On the models and estimation of discretionary accruals

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Abstract

We address two important statistical issues in the estimation of discretionary accruals: the accrual models and the estimation approach. We note that the Jones models (Jones 1991, Dechow et al. 1995) in spite of their popularity in earnings management studies suffer from misspecification issues. We also note that the industry approach, which has virtually been the only method applied to the accrual models, also has some critical caveats. We critically analyze the two statistical issues caused by the predominant reliance on the Jones models and the industry approach; we propose and show the superiority of alternative models and estimation approaches.

We compare two new discretionary models (Yoon and Kim 2013) with the Jones models; and document that the Jones models suffer from misspecification problems and that the new models are superior to the Jones models. We also propose to apply a financial-structure approach to the accrual models; and document that the financial-structure approach achieves superior estimation performance than the industry approach in terms of coefficient stability and the robustness of discretionary accruals. The main contribution of our study to the literature is to show that the financial-structure approach is superior to the widely used industry approach when it comes to applying the models to estimate discretionary accruals.

Key Words: Jones model, modified Jones model, new models, discretionary accruals, nondiscretionary accruals, financial-structure approach, industry approach

On the models and estimation of discretionary accruals

1. The purpose of the study

The study addresses two important statistical issues in the estimation of discretionary accruals: the accrual models and the estimation approaches. As such, the research issues are not related to research-specific earnings management hypotheses but to the statistical issues that are applicable to most earnings management studies. More specifically, the study has two purposes. First, the study addresses the statistical validity of the accrual models. Misspecified accrual models may not properly reflect fundamental performance, but rather generate results that lead those who interpret the literature to erroneous conclusions (Dechow et al. 2010). Therefore, this study examines the statistical issues of the Jones model (Jones 1991), the modified Jones model (Dechow et al. 1995) and their variations ─ hereafter 'the Jones models' ─ in terms of theoretical and empirical aspects. Then, the study compares two alternative models proposed by Yoon and Kim (2013) with the Jones models in terms of the statistical performance of the models. In addressing the second purpose, the study touches upon how to apply the models when it comes to estimating discretionary accruals. Researchers have grappled with classifying data based on industry (Holthausen et al. 1995 and Kothari et al. 2005). These papers identified a fundamental problem; sampling based on industry does not result in grouping firms that are most similar. Dechow et al. (2010) specifically notes that variation induced by using industry classification may result in large residuals that do not reflect earnings management or errors. Specifically, our study proposes and shows that the discretionary accruals estimated by the financial-structure approach are superior to those estimated by the industry approach.

Studies on earnings management require the separation of discretionary accruals from total accruals. Therefore, an improper separation of discretionary components of accruals will lead to improper inferences. If nondiscretionary components are treated as discretionary or vice versa, it will be hard to discern the degree of earnings management appropriately (Dechow et al. 2010). There are numerous models suggested for the separation of discretionary accruals from total accruals. The Jones models have attracted wide popularity from researchers in earnings management and other related studies. However, there are some studies, which raise questions regarding the validity of the Jones models (See, for example, Kothari et al. 2005, Collins and Hribar 2002). Additionally, Dechow et al. (2010) suggests that the Jones models likely suffer from Type I errors, classifying accruals as abnormal when they are not. They note the Jones models have low explanatory power. Is this due to earnings management? Alternatively, is it due to model misspecification?

This study first examines the Jones models in terms of their theoretical and empirical validity. This is due to their continuing popularity in spite of some misspecification problems pointed out in the academic literature. Examination of other models is, therefore, not dealt with in this study since they are not as successful as the Jones models in terms of popularity. Then, this study compares two new models proposed by Yoon and Kim (2013) with the Jones models, and shows why the new models are better than the Jones models from theoretical and empirical perspectives.

This study also examines how accruals are affected by financial structures ー asset/liability composition. We argue that financial structures are related to accruals. We believe that current assets/liabilities will exhibit a strong relationship to current accruals (also called working capital accruals); noncurrent assets/liabilities will exhibit a strong relationship to noncurrent accrual. Additionally, we believe that noncurrent assets will be negatively related to noncurrent accruals primarily due to depreciation and amortization expenses. However, no particular directional relationship can be predicted between current assets/liabilities and current accruals.

The remainder of this study is organized as follows. Section 2 reviews relevant literature and discusses its relationship with the current study. Section 3 describes the methodology. Section 4 describes the samples, and reports and discusses the empirical results. Section 5 provides conclusions.

2. Prior literature and the current study

2.1 Prior literature

Prior literature mainly focused on the motivation for and vehicles of earnings management. However, not many studies delve into the appropriateness of the estimation models of discretionary accruals. Early studies on earnings management used a random walk model that used the changes in earnings between two adjacent periods based on the assumption that the accruals of the previous period are the expected accruals of the current period. Then, Jones (1991) proposed a decomposition of accruals into the current and noncurrent components, and used change in revenues as a proxy for the current component and property, plant and equipment ('PPE' henceforth) as a proxy for the noncurrent component. The Jones model has attracted a lot of attention from researchers. Following a similar theoretical path, Dechow et al. (1995) slightly modified the Jones model by replacing the change in revenue with the change in cash-accompanying revenue as a proxy for current accruals.

This revised model attracted even more popularity from researchers. Researchers have rarely challenged the prevailing popularity of the Jones models even though some studies question their validity and proposed alternative models (See Kothari et al. 2005, Yoon and Miller 2002, Jeter and Shivakumar 1999, Kang and Sivaramkrishnan 1995 among others). Even Dechow et al. (1995) admitted that "firms with all models reject the null hypothesis of no earnings management at rates exceeding the specified test-levels when applied to samples of firms with extreme financial performance." Kothari et al. (2005) also reported that the Jones models tend to reject the null hypothesis of no earnings management too often, and that those models fail to generate mean-zero discretionary accruals.[1]

Some other studies on earnings management, however, avoid the accrual models by using a scatter plot or other types of graph approach (Burgstahler and Dichev 1997), or by using a specific accrual approach (McNichols and Wilson 1988). Another major stream of earnings management research is real earnings management (Roychowdhury 2006). McNichols (2000) and Dechow and Dichev (2002), on the other hand, investigate only current accruals using cash flows as main determinants of current accruals, and do not include noncurrent accrual components. Since these other streams of earnings management studies differ fundamentally from the stream of research investigating the discretionary components of total accruals, we will not discuss these studies.

2.2 Main features of the current study

The current study is different from prior studies. First, the current study attempts to examine the theoretical and empirical validity of the Jones models that are the most widely used models in the earnings management literature. Second, the current study compares two new alternative models (Yoon and Kim 2013) with the Jones models in terms of theoretical soundness and empirical superiority. Last but most importantly, the current study proposes a new application approach for the accrual models; the current study proposes a financial-structure approach in place of the industry approach, which is currently the literature’s standard approach.

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[1]. Kothari et al. (2005) say that winsorized extreme observations led to an inability to generate mean-zero discretionary accruals. However, we argue that the failure of generating mean-zero discretionary accruals is related to the suppression of the intercept term in the models that resulted from incorrectly ordering the development of the Jones models (as discussed in 3.1 and 3.2).

3. Methodology[2]

3.1 Underlying concepts for the development of accrual models

The Jones models are the most popular models in earnings management studies. Therefore, we will focus our examination on how the models are developed and what the underlying concepts are.

The development of the Jones models begins with the decomposition of total accruals ('TA' hereinafter) into current accruals ('CA' hereinafter) and noncurrent accruals ('NCA' hereinafter). Then, a statistical model was derived. The statistical model was then standardized by beginning total assets ('A_{t-1}' hereinafter). The final stage of the modeling was to select proxy variables for current accruals and noncurrent accruals, respectively. The Jones model uses changes in revenues (ΔREV) as a proxy for current accruals and lagged PPE as a proxy for noncurrent accruals. The Modified Jones model varies slightly respecting this measurement. [3] The Jones model followed the developmental stages shown below:

The first stage (Decomposition of total accruals)

$$TA = CA + NCA \quad (1)$$

The second stage (Transformation into a statistical model)

$$TA = \beta_0 + \beta_1 CA + \beta_2 NCA + \varepsilon \quad (2)$$

The third stage (Standardization by A_{t-1} to control for heteroscedasticity)

$$TA/A_{t-1} = \beta_0(1/A_{t-1}) + \beta_1 CA/A_{t-1} + \beta_2 NCA/A_{t-1} + \varepsilon \quad (3)$$

The fourth stage (Selection of proxy variables)

$$TA/A_{t-1} = \beta_0(1/A_{t-1}) + \beta_1 \Delta REV/A_{t-1} + \beta_2 PPE_{t-1}/A_{t-1} + \varepsilon \quad (4)$$

The Jones models have appealing characteristics in two aspects. First, they decompose accruals into current accruals and noncurrent accruals. Second, their selection of proxy variables is based on

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2. This study partially repeats Yoon and Kim (2013) to examine the statistical issues of the Jones models and to propose the new models. Since the article is printed in Korean, we repeat some parts of the article in this study, particularly 3.1 through 3.3, to help non-Korean readers understand those parts.

3. The only difference between the Jones model and the modified Jones model is that the latter uses 'changes in revenues (ΔREV) less changes in receivables (ΔREC) ' as a proxy for current accruals.

the assumption that current accruals will be proportional to changes in revenue, and that noncurrent accruals will be related to the level of PPE that affects depreciation expense. These two appealing characteristics explain why many of the earnings management studies use the models. However, the models suffer from misspecification problems that will be discussed in 3.2.

