8. Exhibits

8.1. Earnings accruals models

8.1.1. Healy and Kaplan (1985)

The authors use the mean of total accruals as a proxy for nondiscretionary accruals (P. M. Dechow et al., 1995, p. 197):

$$\mathrm{NDA_t} = \frac{\sum_t \mathrm{TA_t}}{\mathrm{T}}$$

Where
NDA = estimated nondiscretionary accruals;
TA = total accruals scaled by lagged total assets;
t = 1, 2, …T is a year subscript for years included in the estimation period; and
τ = a year subscript indicating a year in the event period.
For the computation of total accruals, see supra.

The authors assume that nondiscretionary accruals are constant over time. This assumption is justified by the risk embedded in largely negative nondiscretionary accruals. In that case, total accruals would be negative and the researcher wrongly infers a deliberate earnings understatement. According to P. M. Dechow et al. (2011), this specification holds when the nondiscretionary accruals follow a white noise process around a constant mean, but not in the other cases. Indeed, nondiscretionary accruals can't always be equal to zero because they are tied to the business activities of the company, and shift according to the economic circumstances (P. M. Dechow et al., 2011), especially in fast-growing companies (DeAngelo, 1986). The model thus neglects relevant variables controlling for the performance of the firm, resulting in inappropriately high standard errors (P. M. Dechow et al., 1995).

In this model, the partitioning variable PART separates the sample in three sets: two sets, taken as the event period, are assumed to manage earnings downwards. The last set, taken as the estimation period, is assumed to manage earnings upwards. This arrangement makes the particularity of Healy's model, since the author assumes that earnings are managed in each period (P. M. Dechow et al., 1995). Then, the author proceeds to pairwise comparisons between periods managing earnings upwards and downwards.

8.1.2. DeAngelo (1986)

The author uses the total accruals of the last period as a proxy for nondiscretionary accruals (P. M. Dechow et al., 1995, p. 197):

$$NDA_t = TA_{t-1}$$

Similar to Healy and Kaplan (1985), the author assumes that nondiscretionary accruals are constant over time. According to P. M. Dechow et al. (2011), this specification holds when the nondiscretionary accruals follow a random walk. In the other cases, the model suffers from the same weaknesses.

Besides, the author defines the estimation period (i.e. the period of control) as one single year. The researcher can never tell with assurance whether or not earnings are managed in the estimation period. As a result, using one single year is proportionally more risky (P. M. Dechow et al., 1995). Including an additional benchmark year would partially remediate to the problem (DeAngelo, 1986).

8.1.3. Jones (1991)

The author remediates to the weaknesses of the two previous models by including two control variables for nondiscretionary accruals that are linked to the business activities. These variables are the changes in revenues and the gross property, plant and equipment of the company. Total accruals are computed as follows (Jones, 1991, p. 211):

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$$\frac{TA_{it}}{A_{it-1}} = \alpha_i \left[\frac{1}{A_{it-1}}\right] + \beta_{1i} \left[\frac{\Delta REV_{it}}{A_{it-1}}\right] + \beta_{2i} \left[\frac{PPE_{it}}{A_{it-1}}\right] + \varepsilon_{it}$$

Or equivalently (P. M. Dechow et al., 1995, p. 198),

$$NDA_t = \alpha_1 \left[\frac{1}{A_{t-1}}\right] + \alpha_2[\Delta REV_t] + \alpha_3[PPE_t],$$

Where

ΔREV_t = revenues in year t less revenues in year t-1 scaled by total assets at t-1;

PPE_t = gross property plant and equipment in year t scaled by total assets at t-1;

A_{t-1} = total assets at t-1; and

$\alpha_1, \alpha_2, \alpha_3$ = firm-specific parameters.

