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The Impact of a Heterogeneous Accrual-Generating Process on Empirical Accrual Models

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Abstract

The cross-sectional approach that is typically used to estimate accrual models implicitly assumes that firms within the same industry have a homogeneous accrual-generating process (AGP). In this article, the authors examine this implicit assumption along three dimensions. First, they argue that the relationship between working-capital accruals and changes in sales is more complex than portrayed by existing empirical accrual models. In addition to sales changes, accruals are also affected by accrual determinants such as firms' inventory and credit policies. Second, the authors provide evidence that the assumption of a uniform AGP is violated in industries whose firms' accrual determinants are highly dispersed. Third, they document some implications of violating the assumption of a uniform AGP. Firms in industries with high variations in accrual determinants are likely to have large absolute abnormal accruals. The authors show that the previously documented increase in the absolute level of abnormal accruals over time could be attributed, in part, to the increased heterogeneity in industries with respect to their AGPs.

Keyword

earnings management, accrual models, Jones model

Empirical accrual models, such as the Jones and modified-Jones models, have been used extensively in the accounting literature to address central questions regarding firms' accounting choices (for reviews, see Dechow, Ge, & Schrand, 2010; Fields, Lys, & Vincent, 2001; Kothari, 2001).[1] Researchers have also used the output of these models—discretionary or abnormal accruals—as proxies for accrual or earnings quality (e.g., Francis, LaFond, Olsson, & Schipper, 2005; Frankel, Johnson, & Nelson, 2002).

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Despite the popularity of empirical accrual models, several researchers have argued that the models produce abnormal accruals that contain substantial measurement error, which in some cases leads to biased inferences. For example, Kothari, Leone, and Wasley (2005) show that in samples of firms with extreme performance, abnormal accruals contain measurement error, which is correlated with certain firm characteristics. They warn against making inferences about accounting choices if the partitioning variable, which proxies for accounting incentives, is correlated with, for example, past firm performance. Although there are discussions in the literature of potential adverse consequences of using accrual models, little is known about the sources of the problems in the models.

In this article, we examine the homogeneity assumption underlying the estimation of accrual models and the consequences of its potential violation. According to this assumption, a firm either has a stable accrual-generating process (AGP) over time, or groups of firms (typically firms sharing a two-digit Standard Industrial Classification [SIC] code) have a uniform AGP (Bartov, Gul, & Tsui, 2000). Thus, this assumption is relevant to both the time-series or cross-sectional approaches used for estimating accrual models.

First, we examine several firm-specific characteristics, labeled ''accrual determinants.'' Accrual models rely mainly on the shock to sales to describe the generation of accruals. However, accruals do not depend solely on the shock to sales. Firm-specific determinants, *together with the shock to sales*, influence the levels of accruals. These determinants include (a) receivable turnover, (b) payable turnover, (c) inventory turnover, and (d) profit margin. Dechow, Kothari, and Watts (1998) describe how these determinants interact with sales changes to generate accruals. We use these accrual determinants to examine the empirical validity of the uniform AGP assumption. We show that they exhibit large variations within various industries. Therefore, the AGP within an industry is not as homogeneous as is implicitly assumed in existing accrual models.

Second, we document some of the consequences of violating the uniform AGP assumption. The large within-industry variation in the AGP reduces the likelihood that an accrual model captures a statistically significant relationship between sales changes and accruals. Furthermore, large variations in AGP are associated with deviations between the theoretical firm-specific coefficients and the accrual model's estimated coefficients, which are used in computing abnormal accruals. Such deviations generate a large noise component in abnormal accruals, whose consequences are important when studying and making inferences based on the absolute value of abnormal accruals. Studies that make such inferences have grown in popularity in recent years.[2]

Our study contributes to the accounting literature in several ways. First, our results advance our understanding of the complex relationship between sales changes and accruals. This relationship is quite intuitive and is discussed in Dechow et al. (1998). They argue that their ''model can explain how the coefficient on sales in the Jones model would vary across firms and lead to better specification of the relation'' (p. 167). Despite this claim, their model has not yet been utilized in the literature. We attempt to fill this void by (a) linking accrual determinants to existing empirical accrual models and (b) assessing the underlying assumption of homogeneity in the estimation of the accrual models, based on the properties of accrual determinants. Using simple primitives, our study helps in understanding what is ''under the hood'' of accrual models.