3.2 The specification issues

The Jones models suffer from some misspecification problems. The first misspecification comes from the order used in developing the model. The third stage (standardization) should come before the second stage (transformation into a statistical model). By reversing the two stages, the Jones models inadvertently include an unstandardized new variable – the inverse of firm size – into the model in the standardizing process and therefore suppress the intercept term. This will lower the goodness of fit for the models since the inverse of firm size would be independent of total accruals by construction. Furthermore, by suppressing the intercept term, the regression line should go through the origin, which is also unwarranted.[4]

The second misspecification is less clear than the first one, but may have a more pronounced impact on the separation of discretionary accruals from total accruals. The use of ΔREV as a proxy for current accruals may not be as good as it was intended since there are a variety of other elements constituting current accruals. For example, changes in expenses may be equally important as changes in revenues. Therefore, we need to take into account a more comprehensive review of the proxies for changes in operating activities. Because this is an empirical question rather than theoretical prediction, we examine the empirical validity of the proxy variable for current accruals. As a plausible alternative, we propose two proxies for current accruals: changes in revenues and changes in net receivables. We presume that changes in revenues will control for changes in operating activities; current accruals might be proportionately related to changes in revenues. Changes in net receivables represent changes in accounts receivable less changes in accounts payable. Conceptually, this proxy is based on asset/liability management. Firms typically manage related assets and liabilities together for risk management purposes. The asset/liability management technique generally utilizes a net exposure concept. Changes in net receivables represent the net exposure created by the operations-related credit

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4. Some prior literature includes a constant in addition to the inverse of firm size to circumvent this issue (See Zang 2012 for example). Then, this will lead to another misspecification problem in the sense that the inverse of firm size would be included in the model without proper justification.

policies granted or utilized by individual firms. We believe that changes in net receivables will proxy current accruals in a more comprehensive and realistic manner than do changes in revenues.[5]

Finally, even though the use of PPE as a proxy for noncurrent accruals is quite appealing, it may not sufficiently reflect the characteristics of other significant noncurrent accruals. One additional factor this study considers is the level of intangible assets. The significance of intangible assets should increase in the information and knowledge-prone modern business environments. Therefore, the inclusion of intangible assets is warranted as an additional variable to proxy for noncurrent accruals.

3.3 The development of new models and comparison with the Jones models

Based on the above arguments, Yoon and Kim (2013) developed two new models as described in equations (4) and (5) below. We will compare them among themselves as well as with the Jones models which are described in equation (4).

<YK1 Model>

$$TA/A_{t-1} = \beta_0 + \beta_1 \Delta REV/A_{t-1} + \beta_2 \Delta NREC/A_{t-1} + \beta_3 PPE_{t-1}/A_{t-1} + \varepsilon \qquad (5)$$

Here, TA, A_{t-1}, REV, NREC and PPE respectively represent total accruals, lagged total assets, revenue, net receivables, and property, plant and equipment.

New Model 1 does not include the inverse of firm size, but alternatively uses a free constant term. It has two proxy variables for current accruals. However, it does use the same proxy for noncurrent accruals as the Jones models.

<YK2 Model>

$$TA/A_{t-1} = \beta_0 + \beta_1 \Delta REV/A_{t-1} + \beta_2 \Delta NREC/A_{t-1} + \beta_3 PPE_{t-1}/A_{t-1} + \beta_4 INTG_{t-1}/A_{t-1} + \varepsilon \quad (6)$$

Lagged intangible assets (INTG) is added as an additional proxy for noncurrent accruals in New Model 2.

3.4 Application of the models in estimating discretionary accruals

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[5]. Some firms report current assets and current liabilities at their net amount when they prepare balance sheet. See the 2007 consolidated balance sheet of Infosys, Inc.

Prior studies typically estimate discretionary accruals by industries based on the presumption that firms in the same industry will have similar firm characteristics and regression coefficients (For example, see Cohen and Zarowin 2010, Kothari et al. 2005, Xie et al. 2003, Dechow et al.1995, Jones 1991). However, the industry approach has critical caveats. First, the industry approach "assumes time-invariant parameter estimates and typically imposes sample survivorship bias," leading to inconsistent sample sizes within industry (Dechow et al. 2010). The industry approach also implicitly "assumes that firms in the same industry have a common accrual-generating process" (Stubben 2010). Second, the number of firms in each industry differs quite drastically across industries, which makes the regression coefficients inconsistent across industries and less robust resultantly. Third, many firms have multiple business segments that may not belong to the same industry classification. Since the industry approach assumes that the coefficients estimates are constant within the same industry, the third caveat makes industry classification less attractive as a proxy for firm characteristics.

We believe that firms in the same industry may have less similar firm characteristics, but firms with similar financial structures will have more similar firm characteristics. Hence, we propose that discretionary accruals be estimated by firms with similar financial structures. More specifically, we propose to form equal-size portfolios with similar financial structures. Assuming that we construct 10 equal-size portfolios, the portfolios will be constructed based on the ranks of individual financial structure variables (to be discussed later) from the lowest ranks (Portfolio 1) to the highest ranks (Portfolio 10). The financial-structure approach is based on the notion that firms with more operations-related assets and liabilities will have higher relationships with current accruals; firms with more noncurrent assets – possibly noncurrent liabilities too – will have higher relationships with noncurrent accruals. For example, firms with more accounts receivables, inventories, accounts payables and accrued liabilities may tend to have more variability in current accruals, whereas firms with larger PPE and intangible assets may have more depreciation and amortization expenses. Therefore, the second purpose of this study is to examine whether the financial-structure approach is superior to the traditional industry approach in estimating discretionary accruals.

As compared to the industry approach, we believe that the financial-structure approach has some distinct advantages. First, firms with similar financial-structure are more likely to have similar firm characteristics. Second, categorization of firms with similar financial-structures into equal-size portfolios can ensure more robust parameter estimates. Lastly, the financial-structure approach is easy to apply.

3.5 Empirical methods

To achieve the two main purposes of the current study, we compare the performance of alternative discretionary accrual models and estimation approaches in terms of statistical robustness and resulting implications. More specifically, we compare the overall goodness of fit, statistical significance of individual variables, consistency in the coefficients, and standard errors of residuals between alternative models and alternative estimation approaches.

1) Measurement and estimation of accruals

Total accruals are obtained by subtracting operating cash flows from net income. Discretionary accruals are the residuals of the regressions. We estimate them by running the regression models as specified in equations (4) through (6) above.

2) Application of discretionary accrual models

This study uses the financial-structure approach in estimating discretionary accruals and compares them to the ones estimated by the industry approach. For this purpose, we form 10 portfolios based on the ranks of the individual financial-structure variables. Lacking of guidance because this is the first attempt to propose the financial-structure, we examine eight financial structure variables. Then, we use the financial structure variable that demonstrates the highest goodness of fit to carry out the rest of the empirical analyses. The candidate financial-structure variables are accounts receivable, inventory, PPE, intangible assets, accounts payable, current liabilities and noncurrent liabilities. All of the variables are standardized by total assets to control for heteroscedasticity.

The financial-structure approach ensures that we can achieve stability in regression coefficients since each portfolio has the same number of observations. It also enables us to identify whether accruals are associated with differences in financial structure. This is contrasted with the industry approach that may not ensure that the firms in the same industry have similar firm characteristics. Therefore, the assumption that the coefficients are stable or constant within the industry is likely to be violated.

3) Type I and type II error analyses

In addition to the analyses on the overall goodness of the models and significance of individual independent variables, the appropriateness of models and estimation approaches can be determined by doling type I and type II error analyses. Model specification can be identified by type I error analyses;

while the power of models can be determined by type II error analyses. For both type I and type II error analyses, we use standardized prediction errors which are obtained from hold-out samples. We first estimate regression coefficients by running the various models by industries or by financial-structure based portfolios depending on the estimation approaches. We then compute prediction errors using the coefficients estimated from the estimation samples. Prediction errors are divided by standard errors estimated from the estimation samples to obtain standardized prediction errors. We use 5% one-tail tests to identify type I and type II errors. When standardized residuals are greater (less) than 1.645 (-1.645), the null hypotheses of no earnings management are rejected.

Since type II error analyses are designed to determine the power of the models and estimation approaches, we need to conduct simulations by artificially adding or subtracting certain level of seed to total accruals. We believe that there are two important issues with regard to the simulations for this type of research. First, prior literature documents two types of manipulation for simulation analyses. One is revenue manipulation and the other is expense manipulation. For the revenue manipulation approach, seeds are added to both total accruals and relevant independent variables in the models. For example, in case of Jones model, the assumed level of seed is added to total accruals and to revenue and accounts receivable. For the expense manipulation approach, the assumed level of seed is added total accruals only (See Dechow et al. 1995, pp.201-202). We do expense manipulation simulation only in this research since it is more straight forward and easier to interpret than the revenue simulation, while the resulting inferences are basically the same.

Another issue related to simulation is whether we artificially include seeds in the estimation process or in the prediction process. We realize that this issue is also very critical. Kothari et al. (2005) state that "the indicated seed level is added to total accruals *before* estimating the respective discretionary accrual model (p.187)." However, we believe that this does not make sense since the seed will affect only the intercept term, leaving the coefficients on other variables, regression residuals, adjusted R^2 unchanged. The reason is that the seed will be fully reflected in the intercept term since the seed is a constant. The result of adding the indicated seed in the estimation stage will lead to no detection of the seed in the prediction stage since the shifted intercept will fully take into account the seed as nondiscretionary. Therefore, the seed must be added to the hold-out (treatment) sample only.

The simulation procedures employed under the financial-structure approach are as follows:

1. Randomly select 100 firm-years from each of 10 financial-structure portfolios. This will lead us to having 1,000 firm-years in total as the hold-out samples.

2. Simulate expense manipulation by adding artificial level of seed (1%, 10%, 20% and 30% of the lagged total assets) to total accruals of the hold-out sample only.
3. Estimate the models using all firm-years except for the randomly selected 100 firm-years by each financial-structure portfolio.
4. Use each model's coefficient estimates to calculate discretionary accruals for the randomly selected firm-years.
5. Carry out type I and type II error analyses.

The simulation procedures under the industry approach are the same except for the number of randomly selected firm-years. Since firm-years across industries differ, we select hold-out sample randomly in proportion to the number of firm-years in each industry so that we can have 1,000 hold-out observations overall.

There are some cautions about simulation approach which have been neglected in the prior studies. The reasons and actual computational issues are identified in Appendix 2.

4. Sample and Empirical Results

4.1 Sample

The sample consists of multinational data from 66 different countries for the period 2005 to 2010, retrieved from the COMPUSTAT Industrial and Research files. The initial sample is comprised of 2,481 firms[6] for the six-year period, which gives us a total of 14,886 firm-years. Then, we eliminated firms without inventory information (1,102 firm-years), negative intangible assets (128 firm-years), firm-years with less than 100 observations in a two-digit industry (1,244 firm-years), firm-years with $1/A_{t-1}$ greater than 1 (58 firm-years), firm-years with zero PPE and INTG (52 firm-years), and outliers in the total accruals from both sides of the extremes (102 firm-years).[7] The procedure left us with a final sample of 12,200 firm-years.

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6. The country most frequently represented is the USA with 516 firms, followed by Japan with 358 firms. The countries least represented are twelve countries with one firm each.

