.0189	−0.0016	0.1178	0.0318	0.0182	0.0791	−0.0412	0.0343	0.4552	**4.91****
INT/MV	0.0228	0.0030	0.0817	0.0229	0.0053	0.0523	0.0575	0.0090	0.3197	0.06
SPECIAL/MV	−0.0088	0	0.0379	−0.0077	0	0.0322	−0.0246	0	0.2644	1.30
EXT/MV	0	0	0.0010	−0.0001	0	0.0049	−0.0001	0	0.0298	−1.34
PRETAX/MV	−0.0050	−0.0069	0.0446	0.0112	0.0110	0.0389	−0.1107	0.0123	0.5315	**14.64****
TAX/MV	0.0017	0	0.0339	0.0034	0.0024	0.0264	0.0108	0.0022	0.0818	**2.17***
NI/MV	−0.0073	−0.0073	0.0043	0.0076	0.0078	0.0043	−0.1219	0.0094	0.4936	**30****

This table presents number of observations (n), mean, median, standard deviation (SD) and t statistics for difference in means of selected variables for small loss and small profit firms as well as the whole sample for the pre- and post-2002 periods. Observations for 2002, the transition year, are deleted. To lessen the effect of outliers, all the continuous variables are winsorized at 1% tails. Asterisks indicate significance at 1% (**) and 5% (*). Significant differences in means between small loss and small profit firms are in bold

TA, total assets; MV, market value of equity; S, net sales or revenue; INT, interest expense; SPECIAL, special items; EXT, extraordinary items; PRETAX, pre-tax income; NI, net income; DEBT, total debt

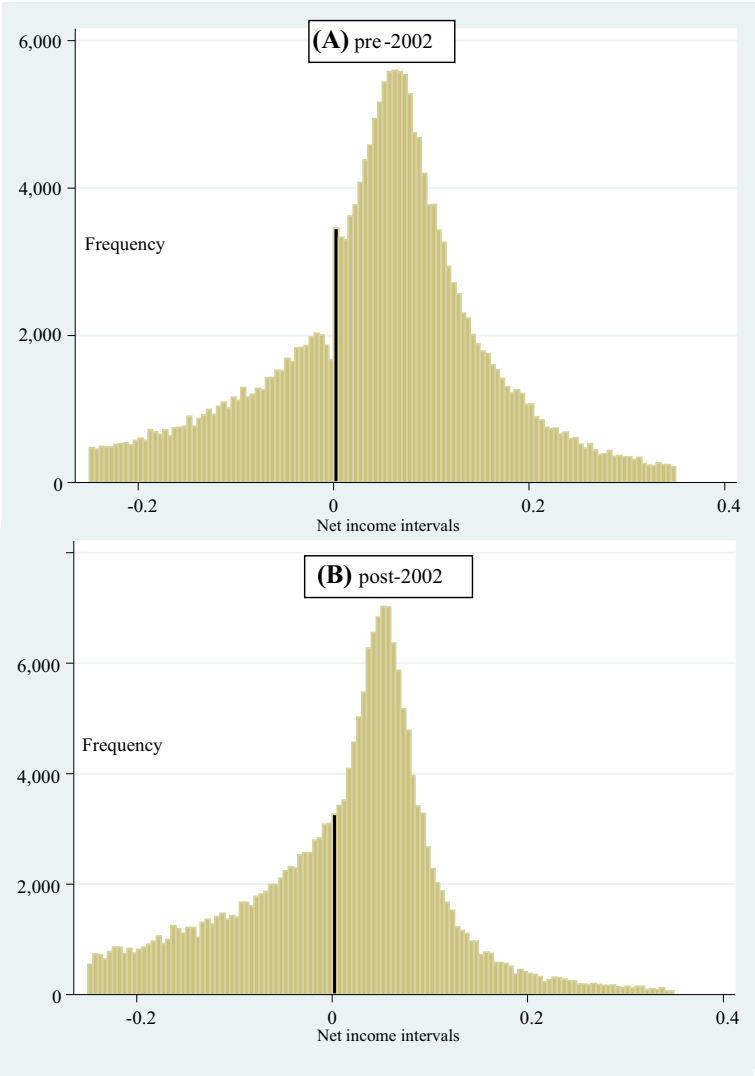

Fig. 1 Distribution of net income pre- and post-2002. This figure illustrates distributions of net income scaled by lagged market value of equity ranging from −0.25 to 0.35 with the interval width of 0.005 (120 intervals). The interval width is consistent with prior studies e.g. Burgstahler and Dichev (1997), Beaver et al. (2007) and Gilliam et al. (2015). The highlighted interval indicates the immediate right of zero. Panel A: pre-2002 (1976–2001) net income (n = 126,642), Panel B: post-2002 (2003–2015) net income (n = 73,156)

4 Results

4.1 Distribution of earnings and earnings components

Following prior studies (e.g. Hayn 1995; Burgstahler and Dichev 1997; Beaver et al. 2007; Gilliam et al. 2015; Burgstahler and Chuk 2017), this section examines earnings

components and their contribution to the discontinuity using earnings distribution graphs. Furthermore, in order to measure the statistical significance of the discontinuities, consistent with Gilliam et al. (2015) and Beaver et al. (2007), we compute annual standardised differences i.e. *t*-statistics calculated as the difference between the actual and expected number of observations in the interval divided by the standard deviation of the difference. The variance of the difference between the actual and expected number of observations in interval *i* is computed as:

$$N_{p_i}(1-p_i)+\left(\frac{1}{4}\right)N(p_{i-1}+p_{i+1})(2-p_{i-1}+p_{i+1})$$

where N is the total number of observations and p_i is the probability that an observation falls into interval i.[4] Annual standardised differences are used to test two hypotheses: (1) the actual number of small loss firms is less than expected; and (2) the actual number of small profit firms is higher than expected. The expected number of observations in an interval is the mean of the number of observations in its two neighbouring intervals. A positive (negative) standardised difference suggests that the actual number of observations in the interval is higher (lower) than expected. Table 3 reports tests of the discontinuities around zero for scaled EBIT and scaled net income.