Second, we specifically investigate *one potential cause* of measurement errors in abnormal accruals, namely, the heterogeneity of the industry underlying the estimation of accrual models. Identifying the sources of measurement error is important for eliminating it. Thus, knowledge of the source of errors in the estimated coefficients of accrual models is key to

improving estimates of abnormal accruals. In this regard, our study is close to Hribar and Nichols (2007). They examine the association between the absolute value of abnormal accruals and certain fairly stable firm characteristics. In contrast, we point to a single *specific source* of measurement error in absolute value of abnormal accruals. This source is related to industry characteristics and to the estimation procedures typically adopted in the literature.

Finally, our results have important implications for the interpretation of abnormal accrual measures and their use in the extant literature. We document that abnormal accruals as a fraction of income before extraordinary items are about 60%. This calls attention to potential noise that exists in these accrual measures. We caution against interpreting the absolute value of abnormal accruals as a measure of earnings quality. We show that firms in industries with high variation in accrual determinants have large errors in their estimated abnormal accruals, leading to large magnitudes of absolute abnormal accruals.

We emphasize that our goal in this study is not to develop an alternative model for abnormal accruals. We refrain from prematurely offering a model before gaining a better understanding of the optimal properties of such a model. Instead, we take a first step in evaluating the strengths and weaknesses of existing accrual models. We think that such a task is necessary before attempting to develop a better model for estimating abnormal accruals. Our contribution is to build a framework around which future research can design accrual models that produce more accurate measures of accounting discretion.

Summary of the Results

Our first set of results shows that the coefficient on changes in sales (μ_1), estimated using different accrual models, is associated with four accrual determinants—the receivable turnover, the payable turnover, the inventory turnover, and profit margin. This implies that accrual models do, in fact, capture some of the underlying relationship between sales and accruals. It also implies that the AGP is related to both the accrual determinants and the coefficient on changes in sales.

To evaluate the assumption of a uniform AGP, we examine the distribution of accrual determinants. We show that a higher variation in three of the four accrual determinants is associated with a lower likelihood that the coefficient on changes in sales (μ_1) will be significant in the models' estimation. This high variation serves as a proxy for the degree of heterogeneity in AGP within a specific industry. This finding suggests that the estimation quality of an accrual model is closely related to the empirical validity of the uniform AGP assumption.

Industries with a high degree of variation in accrual determinants, and in which the uniform AGP assumption is more likely to be violated, contain (a) firms with lower book-to-market (BM) ratios, (b) less profitable firms, and (c) firms with lower rates of past sales growth. We also find that the size of the absolute value of abnormal accruals over our entire sample period is about 7% to 9% of total assets and about 60% of income before extraordinary items. These magnitudes of accounting discretion seem very large especially in comparison with the publicized egregious accounting fraud cases. For example, the largest restatement in U.S. history by WorldCom accounted for approximately 9% of WorldCom's total assets at the end of 2000.

Finally, we investigate the relationship between accrual determinants and abnormal accruals. We argue that the absolute value of abnormal accruals contains a noise component related to the violation of the AGP assumption. This violation, in turn, is related to the variation in accrual determinants. Thus, in cross-sectional, industry-level regressions, we

correlate the absolute value of abnormal accruals with the degree of variation in accrual determinants. We find that firms in industries with higher variation in accrual determinants have larger absolute abnormal accruals. We find that between 10% and 20% of the cross-industry variation in the level of abnormal accruals is related to the variation in accrual determinants.

In a time-series test, we link the increasing trend in the absolute level of abnormal accruals since the 1970s to increasing trends in the variation in accrual determinants across industries. We find that between 14% and 65% of the time-series variation can be explained by the separate variation in accrual determinants over time.