7. Outliers in total accruals are highly related to outliers in net income and cash flows from operations. Accordingly, elimination of outliers based on total accruals resulted in elimination of the most of outliers in some key variables like net income, changes in revenues, and changes in net receivables.

4.2 Estimation results of discretionary accruals

Table 1 reports the estimation results from the eight different accrual models. The eight models are the six variations of the Jones models and two YK models. The reason for having all six variations of the Jones models is because the prior literature inconsistently uses the six different variations. Use of the variations of the Jones models varies. For example, Jones (1991) and Dechow et al. (1995) use $1/A_{t-1}$ and suppress the intercept term, while Kothari et al. (2005) and Zang (2012) use both the intercept term and $1/A_{t-1}$ together. Stubben (2010), on the other hand, drops $1/A_{t-1}$ and uses the intercept term without explanations. The use of the six variations of the Jones models facilitates us to identify the appropriateness of the six variations of the Jones models by comparing them using the same sample firm-years.

We estimated the eight different models using the financial-structure approach and the industry approach. Table 1 reports the summary regression results. Detailed estimation results are provided in Appendix 1 for some selected models under the two alternative estimation approaches. Panel A reports the summary regression results of eight discretionary accrual models by the industry approach, while Panel B report the same by the financial-structure approach. Untabulated results show that inventory level is the best proxy for financial-structure approach in that it gives highest goodness of fit for the eight discretionary accrual models,[8] even though the adjusted R-squares for other financial-structure based regressions are very similar. Therefore, the results based on other financial structures are not reported here for the sake of presentation efficiency.

[INSERT TABLE 1 ABOUT HERE]

$1/A_{t-1}$ fails to exhibit statistical significance since it alone is an unstandardized variable while the dependent variable (total accruals) and all the other variables are standardized ones. In other words, $1/A_{t-1}$ and total accruals should have no significant relationship by construction since $1/A_{t-1}$ was erroneously introduced in the original Jones model by switching the stages of standardization and statistical modeling process as indicated in Yoon and Kim (2013) and in this paper. One more point that needs to be addressed is that $1/A_{t-1}$ varies only a little bit while total accruals vary across firm-years. As a result, $1/A_{t-1}$ lacks power in explaining total accruals. The inappropriateness of $1/A_{t-1}$ in

[8] The results are not reported here since we ran 640 regressions (10 portfolios times eight financial structure variables times eight discretionary accrual models). Results for the regressions can be made available if requested.

explaining total accruals is graphically shown Figure 1. 84.1% of firm-years have $1/A_{t-1}$ less than 0.01; 99.1% of firm-years have $1/A_{t-1}$ less than 0.2. Figure 1 clearly reveals that $1/A_{t-1}$ lacks power in explaining total accruals. This indicates that the original Jones model and the modified Jones model are grossly misspecified.

[INSERT FIGURE 1 ABOUT HERE]

Table 1 reveals that YK models are superior to the Jones models in terms of adjusted R^2 and the statistical significance of individual variables. All the variables of YK models have expected signs and show statistical significances. Considering the fact that the traditional Jones models (J1 and MJ1) are misspecified because 1/At-1 is included in place of intercept terms, the overall appropriateness of models should be compared between YK models and the variations of the Jones models -- namely J2, J3, MJ2 and MJ3. Then, YK models' adjusted R^2 is two to three times better than those of the Jones model variations.

A glance at adjusted R^2 indicates falsely that Jones model and modified Jones model under the industry approach (the financial-structure approach) have decent adjusted R^2 of 0.17 (0.13) and 0.16 (0.12), respectively, primarily thanks to the strong significance of PPE. The adjusted R^2 for Jones model and modified Jones model are more than two times those of their variations. However, one puzzle remains to be answered since standard errors for all the Jones models are basically the same at 0.11 under the industry approach (0.10 under the financial structure approach). In order to solve the puzzle, we have investigated possible clues. As is shown in Table 1, particularly the coefficients and t-ratios for PPE are unduly magnified when intercepts terms are suppressed and $1/A_{t-1}$ is used in its place.

We uncovered that the magnification of PPE's significance is negatively related to the average total accruals. Particularly when total accruals are more negative, the statistical significance of PPE tends to be magnified. Table 2 shows the relationships between average total accruals, t-ratios of PPE and adjusted R^2 of Jones model under the financial-structure approach.[9]

[INSERT TABLE 2 ABOUT HERE]

[9] We found that the same is true with the industry approach.

Table 2 shows that average total accruals are negatively related to PPE as expected. It further shows that the magnification of t-ratios of PPE is particularly serious when average total accruals are more negative. When t-ratios of PPE are magnified, adjusted R-squares tend to be high. If the overly significant PPE reflects the fact that PPE is an important variable in explaining total accruals, then a PPE regression line plot in explaining total accruals should show a clear negative relationship between PPE level and total accruals. However, if PPE's significance is driven by the suppression of the intercept terms in the traditional Jones and modified Jones model, then a PPE regression line plot may fail to show a clear relationship between PPE and total accruals.

Figure 2 shows a regression line plot of PPE in modified Jones model in explaining total accruals. Figure 2 reveals that there is a general negative relationship between PPE and total accruals, but not to the extent of a very strong negative relationship between them. This indicates that the magnification of PPE's significance is driven by the suppression of the intercept terms in the traditional Jones and modified Jones model.

[INSERT FIGURE 2 ABOUT HERE]

Table 1 reveals that ΔREV and ΔCREV have a positive relationship with total accruals, even though occasionally they affect total accruals negatively depending on models and estimation approaches (See Appendix 1 Estimation of accruals by the industry approach and by the financial-structure approach). Along the same line of analysis, we plot a ΔCREV regression line fit in Figure 3 to facilitate identifying linear relationship between ΔCREV and total accruals. Despite that t-ratios of ΔREV and ΔCREV (3.16 for Jones model and 2.00 for modified Jones model under the industry approach; 5.37 for Jones model and 2.97 for modified Jones model) are much smaller than those of PPE (-5.92 for Jones model and -5.66 for modified Jones model under the industry approach; -10.97 for Jones model and -10.50 for modified Jones model under the financial-structure approach) as can be evidenced in Table 1, Figure 3 shows a clearer positive relation between ΔCREV and total accruals. This result further indicates that the magnification of PPE's significance is driven by the suppression of the intercept terms in the traditional Jones and modified Jones model.

[INSERT FIGURE 3 ABOUT HERE]

Figures 4 through 7 are regression line fit of the four variables included in YK2 model. They are provided here as a means to compare YK2 model's appropriateness with modified Jones model. The four figures show that all four variables have expected relationship with total accruals. In other words, the two proxies for current accruals -- ΔREV and ΔNREC-- have clear positive relationship with total accruals while the two proxies for noncurrent accruals -- PPE and INTG-- have negative relationship with total accruals. Particularly, ΔNREC has a very significant positive relationship with total accruals. In sum, YK2 model seems to be a very promising discretionary accrual model.

[INSERT FIGURE 4 ABOUT HERE]

[INSERT FIGURE 5 ABOUT HERE]

[INSERT FIGURE 6 ABOUT HERE]

[INSERT FIGURE 7 ABOUT HERE]

The appropriateness of models can be determined from the perspective of coefficient consistency. For example, ΔREV in Jones model and ΔCREV in modified Jones model are deemed to be proxies for working capital accruals (also called current accruals) while PPE is deemed to be a proxy for noncurrent accruals. Therefore, ΔREV and ΔCREV are likely to have a positive relationship with total accruals while PPE is likely to have a negative relationship with total accruals. Table 3 shows the results of consistency checks for coefficients. Panel A and Panel B show the coefficient consistency under the industry approach and the financial-structure approach, respectively.

Some findings are in order. First, $1/A_{t-1}$ alternates in signs with seldom significances across different industries and different inventory level portfolios. This further confirms the inappropriateness of $1/A_{t-1}$ as explanatory variable in the discretionary accrual models. Second, the two proxies for current accruals, ΔREV and ΔCREV, have mostly positive significant relationship with total accruals. However, they also quite often manifest negative relationship with total accruals. However, the alternative proxy for current accruals, ΔNREC, shows a predominant positive relationship with total accruals(34 out of 35 industries; and 10 out of 10 inventory portfolios), indicating that ΔNREC is a better proxy for working capital accruals than ΔREV or ΔCREV. Third, the first proxy for noncurrent accruals, PPE, has predominantly negative relationship with total accruals (34 or 35 out of 35 industries; and 10 out of 10 inventory portfolios). The second proxy for noncurrent accruals, INTG, also shows similar results as PPE. Finally, the financial-structure approach ensures more consistent coefficients across different inventory level portfolios than the industry approach. Particularly, ΔNREC, PPE and INTG have always expected directional relationships with total accruals under the financial-structure approach.

In sum, the coefficient consistency investigation strongly supports the superiority of YK models and the financial-structure approach.

[INSERT TABLE 3 ABOUT HERE]

4.3 Descriptive statistics and correlation matrix

Table 4 shows the descriptive statistics correlation matrix for key variables used in this study. Panel A shows the descriptive statistics and correlation matrix for total accruals and key variables for the entire sample firm-years (12,200 firm-years) used in this study. Panel B shows them for nondiscretionary accruals and discretionary accruals for the hold-out sample of 1,000 firm-years using the industry approach, while Panel C shows the same using the financial-structure approach.

Total accruals average -0.031 of lagged total assets. Alternative proxies for current accruals and noncurrent accruals have very different standard deviations. Specifically, ΔNREC has much smaller standard deviation (0.071) that those of ΔREV (0.327) and ΔCREV (0.296). The correlation matrix shows that the determinants of total accruals are in the order of ΔNREC (0.334), ΔREV (0.191), PPE (-0.143), ΔCREV (0.123), and INTG (-0.110). It is shown that $1/A_{t-1}$ does not have significant relationship with total accruals as indicated earlier.

[INSERT TABLE 4 ABOUT HERE]

Panel B and Panel C show that Jones model and modified Jones model underestimate the nondiscretionary accruals (NDA) under both the industry approach and the financial-structure approach. Since discretionary accruals (DA) are supposed to be close zero for the hold-out sample (exactly zero for the estimation sample), nondiscretionary accruals should have about the same mean as total accruals (-0.031 as shown in Panel A). However, NDAs for Jones model and modified Jones model range between -0.026 and -0.027; hence DAs are deviated from zero for the two models. This is an indication that the traditional Jones models are misspecified mainly because intercept terms are suppressed.