As a reminder, discretionary accruals are proxied by the residuals of the regression model. They are computed as follows (Jones, 1991, p. 212):

$$u_{ip} = \frac{TA_{ip}}{A_{ip-1}} - \left(a_i \left[\frac{1}{A_{ip-1}} \right] + b_{1i} \left[\frac{\Delta REV_{ip}}{A_{ip-1}} \right] + b_{2i} \left[\frac{PPE_{ip}}{A_{ip-1}} \right] \right)$$

The model suffers from several weaknesses. Firstly, the Jones model implicitly ignores the possibility that discretion is exercised on revenues (P. Dechow et al., 2010). As a result, earnings management derived from revenues will be unintentionally removed from the model and the result will be biased toward zero (P. M. Dechow et al., 1995). Secondly, it assumes that past and future changes in sales are irrelevant, to the benefit of current sales. This assumption does not always hold, as "accruals do not fully adjust to a contemporaneous sales shock; rather, adjustment occurs over succeeding periods." (McNichols, 2002, p. 65). Besides, the manager is likely to adapt his accruals estimation according to his own estimation of future growth. Future sales are thus a relevant omitted variable (2002). Finally, the residuals of the models are likely to be correlated with accruals, earnings and cash flows, resulting in both higher type I error and low explanatory power.

8.1.4. Modified Jones (1995)

The model remediates to the first weakness of the Jones model by adjusting the changes in revenues by the changes in receivables. As a result, any growth in credit sales is excluded in years where earnings are assumed to be managed (P. Dechow et al., 2010; P. M. Dechow et al., 1995). According to P. M. Dechow et al. (1995), the authors of the model, managers have larger discretion on credit sales than on cash sales. The nondiscretionary accruals are computed as follows (P. M. Dechow et al., 1995, p. 199):

$$NDA_t = \alpha_1 \left[\frac{1}{A_{t-1}} \right] + \alpha_2 [\Delta REV_t - \Delta REC_t] + \alpha_3 [PPE_t],$$

Thanks to the adjustment of the changes in revenues, residuals are less correlated with accruals and the model power is improved (P. Dechow et al., 2010). Yet, the model still suffers from a considerable type I error.

8.1.5. Industry (1995)

This model hypothesizes that the determinants of the nondiscretionary accruals of companies active within the same industry tend to move in the same direction. nondiscretionary accruals are computed as follows (P. M. Dechow et al., 1995, p. 199):

$$NDA_t = \gamma_1 + \gamma_2 median_t(TA_t)$$

Where median(TA) is the median value of total accruals scaled by lagged total assets for the firms active in the same 2-digit SIC code.

The model suffers from two limits. Firstly, the model extracts only the nondiscretionary accruals that are prevalent among companies active within the same industry. As a result, some nondiscretionary accruals are not withdrawn from the observations, especially when a large percentage of nondiscretionary accruals comes from firm-specific circumstances (P. M. Dechow et al., 1995). Secondly, some discretionary accruals are correlated across companies active within the same industry. As a result, the model unintentionally removes some discretionary accruals.

8.1.6. Model of Teoh et al. (1998a); (1998b)

The authors believe that managers have more discretion on short-term accruals than on long-term accruals. In particular, their model makes the explicit distinction between the two components for both discretionary and nondiscretionary accruals: discretionary *current* accruals, discretionary *long-term* accruals, nondiscretionary *current* accruals and nondiscretionary *long-term* accruals. Unlike the previous models, they use only the current part of the working capital accruals to compute the total accruals, that is, the short-term assets and liabilities involved in the daily activities of the company (Teoh et al., 1998a, p. 1966):

CA = Δ[current assets (4) – cash (1)] – Δ[current liabilities (5) – current maturity of long-term debt (44)]

The model for nondiscretionary accruals is a cross-sectional version of the Modified Jones model, and compares the company total accruals with the industry mean total accruals. Any unusual level of accruals suggests that the company manages earnings.

8.1.7. Model of P. M. Dechow et al. (2002)

The authors concentrate their effort on the concept of earnings quality rather than on the level of accruals. In particular, they compute the proportion of estimation errors in accruals rather than the level of accruals itself. The previous models implicitly assume that any estimation error comes from intentional manipulation. Yet, P. M. Dechow et al. (2002) provide evidence of systematic estimation errors coming from firm and industry characteristics. As a result, the model does not make any distinction between discretionary and nondiscretionary accruals. It rather computes them as a whole. The authors assume that the firm size has considerable effects on estimation errors, since the operations of small companies are less stable, less predictable, and less diversified than larger companies.