As Table 3 shows, in virtually every year from 1976 to 2002, the standardised difference for the interval to the left of zero net income (small loss firms) is negative and significant, suggesting that the number of small loss observations is lower than expected, while the standardised differences are not significant from 2003 to 2015.[5] The standardised differences for the interval to the right of zero net income (small profit firms) are often positive and significant before 2002 but not afterwards. These findings are consistent with the existence of the discontinuity before 2002 and its disappearance afterwards as reported by Gilliam et al. (2015), which is also observable in the distribution of scaled net income (see Fig. 1).

With regard to EBIT, very few years show significant standardised differences for the intervals to the left and right of zero EBIT, suggesting that there is no discontinuity in the distribution of EBIT before 2002. This is corroborated by the distributions of EBIT presented in Fig. 2, which do not indicate a significant discontinuity around zero EBIT.[6] As shown by both Figs. 1 and 2, the concentration of observations around zero in the distributions of EBIT and net income has increased from pre- to post-2002. This is in line with the results of Panel B of Table 1, which shows an increase in the percentage of firms reporting a small profit or a small loss over time.

Altogether, an abnormally high number of observations in the interval to the right of zero in the net income distribution and the lack of it in the distribution of EBIT suggest that investigating items deducted from EBIT to arrive at net income could shed light on

[4] This was initially developed by Burgstahler and Dichev (1997) and then corrected by Beaver et al. (2007). The corrected version produces more conservative results as it reduces standardised differences test statistics.

[5] Following prior studies (e.g. Gilliam et al. 2015), annual results are presented in order to present more details about inter-temporal variation in the earnings distribution.

[6] It should be noted that Panel A of Fig. 2 indicates a slight peak in the interval to the immediate right of zero and Panel B shows a trough in the second interval to the right of zero EBIT. However, these irregularities are much smaller and less pronounced than the zero-earnings discontinuity observed in the pre-2002 distribution of scaled net income (Panel A of Fig. 1). Furthermore, in the case of the trough, there is less mass to the right of zero than to the left which is inconsistent with the earnings management explanation which entails a concentration of observations to the right of zero.

Table 3 Test of discontinuity at zero in annual distributions of scaled EBIT and net income

Year	Scaled EBIT				Scaled net income				Year	Scaled EBIT				Scaled net income			
	Left of Zero		Right of Zero		Left of Zero		Right of Zero			Left of Zero		Right of Zero		Left of Zero		Right of Zero	
	N	t	N	t	N	t	N	t		N	t	N	t	N	t	N	t
1976	21	0.32	23	1.04	17	−1.71*	29	0.48	1997	188	0.37	205	0.48	187	−5.05**	383	3.15**
1977	19	0.6	16	−0.4	10	−3.29**	46	1.72*	1998	194	0.18	206	−0.7	224	−4.08**	402	2.11*
1978	18	0.52	17	−0.3	14	−1.97*	41	1.71*	1999	168	0.03	178	−0.1	197	−1.69*	283	−0.20
1979	20	−1	35	1.51	21	−3.12**	55	1.78*	2000	264	1.49	216	−1.6	248	−2.27*	344	1.96*
1980	45	0.55	54	0.86	43	−1.46	78	1.32	2001	226	1.1	217	−0.5	226	−2.12*	326	1.08
1981	93	1.2	82	−0.5	80	−1.76*	141	1.13	2002	204	−0.3	228	0.26	190	−3.47**	326	2.39**
1982	97	−0.5	109	0.14	77	−4.22**	181	3.49**	2003	159	0.29	160	0.2	199	2.06	190	−2.3
1983	105	0.75	99	−0.1	79	−2.88**	136	0.28	2004	224	0.91	226	0.44	217	−0.65	279	−0.7
1984	133	0.73	118	−1.4	111	−2.62**	198	1.13	2005	201	−0.1	209	−0.8	213	−1.59	291	−0.5
1985	97	−0.8	116	0.54	102	−2.51**	175	1.06	2006	197	0.18	196	−0.6	210	−0.52	273	−0.5
1986	126	−0.6	131	0.19	108	−3.61**	210	2.07*	2007	209	0.35	200	−0.1	242	0.54	259	−2.5
1987	143	−0.5	141	0	120	−4.55**	243	3.03**	2008	250	1.73	199	−2.2	231	−1.23	289	0.39
1988	138	0.59	132	−0.1	111	−3.92**	208	2.58**	2009	120	−1.3	133	−0.2	162	−0.5	191	0.5
1989	121	0.87	115	0.13	103	−3.54**	201	2.43**	2010	143	0.3	127	−0.7	164	−0.5	180	−1.3
1990	113	−0.7	146	1.68*	129	−2.08*	237	2.04*	2011	188	1.67	153	−1.5	195	−0.53	233	−0.1
1991	97	−0.6	116	0.27	74	−6.11**	223	4.57**	2012	185	2.18	143	−2.0	195	1.09	195	−1.3
1992	111	−1.7*	161	1.66*	118	−4.71**	280	3.72**	2013	208	3.23	130	−2.8	215	0.55	198	−2.2
1993	122	−0.3	152	0.68	121	−3.87**	254	1.67*	2014	206	1.59	166	−1.3	243	1.16	235	−3.3
1994	155	1.63	139	−1.8	135	−4.08**	268	1.39	2015	192	1.18	163	−1.2	201	−0.55	229	−2.1
1995	151	0.41	154	−0.3	157	−2.69**	258	1.22	Total	5824	2.94	5687	−2.3	5885	−12.5**	8844	4.46**
1996	173	−0.1	176	−0.6	196	−1.65*	276	−1.10									

This table reports annual standardised differences for hypotheses that actual number of small loss firms (small profit firms) is significantly lower (higher) than the expected level. The interval width for separating small profit and small loss firms is 0.015, *n* denotes number of observations and t denotes standardised differences. Note that a standardised difference for left (right) of zero is indicative of a discontinuity if it is both significant and negative (positive). Asterisks indicate one-tailed significance at 1% (**) and 5% (*) and significant differences are in bold.