The correlation matrix also reveals that NDAs or DAs between same origin models are extremely positively correlated, while they are less correlated between different origin models. For example, correlation coefficients of NDAs and DAs between Jones models are all range between 0.88 and 1, while correlation coefficients of NDAs and DAs between Jones models and YK models are much lower. This indicates that use of same origin models will lead to similar inferences.

4.4 Results of type I error analyses

Table 5 summarizes the results of type I error analyses. The industry approach and the financial-structure approach results are reported in Panel A and Panel B, respectively. When standardized residuals are greater than 1.645 or less than -1.645, the null hypotheses of no earnings management are rejected.

[INSERT TABLE 5 ABOUT HERE]

Table 5 reveals that type I errors all fall in the confidence interval of 2% and 8% for a one-sided test. This indicates that all models are well specified and that there is no significant difference between the two estimation approaches.

4.5 Results of type II error analyses

Table 6 reports the results for type II error analyses. Panel A and Panel B report the industry approach results and the financial-structure approach results, respectively.

The results show that 1% seed is too small to be detected no matter which model and which estimation approach are used; and that 30% is large enough to be detected no matter which model and which estimation approach are used. Therefore, we need to compare the results when seed level is 10% or 20% to identify better models and better estimation approach. We document that the industry approach performs slightly better than the financial-structure approach across all models when it comes to the power of the test. However, the slight superiority of the industry approach over the financial-structure approach is with a limitation that industries without sufficient firm-years (i.e. 100

firm-years in our study) are not included in the sample. Therefore, when considering the cost of dropping industries without sufficient firm-years, it is not without cost for using the industry approach. We also document that YK models are always more powerful than Jones and modified Jones models and their variations. The power of YK models is about 5 to 20 percent (60.7% for modified Jones model vs. 72.8% for YK2 model when 20% seed is given under the inventory approach) more powerful than Jones models.

5. Conclusions

The purposes of the study are two-fold. First, we identified and analyzed the statistical issues associated with the Jones models that are most frequently used for estimating discretionary accruals. We, then, compared two alternative models proposed by Yoon and Kim (2003) and empirically examined the relative superiority of those models with the Jones models in terms of the adjusted R-squares and the consistency in the coefficients of individual proxy variables for accruals. Second, we propose a financial-structure approach as an alternative for the industry approach for the estimation of discretionary accruals. The industry approach has been the standard approach used in the prior studies for the estimation of discretionary accruals on the premise that those firms in the same industry would have similar firm characteristics. However, we argue that the industry approach has several critical caveats: a false assumption of time-invariant parameter estimates; large differences in the number of observations across industries; and the misrepresentation of firm characteristics when firms have multiple business segments. The advantages of the financial-structure approach include the followings: Firms with similar financial-structure are more likely to have similar firm characteristics; categorization of firms with similar financial-structures into equal-size portfolios can ensure more robust parameter estimates; and the financial-structure approach is easy to apply.

We document evidence that the Jones models suffer misspecification and goodness of fit problems. First, they include the inverse of firm size as an independent variable by incorrectly changing the order of the standardization and the transformation into a statistical model in the modeling process. In addition, the Jones models have poor goodness of fit when the models are applied in empirical research. We document that the Jones models fail to satisfy some critical regression properties. These problems are caused by the suppression of constant terms, the use of the inverse of firm size, improper proxy variables for accruals, and omitted variables. We document that the new models are theoretically sound, and have higher explanatory powers than the Jones models.

We document that the financial-structure approach achieves far superior estimation performance than the industry approach in terms of coefficient stability and the robustness of discretionary accruals.

We contribute to the literature by logically and empirically showing that the Jones models suffer from misspecification and poor goodness of fit problems, and by showing that alternative new models are theoretically and empirically superior to the Jones models. We also contribute to the literature by showing that the financial-structure approach is superior to the widely used industry approach. This study sheds lights on a new but a very simple idea of using the financial variables to classify firms into groups with similar firm characteristics.

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<Table 1>Regression results by models and by estimation approach – A summary

Panel A: The industry approach: Average across 35 industries (t-ratios)

	Models							
	J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2
Intercept		-0.98	-1.02		-0.70	-0.75	-1.12	0.20
$1/A_{t-1}$	-0.32		-0.15	-0.23		-0.09		
ΔREV	3.16	3.29	3.30				2.39	2.36
ΔCREV				2.00	2.09	2.10		
ΔNREC							5.23	5.26
PPE	-5.92	-2.37	-2.25	-5.66	-2.46	-2.34	-2.44	-2.99
INTG								-2.23
Adj. R^2	0.17	0.07	0.08	0.16	0.06	0.06	0.16	0.17
Std.Err.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09

Panel B: The inventory approach: Average across 10 inventory portfolios (t-ratios)

	Models							
	J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2
Intercept		-2.89	-2.67		-2.33	-2.12	-3.40	-0.59
$1/A_{t-1}$	-1.38		-1.01	-1.22		-0.89		
ΔREV	5.37	6.24	6.30				4.21	4.23
ΔCREV				2.97	3.67	3.69		
ΔNREC							11.49	11.61
PPE	-10.97	-4.27	-4.31	-10.50	-4.41	-4.45	-4.25	-5.49
INTG								-4.79
Adj. R^2	0.13	0.06	0.06	0.12	0.04	0.04	0.16	0.18
Std.Err.	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10

[Variables] A_{t-1}: Lagged total assets; ΔREV = Changes in revenues/Lagged total assets; ΔCREV = (Changes in revenues – Changes in accounts receivables)/Lagged total assets; ΔNREC = (Changes in accounts receivable – Changes in accounts payable)/Lagged total assets; PPE = Lagged property, plant and equipment/Lagged total assets; INTG = Lagged intangible assets/Lagged total assets

[Six variations of the Jones models] J1: Original Jones model; J2: Jones model with intercept term but without A_{t-1}; J3: Jones model without intercept term and also with A_{t-1}; MJ1: Original modified Jones model; MJ2: Modified Jones model with intercept term but without A_{t-1}; MJ3: Modified Jones model without intercept term and also with A_{t-1}

<Table 2> Relationships between average total accruals, t-ratios and adjusted R-squares

Portfolios	1	2	3	4	5	6	7	8	9	10
Average total accruals	-0.032	-0.053	-0.047	-0.040	-0.033	-0.031	-0.025	-0.016	-0.023	-0.008
t-ratios of PPE	-12.19	-13.25	-13.91	-11.00	-14.25	-11.61	-9.04	-8.87	-9.70	-5.85
Adjusted R^2	0.14	0.16	0.16	0.11	0.16	0.12	0.11	0.09	0.13	0.14

<Table 3> Coefficient consistency

Panel A: Industry approach (35 two-digit SIC industries)

		Counts(Statistically significant counts)							
		Models							
Variables	Sign	J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2
Intercept	+		10(3)	11(3)		13(3)	14(3)	11(4)	21(8)
	-		25(9)	24(10)		22(9)	21(10)	24(10)	14(5)
$1/A_{t-1}$	+	15(4)		19(5)	16(5)		19(7)		
	-	20(7)		16(6)	19(7)		16(6)		
ΔREV	+	28(22)	30(23)	30(23)				28(19)	27(20)
	-	7(1)	5(1)	5(1)				7(3)	8(3)
ΔCREV	+				24(19)	25(19)	25(19)		
	-				11(1)	10(2)	10(1)		
ΔNREC	+							34(32)	34(32)
	-							1(0)	1(0)
PPE	+	0(0)	1(0)	1(0)	0(0)	0(0)	1(0)	1(0)	0(0)
	-	35(34)	34(22)	34(21)	35(33)	35(24)	34(22)	34(23)	35(28)
INTG	+								3(0)
	-								32(20)

Panel B: Financial-structure approach (10 inventory portfolios)

		Counts(Statistically significant counts)							
		Models							
Variables	Sign	J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2
Intercept	+		0(0)	0(0)		1(0)	1(0)	0(0)	5(0)
	-		10(7)	10(6)		9(5)	9(5)	10(8)	5(1)
$1/A_{t-1}$	+	2(1)		2(1)	2(1)		1(1)		
	-	8(5)		8(2)	8(5)		9(1)		
ΔREV	+	9(8)	9(8)	9(9)				8(7)	8(7)
	-	1(1)	1(1)	1(1)				2(1)	2(1)
ΔCREV	+				8(2)	8(7)	8(7)		
	-				2(2)	2(2)	2(2)		
ΔNREC	+							10(10)	10(10)
	-							0(0)	0(0)
PPE	+	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
	-	10(10)	10(10)	10(10)	10(10)	10(10)	10(10)	10(10)	10(10)
INTG	+								0(0)
	-								10(10)

<Table 4> Descriptive statistics and correlation matrix

Panel A: Total accruals and key variables (N=12,200 firm-years)

Panel A.1 Descriptive statistics

Variables	Mean	Median	Std.Dev.	Skewness	Min.	Max.
NI	0.040	0.044	0.140	-2.787	-2.281	0.891
CFO	0.071	0.071	0.129	-1.768	-1.692	1.069
TA	-0.031	-0.033	0.112	0.273	-0.899	0.836
$1/A_{t-1}$	0.010	0.001	0.041	9.472	0.000	0.865
ΔREV	0.083	0.050	0.327	1.199	-2.990	2.975
ΔCREV	0.068	0.042	0.296	0.980	-2.911	2.944
ΔNREC	0.005	0.002	0.071	1.585	-0.710	1.290
PPE	0.591	0.527	0.409	1.119	0.000	4.289
INTG	0.075	0.010	0.140	2.529	0.000	0.927

Panel A.2 Correlation matrix

	NI	CFO	TA	$1/A_{t-1}$	ΔREV	ΔCREV	ΔNREC	PPE	INTG
NI	1								
CFO	0.660	1							
TA	0.483	-0.335	1						
$1/A_{t-1}$	-0.058	-0.048	-0.017	1					
ΔREV	0.250	0.108	0.191	0.047	1				
ΔCREV	0.231	0.144	0.123	0.033	0.963	1			
ΔNREC	0.099	-0.171	0.334	0.021	0.180	0.019	1		
PPE	0.019	0.144	-0.143	-0.028	-0.068	-0.056	-0.044	1	
INTG	-0.044	0.046	-0.110	0.062	0.007	0.011	0.003	-0.258	1