The model is built upon the relationship between accruals and cash flows and includes the accruals reversals. Precisely, it analyses the extent to which working capital accruals realize into operating cash flows: a high level of realization is interpreted as high earnings quality. The residuals of the regression model are the proxy for the level of accruals estimation errors and the accruals reversals (the correction) (instead of the level of discretionary accruals in the previous models). The authors assume these residuals are uncorrelated between each other and with cash flow realization, and that accruals reverse within one year. Earnings quality decreases as the standard deviation of these residuals increases, meaning that both the estimation error *and* the correction lead to lower earnings quality. Note that they consider a symmetric loss function, that is, the residuals include as much estimation errors that overstate as understate future cash flows realization. Finally, the authors assume that accruals are negatively correlated to current cash flows and positively correlated to prior and future cash flows. The regression model is constructed as follows (P. M. Dechow et al., 2002, p. 40):

$$\Delta WC_t = b_0 + b_1 * CFO_{t-1} + b_2 * CFO_t + b_3 * CFO_{t+1} + \varepsilon_t$$

Where CFO_t is a proxy for CF_t(cash flows related to accruals). Note that the authors take CFOs from the cash flow statements because the CFOs derived from the balance sheet are biased and noisy. The authors define CF_t as follows: $CF_t = CF_t^{t-1} + CF_t^t + CF_t^{t+1}$

Where CF_t^{t-1} represents the cash collection or payments of amounts accrued at t-1 (net), CF_t^t represents the current cash flows (net), and CF_t^{t+1} represents the cash flows deferred to t+1 (net). In other words, "[…] CF_t^{t-1} denotes that the cash flow occurs after the corresponding amount is recognized in earnings. CF_t^t refers to cash flows received or paid in the same period as the cash flows are recognized in earnings. Finally, CF_t^{t+1} refers to cash received or paid before the revenue or expense is recognized in earnings." (P. M. Dechow et al., 2002, p. 37)

Earnings quality is computed as follows:

$$E_t = CF_{t-1}^t + CF_t^t + CF_{t+1}^t + \varepsilon_{t+1}^t - \varepsilon_t^{t-1}$$

Where (P. M. Dechow et al., 2002, p. 62):
CF_t^s represents the cash from operations realized in period t and recognized in period s
ε_t^s represents the estimation error associated with accruals recognized in period s and cash flows realized in period t. In particular, ε_{t+1}^trepresents the level of estimation errors and ε_t^{t-1} their subsequent correction.
E_t represents the earnings.

Note that there is only one term for estimation errors and one term for its correction. Indeed, no estimation is needed when cash flows occur before (CF_t^{t-1}) or at the same time (CF_t^t) than the recognition there is no estimation error. On the contrary, an estimation is needed when the income or expense is recognized before the realization of cash flows (CF_t^{t+1}).

The model suffers from several limits; we list only three of them. Firstly, the estimation errors are likely to be correlated between each other at the firm-level (P. M. Dechow et al., 2002), and with cash flows realization (McNichols, 2002). Secondly, the model viability is can be put at stake when there are long time-lag between cash flows recognition and realization (2002). Finally, one of the model assumptions regarding the residuals does not hold. In particular, the standard deviation of residuals reflects less the variation relative to the variation of accruals than the absolute variation in residuals. McNichols (2002) explain the consequences of such assumption:

"*Holding the R^2 constant, firms with more variable accruals will have a higher standard deviation of the residuals, so firms with greater underlying volatility in earnings are classified as having lower quality earnings. The DD's empirical proxies are likely to be induced mechanically, in that variability in the residual is increasing in the variability in accruals, which in turn is correlated with variability in sales, cash flows, and earnings*." (64)

8.1.8. Model of McNichols (2002)

The paper of McNichols aims to assess the explanatory power of the model of P. M. Dechow et al. (2002) and the model of Jones (1991) individually compared to a modified version of the Jones model. This modified version include the variables of the two models, that is, cash flows from operations, changes in sales and gross property, plant and equipment (McNichols, 2002, p. 62):

$$\Delta WC_t = b_0 + b_1 * CFO_{t-1} + b_2 * CFO_t + b_3 * CFO_{t+1} + b_4 \Delta Sales_t + b_5 PPE_t + \varepsilon_t$$

The individual assessment reveals that the model of P. M. Dechow et al. (2002) is biased due to a wrong specification. In particular, CFOs are a bad proxy for cash flows recognized in accruals, as the residuals from the model are significantly correlated with the change in sales. In turn, the residuals of the Jones model are significantly correlated with past, current and future cash flows. The assessment of the new model shows that all variables are statistically significant. This result suggests that the new model has a higher explanatory power than the two other models taken individually. However, the model still suffers from bias. According to McNichols, as soon as the measurement error of a proxy is correlated with a partitioning variable, the model is biased.