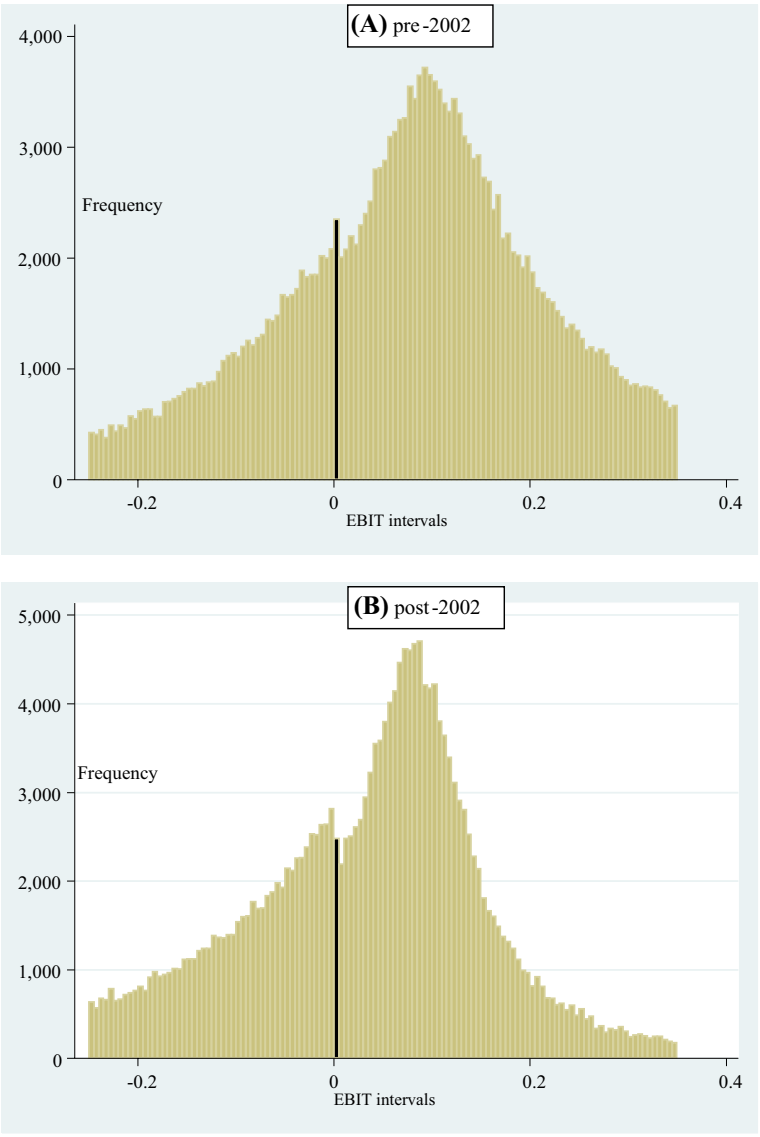

Fig. 2 Distribution of EBIT pre- and post-2002. This figure illustrates distributions of EBIT scaled by lagged market value of equity ranging from − 0.25 to 0.35 with the interval width of 0.005 (120 intervals). The interval width is consistent with prior studies e.g. Burgstahler and Dichev (1997), Beaver et al. (2007) and Gilliam et al. (2015). The highlighted line indicates the interval immediately to the right of zero. Panel A: pre-2002 (1976–2001) EBIT (n = 126,642), Panel B: post-2002 (2003–2015) EBIT (n = 73,156)

factors contributing to the discontinuity. The following section will address this in more detail.

4.2 Distribution of earnings before interest expense, special items and income tax

The main items deducted from EBIT to obtain net income are interest expense, special items and income tax.[7] The literature is inconclusive on the contribution of these earnings components to the discontinuity. Beaver et al. (2007) indicate that income tax and negative special items are essentially asymmetric and thus contribute to the zero-earnings discontinuity. They show that income taxes shift firms with pre-tax profit to the region just above zero in the distribution of net income, while negative special items push loss-making firms away from the region just below zero. This creates a discontinuity around zero earnings. On the other hand, Beaver et al. (2007) examine the impact of some earnings components, including depreciation, interest expense, interest income and non-operating income, on earnings distribution, and find no evidence to support that these items contribute to the earnings discontinuity.[8]

In this study we separately add back tax-adjusted interest expense, special items as well as income tax to net income to examine whether the discontinuity persists. Consistent with Gilliam et al. (2015) tax-adjusted items are computed by multiplying the item amount by one minus tax rate. The tax rate is estimated by dividing income tax expense by pre-tax income. Table 4 presents standardised differences for earnings before interest, earnings before special items (both tax-adjusted) and earnings before tax, respectively, in terms of intervals to both left and right of zero.

As Table 4 illustrates, from 1976 to 2002, both earnings before special items and earnings before tax show significant standardised differences for half the years, while in the case of earnings before interest for the same period only a few years indicate significant standardised differences. Consistent with the results shown in Figs. 3, 4 and 5, these findings suggest that there are obvious discontinuities in distributions of net income before special items and net income before tax but not in the distribution of net income before interest during the pre-2002 period. Moreover, no discontinuity around zero in the distribution of net income before interest expense is observed both before and after 2002 (see Fig. 3), while there is a conspicuous concentration of observations just above zero in the pre-2002 distributions of scaled earnings before special items and earnings before tax (see Figs. 4 and 5).

Comparing the distributions of net income (Panel A of Fig. 1) with net income before interest expense (Panel A of Fig. 3) pre-2002, we can see that adding back tax-adjusted interest expense to net income removes the discontinuity. This is consistent with our hypothesis that interest expense contributes to the discontinuity. However, when comparing the pre-2002 distributions of scaled tax-adjusted earnings before special items and pre-tax income (Panel A of Fig. 4 and Panel A of Fig. 5, respectively) with the pre-2002 distribution of net income (Panel A of Fig. 1), adding back income tax and tax-adjusted special

[7] Other items deducted from EBIT include extraordinary items and discontinued operations. Untabulated results show that the distributions of earnings before extraordinary items and discontinued operations and earnings after them are substantially similar suggesting that they do not contribute to the kink, which is consistent with Beaver et al. (2007). Also, in untabulated results, it is observed that the collective effect of any items other than interest expense, tax expense and special items do not explain the discontinuity.

[8] Beaver et al. (2007) examine distributions of tax-unadjusted Compustat data items. For instance, they compare distributions of OPINCBD (operating income before depreciation) and OPINCAD (operating income after depreciation) to capture the impact of depreciation on the earnings distribution and report that the two distributions are rather similar around zero. However, there is evidence, even in their own study, that income tax affects the earnings distribution around zero, thus, not taking into consideration the potential tax effect may have interfered with their results.