Panel B: Nondiscretionary and discretionary accruals by the industry approach (N=1,000 hold-out sample)

Panel B.1 Descriptive statistics

Accruals	Models	Mean	Median	Std.Dev.	Skewness	Min.	Max.
NDA	J1	-0.026	-0.023	0.039	0.543	-0.235	0.258
	J2	-0.030	-0.032	0.037	0.830	-0.286	0.257
	J3	-0.030	-0.032	0.039	0.867	-0.286	0.257
	MJ1	-0.026	-0.023	0.033	0.315	-0.178	0.262
	MJ2	-0.030	-0.032	0.032	0.801	-0.191	0.262
	MJ3	-0.030	-0.031	0.034	0.837	-0.191	0.262
	YK1	-0.030	-0.033	0.050	1.811	-0.318	0.526
	YK2	-0.030	-0.033	0.052	1.568	-0.316	0.519
DA	J1	-0.004	-0.002	0.114	-0.068	-0.905	0.845
	J2	0.001	0.003	0.114	0.012	-0.904	0.876
	J3	0.000	0.003	0.115	-0.028	-0.904	0.866
	MJ1	-0.003	-0.003	0.115	-0.064	-0.910	0.845
	MJ2	0.001	0.003	0.115	0.017	-0.909	0.875
	MJ3	0.000	0.003	0.115	-0.020	-0.910	0.865
	YK1	0.001	0.003	0.108	0.185	-0.877	0.861
	YK2	0.001	0.003	0.108	0.146	-0.876	0.845

Panel B.1 Correlation matrix

		NDA								DA						
		J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2	J1	J2	J3	MJ1	MJ2	MJ3	YK1
NDA	J2	0.90														
	J3	0.92	0.96													
	MJ1	0.97	0.84	0.88												
	MJ2	0.84	0.96	0.92	0.86											
	MJ3	0.88	0.92	0.96	0.90	0.95										
	YK1	0.67	0.75	0.73	0.60	0.68	0.65									
	YK2	0.65	0.71	0.69	0.58	0.64	0.62	0.95								
DA	J1	-0.14	-0.11	-0.13	-0.17	-0.13	-0.16	0.12	0.15							
	J2	-0.10	-0.13	-0.13	-0.12	-0.16	-0.16	0.11	0.14	0.99						
	J3	-0.12	-0.13	-0.16	-0.14	-0.16	-0.19	0.11	0.13	0.99	1.00					
	MJ1	-0.08	-0.05	-0.07	-0.13	-0.09	-0.12	0.18	0.20	1.00	0.98	0.99				
	MJ2	-0.04	-0.07	-0.08	-0.09	-0.12	-0.13	0.16	0.19	0.98	1.00	0.99	0.99			
	MJ3	-0.06	-0.08	-0.10	-0.11	-0.12	-0.15	0.16	0.18	0.99	0.99	1.00	0.99	1.00		
	YK1	-0.11	-0.14	-0.14	-0.11	-0.15	-0.15	-0.09	-0.05	0.94	0.96	0.95	0.94	0.95	0.94	
	YK2	-0.11	-0.14	-0.14	-0.12	-0.14	-0.15	-0.09	-0.10	0.94	0.95	0.94	0.93	0.94	0.93	0.99

Panel C: Financial-structure approach

Panel C.1 Descriptive statistics

Accruals	Models	Mean	Median	Std.Dev.	Skewness	Min.	Max.
NDA	J1	-0.027	-0.026	0.034	0.051	-0.280	0.234
	J2	-0.031	-0.033	0.031	0.810	-0.280	0.230
	J3	-0.032	-0.033	0.032	0.709	-0.281	0.234
	MJ1	-0.027	-0.025	0.029	-0.563	-0.230	0.140
	MJ2	-0.031	-0.032	0.025	0.404	-0.221	0.144
	MJ3	-0.031	-0.032	0.026	0.269	-0.222	0.141
	YK1	-0.032	-0.035	0.047	2.992	-0.354	0.526
	YK2	-0.033	-0.036	0.050	2.624	-0.345	0.526
DA	J1	-0.006	-0.006	0.105	-0.085	-0.755	0.757
	J2	-0.002	-0.001	0.106	-0.187	-0.749	0.762
	J3	-0.002	-0.001	0.106	-0.146	-0.748	0.762
	MJ1	-0.006	-0.006	0.106	0.080	-0.728	0.817
	MJ2	-0.002	-0.002	0.106	0.017	-0.724	0.823
	MJ3	-0.002	-0.002	0.106	0.056	-0.723	0.823
	YK1	-0.001	-0.001	0.100	-0.560	-0.818	0.567
	YK2	0.000	0.001	0.099	-0.540	-0.760	0.561

Panel C.2 Correlation matrix

		NDA								DA						
		J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2	J1	J2	J3	MJ1	MJ2	MJ3	YK1
NDA	J2	0.93														
	J3	0.96	0.98													
	MJ1	0.97	0.86	0.90												
	MJ2	0.91	0.96	0.94	0.91											
	MJ3	0.95	0.93	0.96	0.96	0.97										
	YK1	0.65	0.68	0.67	0.58	0.62	0.61									
	YK2	0.61	0.64	0.63	0.55	0.59	0.58	0.94								
DA	J1	-0.04	-0.02	-0.03	-0.06	-0.04	-0.05	0.25	0.27							
	J2	-0.07	-0.10	-0.09	-0.06	-0.10	-0.09	0.18	0.21	0.98						
	J3	-0.08	-0.10	-0.10	-0.08	-0.10	-0.10	0.18	0.20	0.98	1.00					
	MJ1	-0.06	-0.04	-0.05	-0.08	-0.07	-0.08	0.22	0.24	0.99	0.99	0.99				
	MJ2	-0.02	-0.04	-0.03	-0.03	-0.06	-0.05	0.23	0.25	0.98	1.00	0.99	0.99			
	MJ3	-0.03	-0.04	-0.04	-0.05	-0.06	-0.07	0.23	0.25	0.99	0.99	1.00	1.00	1.00		
	YK1	-0.09	-0.12	-0.11	-0.08	-0.11	-0.09	-0.07	-0.03	0.92	0.95	0.94	0.93	0.94	0.94	
	YK2	-0.09	-0.12	-0.11	-0.08	-0.11	-0.10	-0.07	-0.09	0.90	0.93	0.93	0.92	0.92	0.92	0.99

<Table 5> Type I errors by model and by estimation approach (1,000 hold-out observations)

Upper limit error (ULE): Standardized residuals > 1.645 (5% one-sided test)

Lower limit error (LLE): Standardized residuals < -1.645 (5% one-sided test)

Panel A: The industry approach (35 two-digit SIC industries)

	Models							
	J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2
ULE(%)	4.0	4.2	3.9	3.9	3.9	4.0	3.9	4.0
LLE(%)	4.4	3.8	4.1	4.4	4.4	4.2	4.3	4.4

Panel B: The inventory approach (10 inventory portfolios)

	Models							
	J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2
ULE(%)	2.9	3.0	3.3	3.1	3.2	3.3	3.2	3.5
LLE(%)	3.7	3.9	3.9	3.7	3.6	3.7	3.3	3.3

<Table 6> Type II errors by model and by estimation approach (1,000 hold-out observations)

Standardized residuals > 1.645 (5% one-sided test)

Panel A: The industry approach (35 two-digit SIC industries)

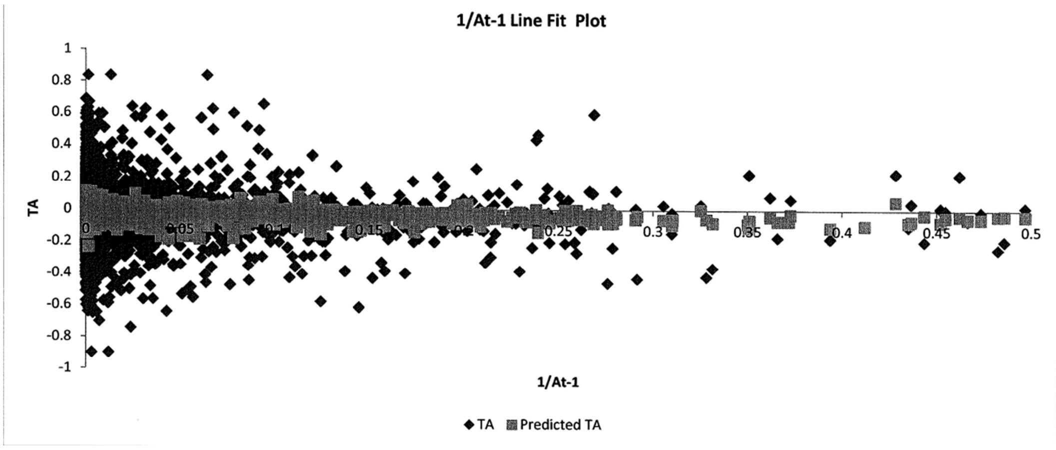
	Models							
Seed	J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2
1%	4.5	4.6	4.6	4.4	4.2	4.3	4.7	4.8
10%	16.8	18.3	18.2	16.9	18.1	18.2	18.4	19.5
20%	64.0	66.3	66.6	64.4	65.3	65.7	72.2	73.4
30%	91.3	91.5	91.4	91.1	91.2	90.8	93.8	94.1

Panel B: The inventory approach (10 inventory portfolios)

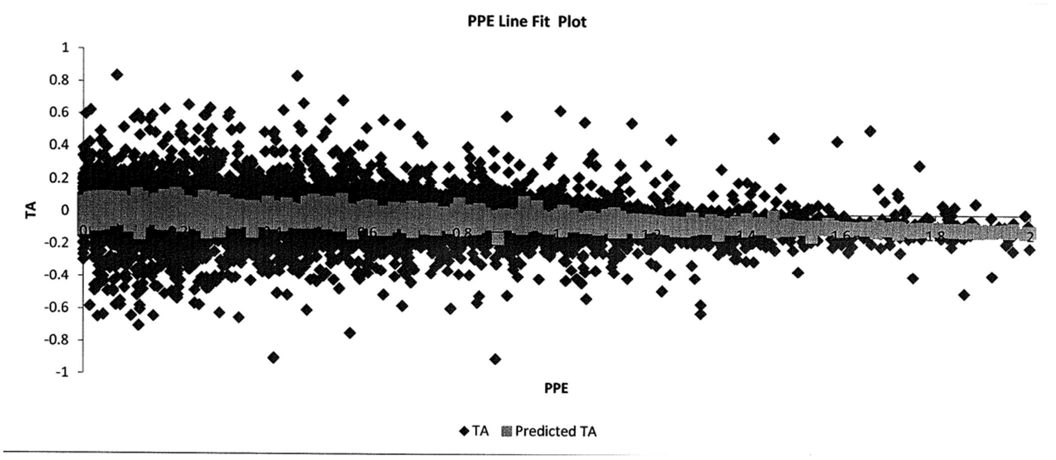
	Models							
Seed	J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2
1%	3.7	3.8	4.1	3.6	3.9	3.8	3.9	3.8
10%	14.2	15.2	15.1	14.2	14.6	14.9	17.4	18.1
20%	61.5	65.0	64.2	60.7	63.3	63.2	71.5	72.8
30%	91.1	91.4	91.5	91.0	91.2	91.3	93.7	93.7

[Note] Cell entries are % rejected of no earnings management when the given seed is artificially added to total accruals.