8.1.9. Model of Kim et al. (2003)

The authors propose two solutions. Firstly, they build a modified version of the Modified Jones model by including cash flows from operations as an additional control variable. Secondly, they provide an alternative way to compute earnings management that are free from bias and measurement errors. In particular, they estimate the discretionary accruals by subtracting the expected level of working capital accruals to the current year’s realized working capital accruals (Kim et al., 2003, p. 348):

$$AWCA_{jt} = WCA_{jt} - \left[\left(\frac{WCA_{jt-1}}{REV_{jt-1}} \right) * REV_{jt} \right]$$

Where WCA denotes non-cash working capital accruals and REV denotes sales revenue. AWCA denotes “[…] the deviation of the current year’s working capital accruals from the normal level of working capital accruals required to support current sales activities.” (Kim et al., 2003, p. 348) The authors interpret AWCA as an outcome of opportunistic earnings manipulation.

Regarding CFO, instead of subtracting CFO from prior period to current CFO, the authors suggest to subtract industry median CFO to the current CFO.

8.1.10. Model of Beuselinck et al. (2004)

The model is worth the development for two reasons: they add further control variables to mitigate the omitted variable bias, and 60% of their sample is composed of Belgian SMEs (Beuselinck et al., 2004, p. 20). As the Belgian SMEs are not obliged to disclose their revenues, the authors replace the changes in sales by the changes in net added value. Total accruals are computed as follows (Beuselinck et al., 2004, p. 32):

$$\frac{CA_{j,t}}{TA_{j,t-1}} = \alpha_0 \left[\frac{1}{TA_{j,t-1}}\right] + \alpha_1 \left[\frac{\Delta NAV_{j,t} - \Delta TR_{j,t}}{TA_{j,t-1}}\right] + \varepsilon_t$$

Where for sector j at time t:
$CA_{j,t}$ = current accruals
$\Delta NAV_{j,t}$ = change in net added value
$\Delta TR_{j,t}$ = trade receivables growth
$TA_{j,t-1}$ = beginning of the year total assets

8.1.11. Model of Kothari et al. (2005)

The model aims to mitigate the performance-related misspecifications of the previous models. The authors bring three changes. Firstly, they control for past performance. The Jones model and Modified Jones model already control for current performance (revenues and receivables), but the authors suggest that past performance is also critical (Kothari et al., 2005, p. 167). Secondly, the authors use the return on assets (ROA hereafter) instead of revenues, as the matching ability of ROA is superior against other performance variables. Thirdly, the authors replace the basic linear framework presented in 3.2.1. by a non-linear framework. They believe that due to accounting conservatism[1], the distribution of the level of earnings management is asymmetric.

The authors present two alternatives. The first option uses the Modified Jones regression model and includes additional variables controlling for performance as well as a

[1] Accounting conservatism is the act of choosing “accounting procedures or estimates that keep the book values of net assets relatively low”. In other words, reporting conservatively means that earnings understatement is preferred (and thus more likely) over overstatement.

constant. The constant is aims to further reduce heteroskedasticity and make the model more symmetric (Kothari et al., 2005, p. 173). The second option computes the discretionary accruals of a performance-matched firm and subtracts them from the discretionary accruals of the firm within the same industry with the closest ROA. The authors believe that the first option is misspecified because it doesn't take into consideration the non-linear relationship between discretionary accruals and performance (Kothari et al., 2005, p. 169). On the opposite, the second option is well specified and shows a low type I error in most situations.

The regression model of the first option is the following (Kothari et al., 2005, p. 174):

$$TA_{it} = \delta_0 + \delta_1 \left[\frac{1}{ASSETS_{it-1}}\right] + \delta_2 \Delta SALES_{it} + \delta_3 PPE_{it} + \delta_4 ROA_{it(or\ it-1)} + v_{it}$$

The matching process of the second option uses two groups of companies from the same industry. The companies are matched with their sibling showing the closest ROA. The authors simplify the model by assuming that performance has an identical effect on discretionary accruals for the test and for the matched control sample. This simplification provides a major advantage to this model, since the researcher doesn't have to model the form of the relationship between discretionary accruals and performance (Kothari et al., 2005, p. 166).