Table 4 Test of discontinuity at zero in annual distribution of net income before interest, special items and tax

Year	Earnings before interest				Earnings before special items				Earnings before tax			
	Left of Zero		Right of Zero		Left of Zero		Right of Zero		Left of Zero		Right of Zero	
	N	t	N	t	N	t	N	t	N	t	N	t
1976	15	−0.77	27	1.18	19	−1.32	28	0.34	17	−0.65	23	0.54
1977	23	0.62	23	0.46	12	**−2.79****	44	1.57	13	**−1.67***	31	1.32
1978	18	0.08	20	0.08	16	−1.12	35	0.75	20	0.581	21	−0.8
1979	25	−0.87	41	**2.05***	22	**−2.78****	50	1.06	17	**−2.62****	45	1.62
1980	54	1.40	43	−1	48	−1.12	84	1.31	54	0.754	63	0.69
1981	98	1.29	102	0.11	87	−1.18	134	0.51	79	−0.08	103	0.39
1982	115	1.51	105	−0.7	88	**−3.26****	166	**2.32****	63	**−3.28****	128	**2.53****
1983	98	−0.71	114	0.48	88	**−2.25***	133	−0.1	72	**−2.23***	130	**2.58****
1984	124	0.42	133	0	131	−1.3	196	0.63	111	−1.21	149	1.31
1985	141	2.12	123	−0.9	124	−0.97	170	0.73	93	−1.51	133	1.5
1986	135	0.85	132	−1.4	111	**−3.82****	211	**2.31***	109	**−1.81***	167	**2.4****
1987	117	**−2.79****	173	1.39	132	**−3.78****	230	**2.13***	114	**−3.4****	197	**3.68****
1988	123	0.16	139	−0.1	123	**−3.36****	204	**2.41****	107	**−2.42***	164	**1.83***
1989	114	−0.13	126	0.03	123	**−1.75***	180	1.08	92	**−2.61****	153	**2.26***
1990	109	−0.44	140	0.03	132	−1.15	208	1.62	117	−1.27	178	**1.66***
1991	86	−1.6	122	0.26	83	−4.2	186	**2.9****	59	**−5.49****	163	**3.6****
1992	126	−1.2	180	0.33	155	**−1.69***	249	**1.65***	115	**−1.74***	183	**1.75***
1993	109	**−2.05***	161	−1.3	149	−1.47	218	−0.2*	101	**−2.42***	173	1.18
1994	139	0.09	173	−0.8	142	**−3.27****	254	0.86	138	−1.63	196	1.16
1995	144	0.33	167	−0.7	169	−1.41	245	0.85	153	0.087	173	−0.35
1996	176	0.74	191	−2.0	194	−1.32	258	−1.4	186	−0.85	220	0.49
1997	175	**−1.98***	260	0.77	203	**−3.33****	359	**2.36***	181	**−1.64***	262	**1.95***
1998	202	−0.52	253	−1.1	233	**−2.12***	376	1.74	187	**−2.37***	265	0.93
1999	168	−0.19	194	−1.3	194	−2.01	291	0.47	160	−1.52	215	0.82
2000	206	−1.00	254	1.47	278	−0.19	325	0.38	237	−0.32	256	0.55
2001	193	−1.45	249	0.88	253	−1.6	337	0.9	192	−1.4	230	0.97
2002	193	−0.79	232	0.58	255	−0.29	308	0.21	182	−1.36	235	0.64
2003	183	2.76	149	−1.8	202	1.87	188	−2.3	177	0.938	183	0.65
2004	168	−1.39	220	−0.1	238	0.688	262	−1.7	204	−0.72	240	0.26
2005	186	−0.37	220	−1.3	214	−1.01	261	−1.6	187	**−2.68****	263	1.33
2006	188	0.29	210	−0.4	224	0.364	266	−0.5	194	−1.01	243	0.87
2007	200	0.18	222	−0.4	241	0.352	262	−1.7	215	−0.02	250	0.74
2008	207	−0.17	219	−1.5	247	−0.9	307	0.52	214	−0.58	248	0.25
2009	161	0.60	153	−0.6	159	−1.13	189	0.42	126	−1.14	145	0.33
2010	147	0.36	150	−0.9	170	−0.22	174	−0.8	159	0.057	160	−0.37
2011	172	−0.83	194	−0.1	200	0.516	211	−1.3	186	0.0	196	−0.46
2012	181	1.41	173	−1	183	0.187	191	−0.9	196	1.603	179	−0.74
2013	204	1.41	176	−1.3	222	1.194	195	−1.8	206	1.001	192	−0.81
2014	215	1.55	190	−2.5	224	0.76	214	−2.8	230	0.997	221	−0.57
2015	194	1.12	175	−2.8	215	0.752	224	−1.7	199	0.413	194	−1.78
Total	5632	−0.08	6328	−3.0	6303	**−7.1****	8423	1.51	5462	**−6.51****	6970	**5.42****

Table 4 (continued)

This table reports annual standardised differences for hypotheses that actual number of small loss firms (small profit firms) is lower (higher) than the expected level. The interval width for separating small profit and small loss firms is 0.015. Asterisks indicate one-tailed significance at 1% (**) and 5% (*) and significant differences supporting the existence of a discontinuity are in bold