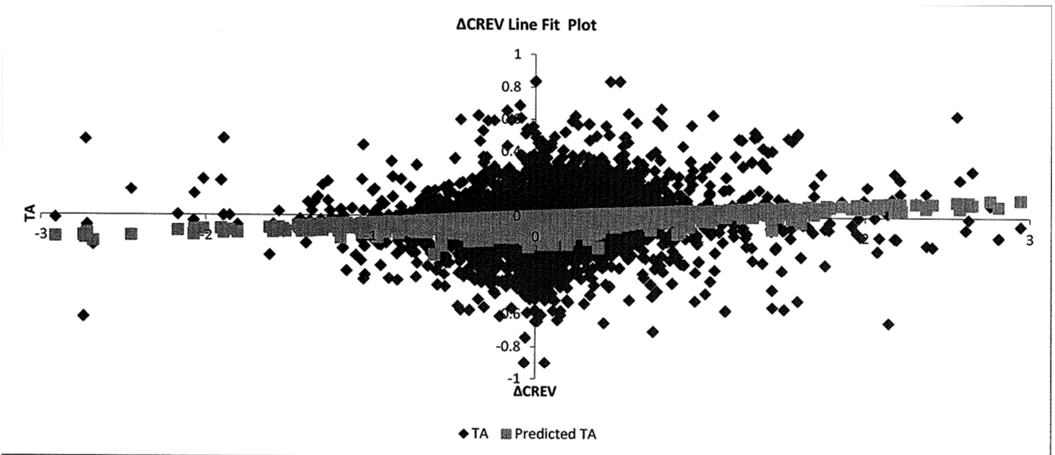
[Figure 1] Regression line fit of $1/A_{t-1}$: Modified Jones model (Entire sample of 12,200 observations)



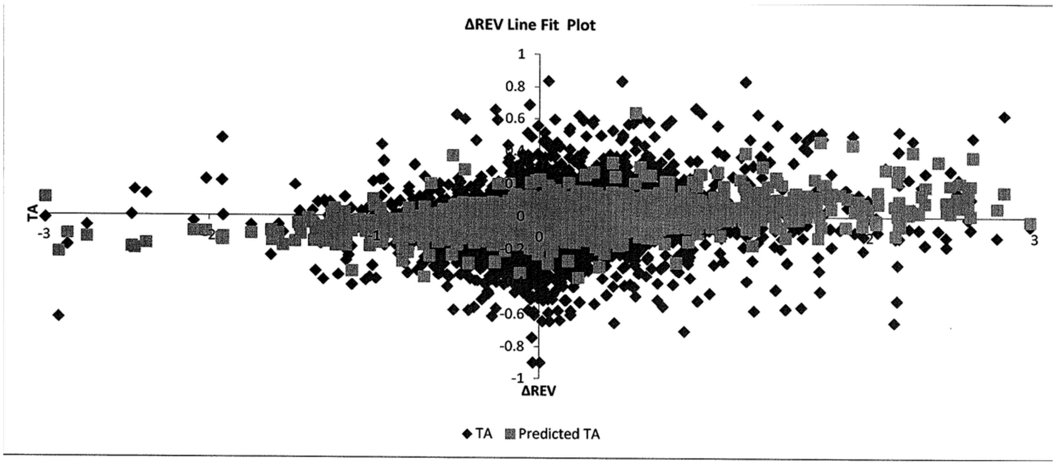
[Figure 2] Regression line fit of PPE: Modified Jones model (Entire sample of 12,200 observations)



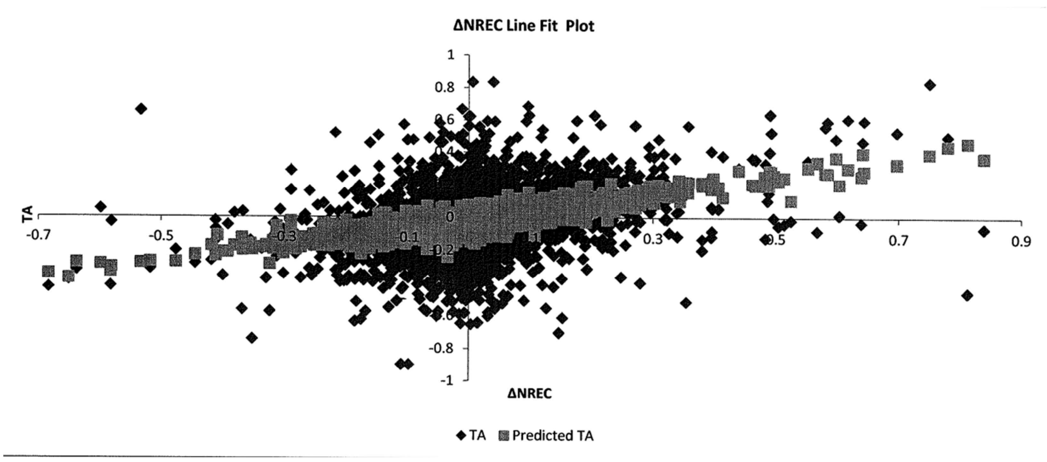
[Figure 3] Regression line fit of ΔCREV: Modified Jones model (Entire sample of 12,200 observations)



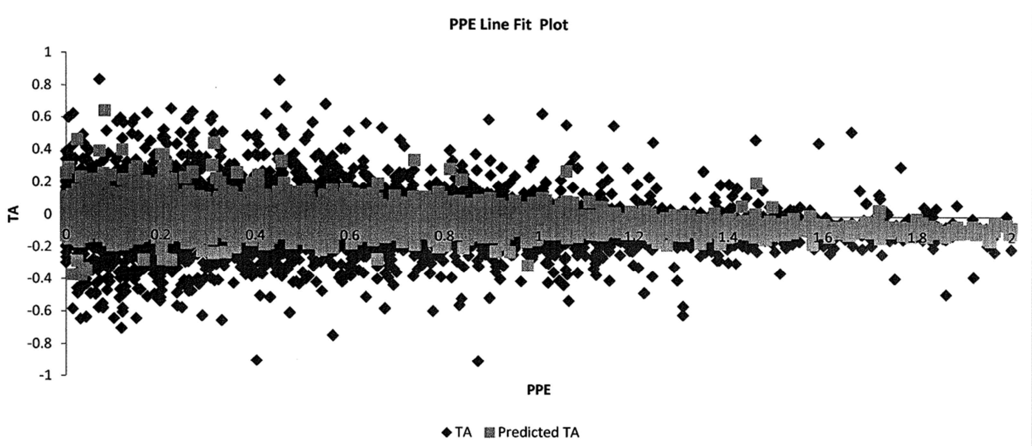
[Figure 4] Regression line fit of ΔREV: YK2 model (Entire sample of 12,200 observations)



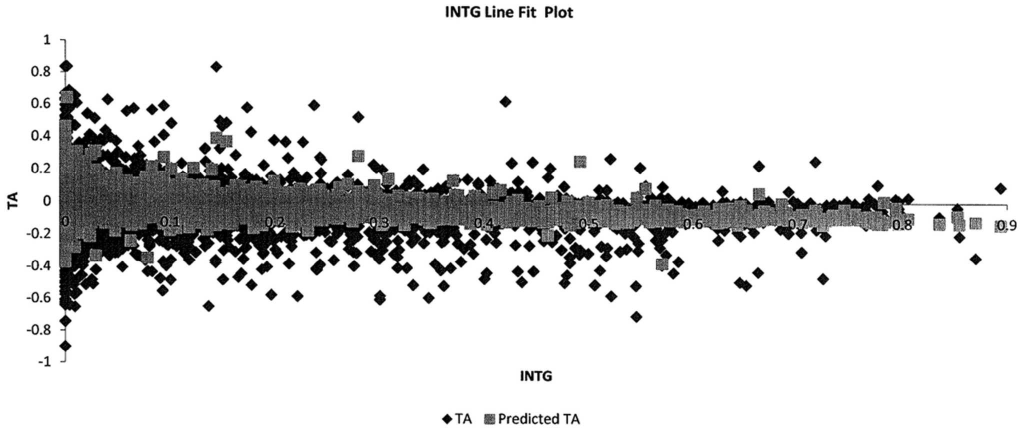
[Figure 5] Regression line fit of ΔNREC: YK2 model (Entire sample of 12,200 observations)



[Figure 6] Regression line fit of PPE: YK2 model (Entire sample of 12,200 observations)



[Figure 7] Regression line fit of INTG: YK2 model (Entire sample of 12,200 observations)



Appendix 1: Estimation of accruals

Panel A: The industry approach:

(1) Modified Jones model

		$1/A_{t-1}$		ΔCREV		PPE			
SIC	Obs	Coeff	t	Coeff	t	Coeff	t	Adj.R^2	Std.Err.
1000	156	-1.53	-2.96	-0.05	-1.64	-0.04	-3.38	0.25	0.13
1300	207	-0.45	-3.49	0.11	3.18	-0.08	-9.02	0.41	0.11
1500	224	3.42	2.39	-0.01	-0.29	-0.05	-2.06	0.02	0.12
1600	220	3.17	2.72	0.03	0.80	-0.05	-2.04	0.03	0.14
2000	761	0.08	1.38	0.04	2.99	-0.03	-6.76	0.06	0.10
2200	249	0.50	0.96	0.11	3.09	-0.04	-6.47	0.16	0.09
2300	208	0.01	0.06	0.12	3.64	-0.04	-2.98	0.08	0.11
2600	240	-0.01	-0.09	0.11	5.14	-0.04	-7.71	0.15	0.08
2700	196	-1.92	-2.92	-0.01	-0.18	-0.07	-8.09	0.40	0.06
2800	970	-0.11	-0.87	0.04	2.48	-0.04	-7.94	0.07	0.11
2900	112	6.71	2.73	-0.01	-1.21	-0.05	-3.73	0.13	0.09
3000	310	-0.16	-0.27	0.13	7.22	-0.04	-4.16	0.17	0.10
3200	274	-0.18	-1.17	0.12	6.03	-0.04	-11.00	0.35	0.06
3300	382	-2.25	-2.62	0.11	6.86	-0.01	-1.36	0.13	0.12
3400	274	0.86	1.42	0.08	2.93	-0.03	-2.94	0.05	0.10
3500	934	0.11	1.65	0.08	6.15	-0.07	-10.15	0.13	0.11
3600	1336	-0.08	-0.70	0.05	3.67	-0.06	-12.71	0.13	0.12
3700	473	-0.29	-1.34	0.04	2.32	-0.05	-7.41	0.11	0.11
3800	487	-0.06	-0.35	-0.02	-0.85	-0.07	-5.15	0.06	0.13
3900	183	0.13	0.75	0.06	2.17	-0.08	-4.36	0.11	0.13
4400	178	0.76	0.48	0.01	0.46	-0.04	-5.07	0.14	0.10
4800	353	0.08	0.18	-0.18	-3.98	-0.07	-11.33	0.33	0.11
4900	608	0.05	0.51	0.12	7.36	-0.05	-13.17	0.27	0.08
5000	547	0.44	2.31	0.04	4.65	-0.05	-2.99	0.06	0.11
5100	233	-0.27	-0.76	0.03	2.15	-0.03	-2.29	0.05	0.08
5300	148	-0.44	-2.69	0.07	3.13	-0.06	-5.76	0.24	0.08
5600	100	-0.13	-0.20	-0.02	-0.42	-0.09	-4.90	0.26	0.10
5800	106	2.43	0.49	-0.01	-0.14	-0.07	-5.86	0.30	0.10
5900	164	-0.46	-1.36	0.02	0.91	-0.07	-5.43	0.20	0.08
7000	163	0.36	0.73	-0.04	-0.63	-0.03	-3.93	0.09	0.08
7300	792	-0.19	-2.56	0.05	2.96	-0.09	-6.36	0.07	0.14
7900	105	-0.35	-0.35	-0.02	-0.70	-0.03	-1.89	0.10	0.10
8000	107	-0.30	-2.55	-0.05	-1.26	-0.06	-4.53	0.32	0.08
8700	233	-0.04	-0.49	0.02	0.70	-0.05	-4.33	0.07	0.09
9900	167	0.41	0.89	0.01	0.18	-0.01	-0.79	-0.01	0.11
	Average	0.30	-0.23	0.03	2.00	-0.05	-5.66	0.16	0.10

(2) YK1 model

		Constant		ΔREV		ΔNREC		PPE			
SIC	Obs	Coeff	t	Coeff	t	Coeff	t	Coeff	t	Adj.R^2	Std.Err.
1000	156	0.01	0.43	-0.07	-2.19	0.65	4.50	-0.07	-2.97	0.18	0.13
1300	207	0.02	1.03	0.01	0.21	0.48	4.13	-0.10	-6.05	0.27	0.11
1500	224	0.03	2.43	-0.02	-0.76	0.39	3.08	-0.09	-2.78	0.06	0.11
1600	220	0.06	3.18	0.01	0.40	0.41	5.34	-0.16	-3.85	0.22	0.13
2000	761	0.00	0.15	0.04	3.78	0.37	6.32	-0.04	-3.35	0.09	0.10
2200	249	-0.01	-0.73	0.11	3.44	0.62	5.62	-0.03	-2.09	0.21	0.08
2300	208	-0.02	-1.09	0.12	4.13	0.32	2.23	-0.02	-0.57	0.11	0.10
2600	240	-0.01	-1.26	0.10	5.45	0.52	6.46	-0.03	-2.85	0.20	0.08
2700	196	-0.02	-2.41	0.08	2.34	0.56	4.78	-0.05	-4.32	0.20	0.06
2800	970	-0.03	-3.82	0.03	2.13	0.72	12.06	-0.02	-1.85	0.17	0.10
2900	112	0.04	2.10	-0.02	-1.67	0.58	5.38	-0.08	-3.19	0.26	0.08
3000	310	-0.01	-0.97	0.11	6.41	0.36	4.88	-0.02	-1.11	0.28	0.09
3200	274	0.00	-0.32	0.11	5.57	0.15	2.10	-0.04	-3.71	0.22	0.06
3300	382	-0.01	-0.86	0.10	7.78	0.64	9.58	-0.01	-0.92	0.35	0.10
3400	274	-0.02	-1.38	0.08	3.50	0.76	7.49	-0.01	-0.34	0.24	0.09
3500	934	-0.02	-3.16	0.10	9.06	0.38	8.00	-0.05	-4.01	0.20	0.10
3600	1336	-0.04	-7.36	0.06	5.43	0.64	14.86	-0.03	-3.72	0.20	0.11
3700	473	-0.02	-1.96	0.05	3.50	0.56	6.92	-0.03	-2.51	0.14	0.10
3800	487	-0.04	-4.11	-0.02	-1.01	0.46	4.61	-0.01	-0.46	0.04	0.13
3900	183	0.01	0.59	0.08	3.49	0.55	5.20	-0.10	-3.26	0.24	0.12
4400	178	-0.01	-0.57	0.02	0.88	0.88	4.72	-0.03	-1.56	0.12	0.09
4800	353	-0.05	-4.58	-0.08	-2.24	0.63	6.55	-0.03	-3.58	0.15	0.10
4900	608	-0.01	-0.62	0.11	7.28	0.22	3.04	-0.04	-4.47	0.16	0.07
5000	547	0.01	1.59	0.04	5.40	0.42	7.98	-0.08	-3.37	0.19	0.10
5100	233	0.00	0.23	0.03	2.87	0.18	3.10	-0.04	-2.08	0.08	0.08
5300	148	-0.03	-1.61	0.10	3.93	0.39	2.80	-0.03	-0.90	0.11	0.08
5600	100	0.01	0.33	-0.01	-0.15	0.65	2.41	-0.11	-2.66	0.10	0.10
5800	106	-0.05	-2.25	0.06	0.89	-0.06	-0.08	-0.03	-1.22	0.01	0.10
5900	164	0.00	-0.35	0.02	1.23	0.19	1.33	-0.07	-3.47	0.09	0.08
7000	163	-0.01	-0.41	0.04	0.58	0.47	4.01	-0.02	-1.28	0.10	0.08
7300	792	-0.05	-6.84	0.03	2.45	0.41	9.15	-0.02	-1.30	0.13	0.13
7900	105	-0.05	-2.98	0.01	0.36	0.35	1.29	0.00	-0.08	-0.01	0.10
8000	107	-0.06	-3.22	-0.05	-1.34	0.51	3.25	0.00	0.04	0.07	0.07
8700	233	-0.01	-1.57	0.00	0.20	0.51	6.16	-0.04	-2.36	0.19	0.08
9900	167	0.05	3.25	0.01	0.42	0.59	3.94	-0.07	-3.18	0.12	0.10
	Average	-0.01	-1.12	0.04	2.39	0.47	5.23	-0.05	-2.44	0.16	0.10

(3) YK2 model

		Constant		ΔREV		ΔNREC		PPE		INTG			
SIC	Obs	Coeff	t	Coeff	t	Coeff	t	Coeff	t	Coeff	t	Adj.R^2	Std.Err.
1000	156	0.00	0.06	-0.07	-2.19	0.64	4.44	-0.07	-2.71	0.07	0.80	0.18	0.13
1300	207	0.04	1.94	0.01	0.37	0.48	4.17	-0.12	-6.27	-0.16	-1.90	0.28	0.11
1500	224	0.03	2.45	-0.02	-0.78	0.39	3.09	-0.09	-2.81	-0.04	-0.47	0.06	0.11
1600	220	0.07	3.55	0.01	0.54	0.40	5.30	-0.18	-4.12	-0.19	-1.65	0.22	0.12
2000	761	0.02	1.70	0.04	3.54	0.37	6.34	-0.05	-4.24	-0.10	-3.23	0.10	0.09
2200	249	-0.01	-0.32	0.11	3.37	0.62	5.62	-0.04	-2.29	-0.08	-1.05	0.21	0.08
2300	208	0.01	0.28	0.12	4.17	0.32	2.25	-0.05	-1.47	-0.15	-2.22	0.13	0.10
2600	240	0.00	0.37	0.10	5.56	0.51	6.40	-0.04	-3.77	-0.12	-3.39	0.22	0.08
2700	196	0.01	1.20	0.06	1.94	0.61	5.43	-0.08	-5.86	-0.08	-3.88	0.26	0.06
2800	970	0.00	-0.15	0.03	2.03	0.72	12.26	-0.04	-3.76	-0.19	-6.37	0.21	0.10
2900	112	0.07	2.95	-0.02	-1.82	0.61	5.71	-0.10	-3.81	-0.19	-2.34	0.29	0.08
3000	310	0.00	0.09	0.10	6.23	0.36	4.79	-0.04	-1.72	-0.16	-1.91	0.28	0.09
3200	274	0.00	0.01	0.10	5.48	0.15	2.10	-0.04	-3.81	-0.06	-0.87	0.22	0.06
3300	382	0.01	0.44	0.10	7.97	0.63	9.63	-0.03	-1.78	-0.22	-4.02	0.38	0.10
3400	274	-0.01	-0.57	0.08	3.45	0.75	7.42	-0.02	-0.74	-0.10	-1.87	0.25	0.09
3500	934	0.00	-0.41	0.10	9.25	0.38	8.15	-0.06	-5.19	-0.15	-5.23	0.22	0.10
3600	1336	-0.03	-6.04	0.06	5.44	0.64	14.84	-0.03	-3.91	-0.04	-1.32	0.20	0.11
3700	473	-0.01	-1.21	0.05	3.67	0.56	6.92	-0.04	-2.80	-0.08	-1.64	0.14	0.10
3800	487	-0.02	-1.93	-0.02	-1.05	0.45	4.57	-0.03	-1.20	-0.10	-2.56	0.05	0.13
3900	183	0.05	2.31	0.08	3.48	0.53	5.18	-0.12	-4.21	-0.23	-3.51	0.29	0.12
4400	178	0.00	-0.05	0.02	0.91	0.87	4.72	-0.04	-1.87	-0.13	-1.57	0.13	0.09
4800	353	-0.01	-0.89	-0.09	-2.40	0.62	6.59	-0.05	-4.60	-0.09	-3.05	0.18	0.10
4900	608	0.00	0.32	0.11	7.32	0.23	3.19	-0.05	-4.86	-0.08	-1.92	0.16	0.07
5000	547	0.02	2.41	0.04	5.52	0.42	7.99	-0.08	-3.70	-0.13	-2.57	0.19	0.10
5100	233	0.01	0.66	0.03	2.86	0.17	3.10	-0.04	-2.23	-0.07	-1.20	0.09	0.08
5300	148	-0.03	-1.36	0.10	3.84	0.39	2.78	-0.03	-0.80	0.00	0.01	0.10	0.08
5600	100	0.01	0.47	-0.02	-0.25	0.66	2.46	-0.11	-2.66	-0.25	-1.24	0.11	0.10
5800	106	0.03	0.80	-0.02	-0.25	-0.06	-0.10	-0.08	-2.94	-0.19	-3.36	0.10	0.09
5900	164	0.01	0.77	0.02	1.09	0.19	1.37	-0.08	-3.97	-0.09	-2.20	0.11	0.07
7000	163	0.00	-0.06	0.05	0.85	0.45	3.86	-0.02	-1.20	-0.17	-1.50	0.11	0.08
7300	792	-0.02	-2.09	0.03	2.61	0.40	9.01	-0.04	-2.39	-0.14	-6.13	0.17	0.12
7900	105	-0.04	-2.01	0.01	0.56	0.36	1.31	-0.01	-0.43	-0.06	-1.22	-0.01	0.10
8000	107	-0.04	-1.80	-0.05	-1.23	0.49	3.08	-0.01	-0.48	-0.04	-1.12	0.08	0.07
8700	233	0.01	0.50	0.01	0.36	0.50	6.23	-0.06	-3.15	-0.12	-3.72	0.23	0.08
9900	167	0.04	2.66	0.01	0.21	0.60	4.02	-0.07	-3.03	0.12	1.21	0.12	0.10
	Average	0.01	0.20	0.04	2.36	0.47	5.26	-0.06	-2.99	-0.11	-2.23	0.17	0.09