The model suffers from five limits. Firstly, the authors assume that the impact of the performance on accruals is uniform over the test sample and the matched control sample. Yet, the validity of this hypothesis is debatable (Kothari et al., 2005, p. 170). Secondly, the authors ignore the consequences embedded in the inclusion of irrelevant variables and/or the poor modelling of the determinants. In such cases, the standard error increases to the detriment of the test power (P. M. Dechow et al., 2011). Thirdly, the model tends to worsen misspecification in samples that contain firms of large size and large CFOs (2011). The model is well specified when applied to samples with large ROA though. Fourth, the authors use the discretionary accruals from the Jones model, which explain only 10 to 12% of the variation in accruals. As a result, the matching process may well add further noise in the interpretation (P. M. Dechow et al., 2011). Finally, the model still suffers from high type I error for two reasons: the researcher cannot assure the matched control firm doesn't manipulate as well, and the ROA of the two companies may appear to be the same whereas one manipulates and not the other (P. Dechow et al., 2010). Indeed:

"[…] assume ROA is 20% for firms A and B, with firm A using discretionary accruals to boost its ROA by 2% to report 20%. Firm B is not manipulating earnings; it has achieved 20% ROA because it has higher non- discretionary accruals than firm A. Matching firm B to firm A would suggest that firm A's level of non- discretionary accruals should be the same as firm B's, but this match is incorrect since the correct match should be a firm with ROA of 18%."(P. Dechow et al., 2010, p. 359)

But according to the authors of the model, "[…] the power of test using performance-based discretionary accruals measures is not sacrificed so long as the researcher seeks to estimate the earnings management impact of the treatment event itself" (Kothari et al., 2005, p. 171). In order words, the model is still misspecified for the cases where the researcher tests for discretionary accruals affecting both treatment and control firms, and when discretionary accruals are correlated with performance.

8.1.12. Model of P. M. Dechow et al. (2011)

After Healy (1985) and DeAngelo (1986), all subsequent models tried to mitigate the problem of omitted relevant variables. As a reminder, this problem arises from the partial correlation between earnings management and the economic characteristics of the firm, and has no ultimate solution. P. M. Dechow et al. (2011) offer a model with superior test power where the relevant omitted variables is not a problem anymore. In particular, the regression model incorporates the reversal of the earnings accruals, provided that the researcher has some guesses on the period in which accruals reverse.

Nondiscretionary accruals do not reverse permanently because they are part of the continuous business of the company. Discretionary accruals, on the contrary, do reverse. This reversion allows the researcher to isolate and identify the level of discretionary accruals. With the previous model, low nondiscretionary accruals firms (typically large firms) may be (unintentionally) controlled by high nondiscretionary accruals firms (typically small firms). The researcher will incorrectly infer that earnings are manipulated downwards. If instead the researcher includes accruals reversal in his model, he searches a potential increase in accruals. Firm size being a persistent feature of the firm, the accruals would stay low, indicating that they are not sign of earnings management. Note that the test power and the specification are improved *conditionally* to the persistence (at least partially) of the omitted variables. If the omitted variables (i.e. the nondiscretionary accruals) reverse completely, the model has no higher explanatory power than the previous models.

The authors consider three scenarios: (1) no guess about the reversal period; (2) outright reversal in the period subsequent to the earnings management period; (3) outright reversal over the two years subsequent to the earnings management period. The template of the model follows the same path as in 3.2.1. with an additional partitioning variable. This new variable determines the period in which occurs the reversal.

The model suffers from two limits. Firstly, if the omitted variables completely reverse within a year, the test has no superior power test in comparison with previous models. Secondly, the model suffers from an overcorrection problem if the two periods include highly serially negatively correlated omitted variables (P. M. Dechow et al., 2011, p. 331).

8.2. Earnings distribution models

Earnings distribution models investigate the repartition of earnings around zero. When the companies incur minor losses, they are motivated to manage earnings slightly just to cross the red line and report small positive earnings (Huang et al., 2011, p. 2689).