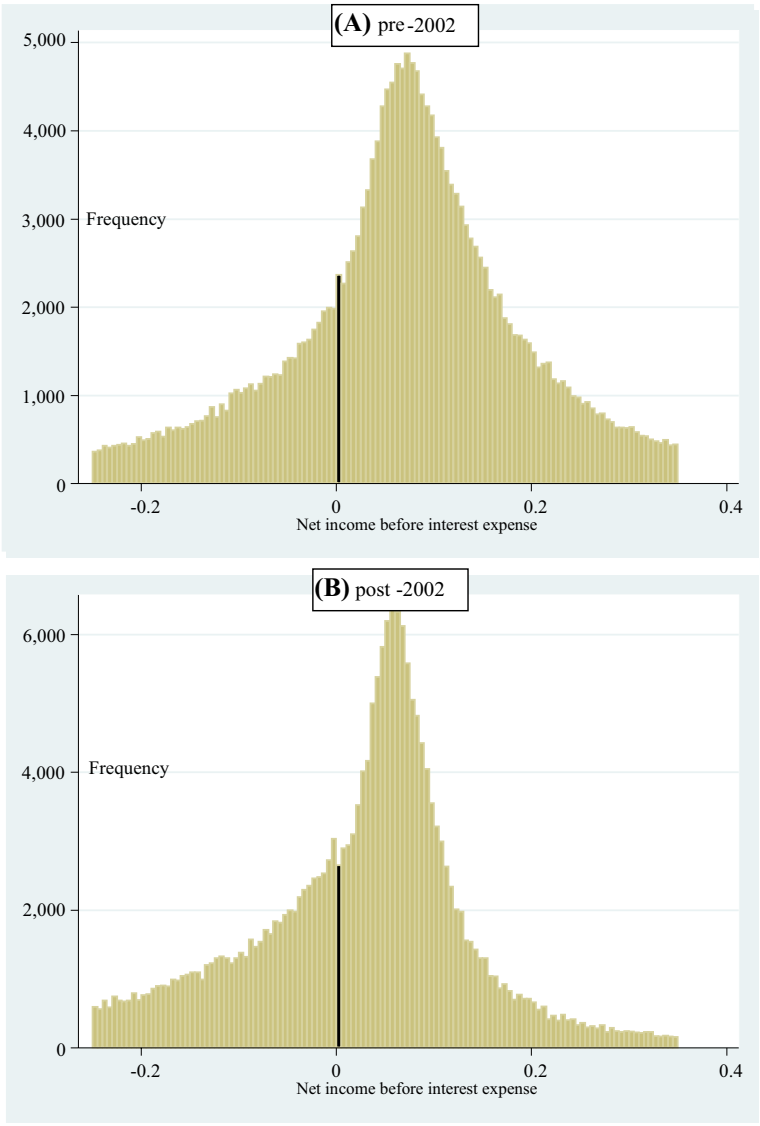

Fig. 3 Distribution of income before interest pre- and post-2002. This figure illustrates distributions of income before interest scaled by lagged market value of equity ranging from − 0.25 to 0.35 with the interval width of 0.005 (120 intervals). The interval width is consistent with prior studies e.g. Burgstahler and Dichev (1997), Beaver et al. (2007) and Gilliam et al. (2015). The highlighted line indicates the interval immediately to the right of zero. Panel A: pre-2002 (1976–2001) income before interest (n = 126,642), Panel B: post-2002 (2003–2015) income before interest (n = 73,156)

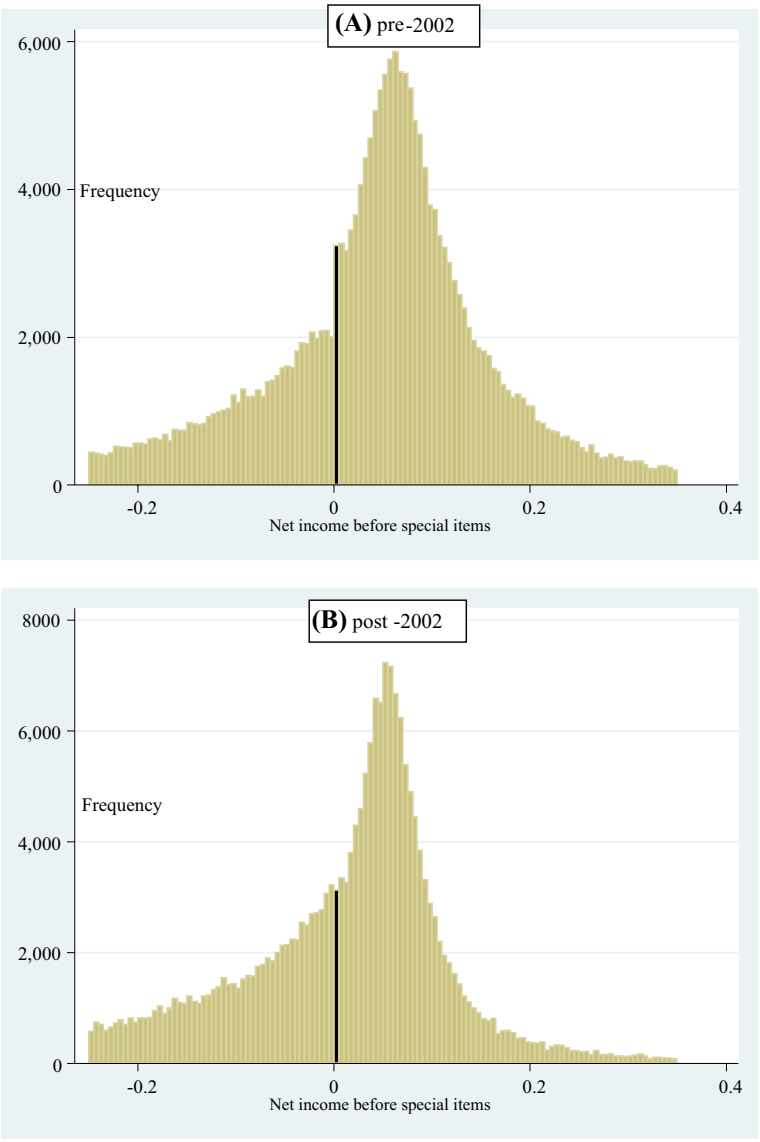

Fig. 4 Distribution of income before special items pre- and post-2002. This figure illustrates distributions of income before special items scaled by lagged market value of equity ranging from − 0.25 to 0.35 with the interval width of 0.005 (120 intervals). The interval width is consistent with prior studies e.g. Burgstahler and Dichev (1997), Beaver et al. (2007) and Gilliam et al. (2015). The highlighted line indicates the interval immediately to the right of zero. Panel A: pre-2002 (1976–2001) of income before special items (n = 126,642), Panel B: post-2002 (2003–2015) income before special items (n = 73,156)

items to net income only slightly diminishes the gap between the frequencies to the right and left of zero intervals. This implies that, in line with the results in Table 4, special items and income tax to some extent have contributed to the discontinuity, although their contribution is not as substantial as that of interest expense. These results for earnings before