Panel B: The financial-structure approach

(1) Modified Jones model

		$1/A_{t-1}$		ΔCREV		PPE			
Portfolios	Obs	Coeff	t	Coeff	t	Coeff	t	Adj.R^2	Std.Err.
1	1120	-0.26	-3.85	-0.04	-2.59	-0.05	-11.94	0.15	0.12
2	1120	-0.12	-1.75	-0.05	-3.92	-0.05	-13.26	0.16	0.11
3	1120	-0.25	-2.23	0.01	0.64	-0.06	-13.53	0.16	0.11
4	1120	-0.19	-1.90	0.02	1.50	-0.04	-10.59	0.10	0.10
5	1120	0.06	0.63	0.04	3.91	-0.06	-13.53	0.14	0.10
6	1120	-0.08	-1.01	0.02	1.73	-0.04	-11.17	0.11	0.09
7	1120	-0.20	-1.83	0.06	6.10	-0.03	-8.29	0.08	0.10
8	1120	-0.08	-1.12	0.04	3.77	-0.04	-8.29	0.06	0.10
9	1120	0.15	2.00	0.08	7.97	-0.05	-9.04	0.10	0.12
10	1120	-0.09	-1.11	0.10	10.62	-0.04	-5.33	0.10	0.14
	Average	-0.11	-1.22	0.03	2.97	-0.05	-10.50	0.12	0.11

(2) YK1 model

		Constant		ΔREV		ΔNREC		PPE			
Portfolios	Obs	Coeff	t	Coeff	t	Coeff	t	Coeff	t	Adj.R^2	Std.Err.
1	1120	-0.03	-5.73	-0.01	-0.70	0.28	6.33	-0.03	-3.64	0.05	0.12
2	1120	-0.03	-6.05	-0.04	-3.49	0.49	10.47	-0.02	-3.43	0.10	0.10
3	1120	-0.03	-5.79	0.02	1.26	0.45	8.62	-0.03	-4.78	0.09	0.11
4	1120	-0.02	-3.37	0.02	2.11	0.49	10.29	-0.03	-3.76	0.11	0.10
5	1120	-0.02	-3.28	0.04	4.78	0.65	15.54	-0.04	-5.83	0.24	0.09
6	1120	-0.02	-3.31	0.02	2.25	0.57	13.94	-0.03	-4.16	0.18	0.08
7	1120	-0.01	-2.47	0.05	6.70	0.53	13.19	-0.02	-3.42	0.20	0.09
8	1120	-0.01	-1.82	0.02	3.06	0.65	16.40	-0.03	-4.15	0.24	0.09
9	1120	-0.01	-1.49	0.08	8.48	0.51	11.67	-0.04	-4.19	0.20	0.11
10	1120	-0.01	-0.99	0.11	12.87	0.45	10.34	-0.05	-3.79	0.21	0.13
Average		-0.02	-3.43	0.03	3.73	0.51	11.68	-0.03	-4.12	0.16	0.10

(3) YK2 model

		Constant		ΔREV		ΔNREC		PPE		INTG			
Portfolio	Obs	Coeff	t	Coeff	t	Coeff	t	Coeff	t	Coeff	t	Adj.R^2	Std.Err.
1	1120	-0.01	-1.10	-0.01	-0.72	0.28	6.32	-0.04	-5.59	-0.11	-6.03	0.08	0.12
2	1120	-0.01	-1.56	-0.04	-3.61	0.48	10.55	-0.04	-5.53	-0.12	-6.46	0.13	0.10
3	1120	-0.02	-2.48	0.02	1.26	0.46	8.85	-0.04	-6.06	-0.10	-4.90	0.11	0.11
4	1120	-0.01	-1.19	0.02	1.97	0.49	10.36	-0.03	-4.69	-0.09	-3.90	0.13	0.09
5	1120	0.00	0.34	0.04	4.56	0.66	16.03	-0.05	-7.58	-0.13	-6.70	0.27	0.08
6	1120	-0.01	-1.31	0.02	2.33	0.58	14.06	-0.03	-5.02	-0.07	-3.42	0.18	0.08
7	1120	0.00	0.63	0.06	7.02	0.52	13.21	-0.04	-5.04	-0.13	-5.89	0.22	0.09
8	1120	0.00	0.59	0.02	3.13	0.65	16.51	-0.04	-5.28	-0.15	-4.87	0.25	0.09
9	1120	0.00	0.37	0.07	8.45	0.50	11.46	-0.05	-5.01	-0.13	-3.22	0.21	0.11
10	1120	0.01	0.76	0.11	13.08	0.45	10.46	-0.06	-4.53	-0.28	-4.08	0.22	0.13
Average		0.00	-0.49	0.03	3.75	0.51	11.78	-0.04	-5.43	-0.13	-4.95	0.18	0.10

Appendix 2: Cautions about simulations.

Seed		Models							
		J1	J2	J3	MJ1	MJ2	MJ3	YK1	YK2
0%	Intercept		-2.25	-2.31		-1.55	-1.64	-3.28	0.34
	$1/A_{t-1}$	0.33		0.61	0.63		0.84		
	ΔREV	6.74	7.13	7.08	3.91	4.19	4.14	4.78	4.56
	ΔNREC							15.54	16.03
	PPE	-14.25	-6.06	-6.06	-13.53	-6.20	-6.20	-5.83	-7.58
	INTG								-6.70
	Adj. R^2	0.16	0.08	0.07	0.14	0.05	0.05	0.24	0.27
1%	Intercept		-0.53	-0.60		0.20	0.09	-2.63	0.87
	$1/A_{t-1}$	0.54		0.61	0.85		0.84		
	ΔREV	7.12	7.13	7.08	4.25	4.19	4.14	4.78	4.56
	ΔNREC							15.54	16.03
	PPE	-11.68	-6.06	-6.06	-10.91	-6.20	-6.20	-5.83	-7.58
	INTG								-6.70
	Adj. R^2	0.12	0.08	0.07	0.10	0.05	0.05	0.24	0.27
10%	Intercept		14.17	14.02		15.01	14.83	2.12	4.47
	$1/A_{t-1}$	1.92		0.61	2.26		0.84		
	ΔREV	12.06	7.13	7.08	9.41	4.19	4.14	4.78	4.56
	ΔNREC							15.54	16.03
	PPE	7.89	-6.06	-6.06	8.40	-6.20	-6.20	-5.83	-7.58
	INTG								-6.70
	Adj. R^2	0.25	0.08	0.07	0.22	0.05	0.05	0.24	0.27

[Notes] Cell contents are t-ratios.

One important constraint is that coefficients on individual regressors should stay the same except for the intercept terms when seeds differ since seeds are treated as constants when regressions are run. The corollary of this is that the adjusted R^2 and standard errors of the residuals should stay the same across the different seed levels. This is true for the models when the intercept terms are not suppressed. However, when the intercepts are suppressed to pass through the origin as is the case with Jones model (J1) and modified Jones model (MJ1), everything changes when different levels of seeds are added to total accruals. For the case of Jones model, t-ratio for 1/At-1 change from 0.33 (0% seed) to 0.54 (1% seed) and to 1.92 (10% seed); t-ratio for ΔREV change from 6.74 (0% seed) to 7.12 (1% seed) and to 12.06 (10% seed); and t-ratio for PPE change from -14.25 (0% seed) to -11.68 (1% seed) and to 7.89 (10% seed). In fact, t-ratios for all the variables increase as positive seeds are added. Adjusted R^2 also changes from 0.16 (0% seed) to 0.12 (1% seed) and to 0.25 (105 seed). The same phenomena are observed with modified Jones model. This indicates that the suppression of intercepts will lead to wrong inferences from simulation results. This, in turn, casts a very serious concern about the findings of simulation results documented by Dechow et al. (1995) and Kothari et al. (2005).

In order to avoid the possible wrong inferences, we do not add seeds to total accruals in the estimation stage of the discretionary accruals. Instead, we add seeds to total accruals in the prediction stage only when we carry out type II error analyses.