As a first step, the researcher plots a histogram with the means and the median of earnings (or earnings per share) of all observation included in the sample. His objective is to detect any unusual discontinuity between the distribution of earnings below zero, and the distribution of earnings above zero with zero included. Any unusual low prevalence of earnings in the first partition, coupled with a high prevalence of earnings in the second partition suggests that companies did manipulate earnings. As this step remains subjective to the researcher, the analysis is paired with a Z test resulting in a t value statistic test. This step aims to test whether or not to reject the null hypothesis that the earnings distribution is smooth at the threshold point. Usually, researchers consider that a t value greater than 2 means that the distribution of earnings is asymmetric, that is, earnings are more concentrated in a particular area (Huang et al., 2011, p. 2690).

This trend can be explained by three psychological effects (Burgstahler & Dichev, 1997; Degeorge et al., 1999). Firstly, no matter the scale of absolute value, the human thought process favors positive over negative numbers. As a result, companies experiencing minor losses are tempted to replace them by slight gains. Secondly, according to the prospect theory, the incentive to manage earnings relies on the value function of the participants. Thirdly, earnings are used as basis for contracts conditions with creditors (covenants, loans, interest rates, etc.). The “zero thresholds” is often a red line as an initial screen in such contracts.

With regard to earnings accruals models, earnings distribution models have two advantages. Firstly, besides the statistical test, they include an histogram that allows visualizing the discontinuity (McNichols, 2001). In the absence of earnings manipulation, the histogram should show a convex, smooth, distribution (Huang et al., 2011, p. 2689). Secondly, earnings distribution models do not make assumptions regarding incentives for earnings management (for example, Jones (1991) hypothesizes that managers do not manipulate revenues). These assumptions strongly restrict the testing method and lead to the problems abovementioned (Burgstahler & Dichev, 1997, p. 112).

Earnings distribution models bear two main weaknesses. Firstly, the researcher cannot tell whether the discontinuity observed near zero is due to earnings management or to other unknown factors (P. M. Dechow, Richardson, & Tuna, 2003). This problem is similar to the omitted variable problem of earnings accruals models. Secondly, earnings manipulation can occur in intervals other than immediately next to zero. As a result, this method can detect only a small portion of companies that manipulate.

8.2.1. Model of Burgstahler and Dichev (1997)

The authors proceed to a double testing: they believe that earnings can be managed either to avoid losses or to avoid earnings decreases. Regarding the first test, the prospect theory suggests that people are averse to absolute and relative losses, and prefer to maintain small positive earnings. Regarding the second test, managers are more tempted to avoid reporting earnings decreases when the period is preceded by a long succession of earnings increases.

The authors intentionally avoid strong assumptions about the form of the distribution of earnings changes and earnings levels. They assume that the distribution is smooth under the null hypothesis of no earnings management. That is, “[…] the expected number of observations in any given interval of the distribution is the average of the number of observations in the two immediately adjacent intervals.” (Burgstahler & Dichev, 1997, pp. 102-103). The results show lower than expected frequencies of earnings decreases/losses and higher than expected frequencies of earnings increases/benefits. They also show that earnings management involves both cash flows from operations and changes in working capital.

The model suffers from two limits. Firstly, the discontinuity observed around zero depends on the number of observations, which is not the same across the intervals. Secondly, earnings manipulation can occur in intervals other than immediately next to zero. According to the authors, the histogram mitigates this weakness.

8.2.2. Model of Degeorge et al. (1999)

This model is different from Burgstahler et al. (1997) for three reasons. Firstly, besides absolute loss and failure to maintain past performance, the authors explore a third threshold for earnings manipulation: the failure to reach analysts' forecasts. Secondly, the authors focus less on the accounting issues and misreporting mechanisms than the motivations for earnings manipulation. Thirdly, they organize the thresholds into a hierarchy according to their prevalence: positive earnings threshold, performance of prior period, and analysts' forecasts, by decreasing importance.

Their results show that negative earnings situated close to zero will be manipulated to cross the red line. Negative earnings situated far from zero will be adjusted in order to get closer from the red line. Finally, the authors find that manipulating companies have worse future performance than control group firms.