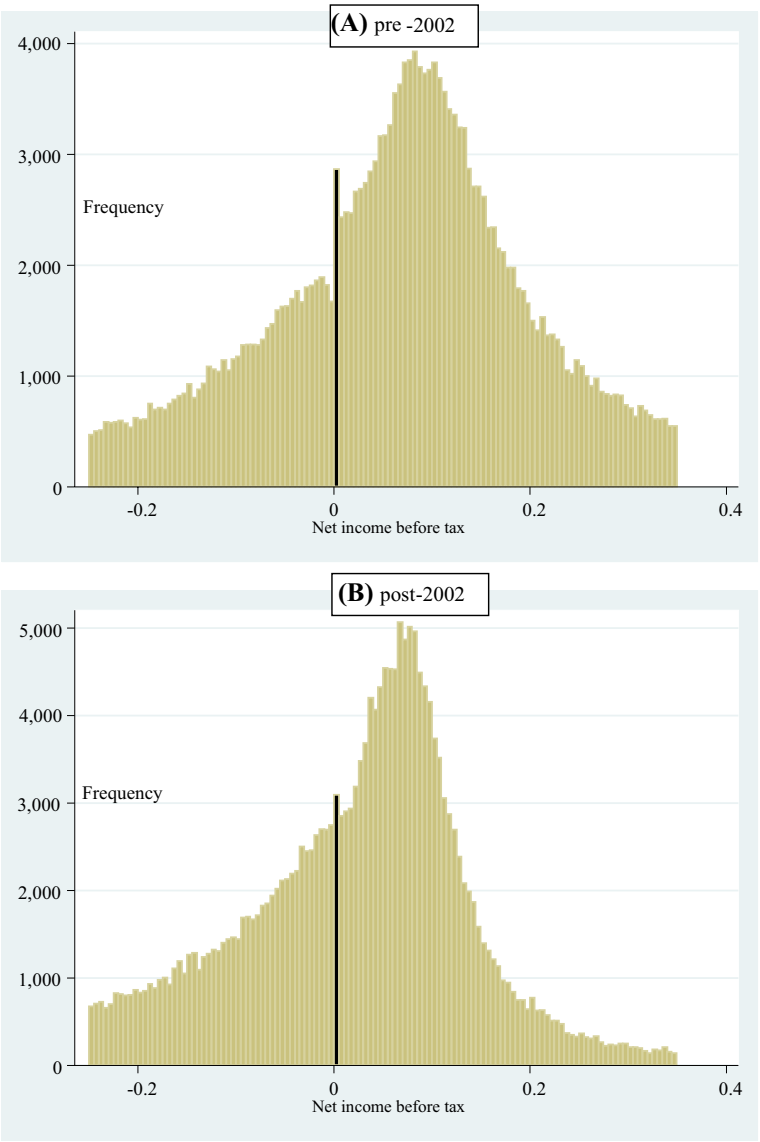

Fig. 5 Distribution of income before tax pre- and post-2002. This figure illustrates distributions of income before tax scaled by lagged market value of equity ranging from − 0.25 to 0.35 with the interval width of 0.005 (120 intervals). The interval width is consistent with prior studies e.g. Burgstahler and Dichev (1997), Beaver et al. (2007) and Gilliam et al. (2015). The highlighted line indicates the interval immediately to the right of zero. Panel A: pre-2002 (1976–2001) income before tax (n = 126,642), Panel B: post-2002 (2003–2015) income before tax (n = 73,156)

special items and before tax are consistent with findings of Beaver et al. (2007). Specifically, Beaver et al. (2007, p. 526) suggest that "although both earnings components [i.e. income taxes and special items] contribute to the discontinuity at zero, neither component

causes a substantial shift of observations across the 'red line' from a small loss to a small profit as suggested by an earnings management explanation for the discontinuity".

Panel B of Table 2 indicates that interest expense for small profit firms scaled by market value of equity is 1% greater than for small loss firms before 2002. After 2002 when there is no discontinuity, small profit and small loss firms show substantially the same level of scaled interest expense. The results indicate that: (1) the discontinuity occurs after deducting interest expense, special items and income tax from EBIT; (2) income tax and special items only marginally contribute to the discontinuity; and (3) there is an obvious difference between small profit and small loss firms in terms of scaled interest expense. We interpret these results as evidence of interest expense contributing to the zero-earnings discontinuity.

4.3 Test of discontinuity using Byzalov and Basu (2019) method

In order to provide more compelling evidence on the impact of interest expense on the discontinuity around zero earnings, we conduct further tests by following the work of Byzalov and Basu (2019). Byzalov and Basu (2019) propose a new method for earnings discontinuity tests, which incorporates information on firms adjacent to the zero earnings with information on other firms in order to isolate the net effect of the explanatory variable on the probability of meet/just beat behavior around zero earnings.[9] The method involves a two-stage OLS procedure, with the first stage estimating the pre-managed earnings distribution and the second stage estimating the probability of meet/just beat behavior. Compared with logit model which is commonly used in previous studies, Byzalov and Basu's (2019) method measures the impact of multiple explanatory variables on the earnings discontinuity and therefore allows to test hypotheses about the determinants of meet-or-just-beat behaviour (Byzalov and Basu 2019).

We run Byzalov and Basu's (2019) test separately for pre- and post-2002 subsamples. The results are reported in Table 5. The estimated parameters include α_0, α_1, α_2 and α_3 which are polynomial coefficients in the pre-managed earnings distribution and π which is the probability of meet/just beat behavior conditional on the explanatory variable. The explanatory variable is the lagged tax-adjusted interest expense.

As Table 5 indicates, while in the pre-2002 period the coefficient on π is positive and statistically significant (coef. = 0.2250), it is insignificant in the post-2002 period. This result supports the existence of the discontinuity before 2002 and its disappearance afterwards. It suggests that on average 22.5% of small profit firms were engaged in meet/beat behavior before 2002. Similar results are observed with the interaction between π and interest expense. The coefficient on $\pi \times INT$ is positive and significant for the pre-2002 period, while it is insignificant for the post-2002 period, indicating that there is a positive association between interest expense and meet/beat behavior before 2002 but such an association is not observed after 2002.[10] Overall, consistent with the findings in the previous section,

[9] The method assumes smoothness of the distribution of pre-managed earnings and an incremental discontinuity at zero earnings. A local polynomial approximation is employed to model the pre-managed smooth distribution. The polynomial terms interact with the explanatory variable to implement the conditioning on it. Firms outside the area around zero earnings determine the pre-managed distribution conditional on the explanatory variable while abnormal small losses and small profits determine the managed distribution conditional on the explanatory variables (Byzalov and Basu 2019).

[10] It should be noted that although we follow Byzalov and Basu's (2019) method which is argued to be appropriate in examining the determinants of earnings distribution, the impact of interest expenses on earnings discontinuity should be explained with caution, as referring association does not necessarily lead to

Table 5 Interest expense and earnings distribution pre- and post-2002

	Pre-2002		Post-2002	
	Coef	t stat	Coef	t stat
α_0	0.0290**	70.69	0.0272**	52.48
α_1	0.5296**	21.28	0.2857**	8.86
α_2	0.4575**	7.86	0.7145**	9.46
α_3	−0.9017**	−3.89	1.1332**	3.83
π	0.2250**	16.48	−0.0130	−0.76
$\pi \times$INT	0.0049*	1.99	−0.0000	−1.49
Adj. R^2	0.43%		0.32%	
N	23,332		15,628	

This table reports the results of Byzalov and Basu (2019) test with tax-adjusted interest expense (*INT* interest expense multiplied by complement of tax rate) as the explanatory variable. Following Burgstahler and Dichev (1997) and Byzalov and Basu (2019), the explanatory variable is lagged. The Stata code used is kinkyX NI INT, binwidth(0.0025) est_bins(16) em_bins(4) em_type(ii) degree(3) cluster(gvkey). The bins width, est_bins, and em_bins are consistent with Byzalov and Basu (2019). *NI* is the dependent variable computed as net income before extraordinary items divided by lagged market value of equity. The estimated parameters α_0, α_1,α_2 and α_3 are polynomial coefficients in the pre-managed earnings distribution from stage 1. π is the meet/just beat behavior probability from stage 2. Sake of brevity, the interaction between the interaction terms between the explanatory variable and the parameters α_0, α_1,α_2 and α_3 are not tabulated. The t-statistics are clustered by firm (gvkey). Asterisks indicate significance at 1% (**) and 5% (*) level

the results suggest that interest expenses, as a result of firm's financing decisions, are likely to affect the earnings distribution around zero.

4.4 Zero-earnings discontinuity and cost of financing

In previous sections we show that financing decisions through their impact on interest expense are likely to affect the distribution of earnings. As financing decisions are affected by cost of financing, this section further investigates whether the cost of financing, measured by the weighted average cost of capital (WACC), can explain the discontinuity around zero-earnings by employing the model used in Sect. 4.3. WACC is calculated as the weighted average of cost of debt and cost of equity. The results are reported in Table 6.

As the table indicates, the coefficient on $\pi \times WACC$ is positive and significant for the pre-2002 subsample, which shows a direct association between cost of financing and probability of meet/just beat behaviour. The coefficient on the interaction term turns to be negatively significant for the post-2002 period, suggesting that the relationship between meet/just beat behavior and cost of financing has reversed after 2002. It shows that there is a shift

Footnote 10 (continued)
causal inference (Pearl, 2010). Indeed, to the best of our knowledge, no prior studies on the zero-earnings discontinuity have been able to provide solid causal evidence.

Table 6 Weighted average cost of capital and earnings distribution pre- and post-2002

	Pre-2002		Post-2002	
	Coef	t stat	Coef	t stat
α_0	0.0288**	63.49	0.0266**	40.13
α_1	0.5876**	21.85	0.4416**	11.47
α_2	0.5151**	8.04	0.8172**	8.59
α_3	−0.9858**	−3.84	0.9363*	2.52
π	0.2539**	16.57	0.0008	0.04
$\pi \times$WACC	0.028*	3.27	−0.3040*	−2.29
Adj. R^2	0.53%		0.52%	
N	18,646		10,123	

This table reports the results of Byzalov and Basu (2019) test weighted average cost of capital (*WACC* computed as weighted average of cost of equity capital and cost of debt) as the explanatory variable. Following Burgstahler and Dichev (1997) and Byzalov and Basu (2019), the explanatory variable is lagged. The Stata code used is kinkyX NI WACC, binwidth(0.0025) est_bins(16) em_bins(4) em_type(ii) degree(3) cluster(gvkey). The bins width, est_bins, and em_bins are consistent with Byzalov and Basu (2019). *NI* is the dependent variable computed as net income before extraordinary items divided by lagged market value of equity. The estimated parameters α_0, α_1,α_2 and α_3 are polynomial coefficients in the pre-managed earnings distribution from stage 1. π is the meet/just beat behavior probability from stage 2. Sake of brevity, the interaction between the interaction terms between the explanatory variable and the parameters α_0, α_1,α_2 and α_3 are not tabulated. The t-statistics are clustered by firm (gvkey). Asterisks indicate significance at 1% (**) and 5% (*) level

in the cost of financing in the post-SOX era. As discussed in Sect. 1, we assume that the zero-earnings discontinuity disappear during the post-SOX era due to a shift in financing behaviour of firms. Our findings are consistent with prior evidence on the impact of SOX on capital structure (Carter 2013) and the cost of debt (Andrade et al. 2014) suggesting that the differential impact of financing decisions on the earnings discontinuity in the pre- and post-2002 periods can be explained by a corresponding change in the cost of financing.

Based on our initial findings that interest expense has contributed to the discontinuity, the following section will further explore how and why interest expense resulted in the discontinuity before 2002.

5 Financing decisions and zero-earnings discontinuity

This section explains how interest expense contributes to the discontinuity. Carter (2013) shows that the passage of SOX resulted in a shift in financing behaviour of firms. He examines the impact of SOX on capital structure and finds that long-term debt increased after the passage of the Act because of a reduction in information asymmetry which made debt less costly. In the same vein, Andrade et al. (2014) indicate that as a result of better corporate governance and more transparency brought by SOX, the cost of debt has declined. Pinnuck and Shekhar (2013) report a discontinuity around zero earnings in the distribution of debt issuance, with small loss firms issuing significantly lower debt than small profit firms.

Table 7 Test of discontinuity at zero earnings in the frequency of firms issuing debt

	Left of zero		Right of zero	
	N	t	N	t
Pre-2002	1286	− 12.90**	2667	6.69**
Post-2002	804	− 1.19	1051	− 1.81

This table reports standardised differences for firms reporting a small loss and a small profit that issue debt for the pre- and post-2002 periods. *t* statistics tests for the hypotheses that actual number of debt issuance by small loss firms (small profit firms) is lower (higher) than the expected level. The expected level of debt issuance for small loss/profit firms is determined as the average of the frequency of debt issuance in the immediate neighbouring intervals. The interval width for separating small profit and small loss firms is 0.015. Asterisks indicate one-tailed significance at 1% (**) and 5% (*) and significant differences are in bold

They argue that while small loss and small profit firms are essentially similar in economic fundamentals, lenders use the binary classification of firms into profitable and loss-making and offer better terms to small profit firms. However, their evidence is predominantly for the pre-2002 period (i.e. 1976 to 2006). Given the evidence of a difference between small profit and small loss firms in the decision to issue debt before 2002 (Pinnuck and Shekhar 2013) and the shift in firm financing behaviour after 2002 (Carter 2013), examining the distribution of debt issuance in the post-2002 period could indicate whether financing decisions contribute to the zero-earnings discontinuity.

To examine whether there is a discontinuity in the debt issuance distribution, similar to previous sections and consistent with prior research studying discontinuities in earnings distributions (e.g. Burgstahler and Dichev 1997), standardised differences are used. The only assumption of the test is that under the null hypothesis of no discontinuity, the expected level of debt issuance in any earnings interval is the average of the actual levels of debt issuance in the immediate neighbouring intervals. We first compute the frequency distribution of debt issuance for pre- and post-2002 for each earnings interval. The intervals are determined based on earnings scaled by lagged market value of equity with the width of 0.015.

Table 7 shows standardised differences in the frequency of debt issuance (*t* statistics) for firms around zero earnings. The standardised difference is significant before 2002 which signifies the existence of the discontinuity in debt issuance which is consistent with Pinnuck and Shekhar (2013) who showed a kink around zero earnings in the distribution of debt issuance. However, the difference is not statistically significant after 2002, suggesting no discontinuity in the distribution of debt issuance as we expected. This is consistent with our earlier evidence on the level of debt shown in Table 2, that there is a significant difference between small loss and small profit firms in terms of scaled level of debt (DEBT/MV) and, in turn, interest expense (INT/MV) before 2002 which disappeared afterwards. These findings collectively support our hypothesis that financing decisions contribute to the earnings discontinuity.

To explain how financing decisions and level of debt contribute to the zero-earnings discontinuity, we argue that in the pre-SOX era there was a gap between small loss and small profit firms in terms of the level of debt and interest expense (see Table 2) because of the higher cost of financing imposed on loss-making firms compared with profit-making

firms. This is due to the binary classification of firms into profitable and loss-making by lenders. As a result, better terms were offered to small profit firms although the economic fundamentals of firms with very small positive earnings and those with very small negative earnings are basically similar (Pinnuck and Shekhar 2013). This differential lending behaviour results in small loss firms issuing less debt due to high cost of debt, while firms expecting a small profit tend to issue more debt which results in higher interest expense and in turn pushes them towards the right interval of zero earnings. In other words, the gap in the interest expense between small loss and small profit firms affects the frequency of firms around zero earnings.

In the post-SOX era, on the other hand, by virtue of improvements in corporate transparency (Andrade et al. 2014) and reduction in information asymmetry (Carter 2013) brought with SOX enactment, the market is more aware that the fundamentals of small loss and small profit firms are similar and thus is less impressed by beating the zero earnings benchmark by a small margin (see Koh et al. 2008). Therefore, as suggested by our findings, small loss and small profit firms are treated similarly by lenders and have a similar cost of debt, which results in a similar level of debt and interest expense for the two groups. This is in line with the post-SOX disappearance of the zero-earnings discontinuity.

6 Conclusions

In the light of recent evidence that the discontinuity in the distribution of earnings around zero disappeared after 2002, this study seeks to identify factors that contributed to the emergence of the discontinuity and its subsequent disappearance. While there is an apparent discontinuity in the distribution of net income pre-SOX, we find no discontinuity in the distribution of EBIT during the existence of the zero-earnings discontinuity (i.e. pre-SOX) and its disappearance post-SOX. This suggests that the discontinuity is due to non-operating items deducted from EBIT to arrive at net income. This finding explains why earnings management measures that use operating performance have not been able to find a significant difference between small loss and small profit firms (see Dechow et al. 2003; Siriviriyakul 2014; Makarem et al. 2018). Our results reveal that interest expense contributes to the zero- earnings discontinuity. We show that the pre-SOX discontinuity in the distribution of debt issuance (Pinnuck and Shekhar 2013) has also recently disappeared which further supports the idea that financing decisions contributed to the zero-earnings discontinuity. We argue that, in the pre-SOX period, small loss (profit) firms had a higher cost of debt and hence lower (higher) debt which led to lower (higher) scaled debt and interest expense. By virtue of higher transparency and market efficiency with SOX, small loss and small profit firms have a similar cost of debt which is reflected in their similar scaled debt and interest expenses. Our findings suggest that interest expense contributes to the discontinuity. It should be noted that this does not rule out the earnings management explanation since our findings could be interpreted as earnings management through the manipulation of financing activities. While the current earnings management literature is focused on operating activities, our study sheds light on the investigation of real activities manipulation through financing activities.

This study reveals the role of financing decisions in explaining zero-earnings discontinuity. Apart from the zero-earnings benchmark, discontinuities have been observed around other earnings benchmarks, such as meeting analysts' forecast. Jing (2008) finds that beating earnings benchmarks, including the profit benchmark and the analyst earnings forecast,

can lead to low cost of debt. Therefore, managers may adjust their level of debts if they anticipate that they are likely to miss the analysts' earnings forecast. Future research can extend our study by looking at the role of financial decisions in the discontinuity around analysts' earnings forecasts. It is also worthwhile to study whether the disappearance of zero-earnings discontinuity indicates any shift in investors' perception making zero earnings a less important earnings benchmark to meet/beat.

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Conflicts of interest The authors declared that they have no conflict of interest.

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