Caveats

Our study shows that measurement errors can arise from the violation of the uniform AGP assumption that is implied by accrual models. The source of the measurement error is the noise in the estimated coefficients which are used to calculate abnormal accruals. We do not examine the effects of other factors that could lead to measurement errors in abnormal accruals. For example, miscalculation of the accrual variable itself (e.g., Francis & Smith, 2005; Hribar & Collins, 2002) could lead to estimation problems and erroneous abnormal accruals. In addition, Hribar and Nichols (2007) show that firm-specific factors, such as the volatility of operations, can also contribute to the measurement error. Furthermore, mis-measurement of the coefficients in the model could stem from violations of the assumptions underlying the classical linear regression model. Finally, potential biases could arise due to nonlinearities in the relationship between accruals and sales changes (e.g., Ball & Shivakumar, 2006).

In most of our tests, we include separate measures for the four accrual determinants. Although the AGP is more likely affected by a combination of these (and potentially other) accrual determinants, we do not provide specific guidance on how to aggregate the variation across firms in accrual determinants to reflect the overall AGP. However, we show that there is a positive correlation between the variations of the four accrual determinants across industries. This suggests that our results regarding separate measures of the determinants potentially understate the combined effect of these measures on the overall AGP and thus on the outcome of accrual models. Finally, although the effect of our results on the interpretation of the absolute level of abnormal accruals is fairly evident, our results' effect on signed tests of abnormal accruals are less clear.

The rest of the article is organized as follows: In the section titled ''Hypotheses Development'' we develop our hypotheses. In the sections titled ''Data'' and ''Results'' we describe our data and report the main results, respectively. The last section concludes the article.

Hypotheses Development

Background

Empirical accrual models. The need for aggregate accrual models arose when researchers realized that studies of discrete accounting choices were incomplete, as managers make joint decisions from a set of accounting choices at their disposal (Fields et al., 2001). Over the years, the literature has evolved from using naïve models, as in Healy (1985), to the current industry standards: the Jones (1991) model; the ''modified-Jones'' model in Dechow, Sloan, and Sweeney (1995); and their variants (e.g., Dechow, Richardson, &

Tuna, 2003). The outputs of such models, often referred to as discretionary or abnormal accruals, are typically used in examining whether earnings management is present in a particular sample in which it is hypothesized to have occurred. More recently, abnormal accruals and the absolute value of abnormal accruals have been used as proxies for earnings quality and as explanatory variables in studying issues other than earnings management (see Note 2).

Accrual models structurally describe the behavior of accruals. The original version of the Jones (1991) model described in Equation 1 below is quite parsimonious, relying on changes in sales and the level of property, plant, and equipment to explain total accruals:

$$TA_i = \alpha + \mu_1 Ch\_Sales_i + \mu_2 PPE_i + \varepsilon_i. \quad (1)$$

Abnormal accruals are the residuals resulting from estimating these accrual models. Several studies have noted that abnormal accruals are exposed to various biases, and inferences based on them need to be made with caution (e.g., Dechow et al., 1995; Hribar & Collins, 2002; Hribar & Nichols, 2007; Kothari et al., 2005).

The estimation of accrual models. An important element that affects the estimated coefficients of an accrual model (μ_1 and μ_2 in Equation 1) is the way in which the accrual model is estimated. Ideally, researchers would like to estimate a model in a sample that is relatively homogeneous with respect to the AGP. This increases the probability that the accrual model would adequately capture the AGP and ensures that the coefficients are estimated with precision and with sufficient power.

Originally, the accrual models were estimated separately for each firm, utilizing a time series of observations (e.g., Jones, 1991). Underlying this implementation is the notion that a particular firm's AGP is stable over time. Moreover, under this approach, the implied assumption is that there was no accrual manipulation in the ''estimation period'' and that accrual manipulation is only present in the ''test period.'' The disadvantage of this approach is that many firms drop from the sample because they do not have a sufficiently large time series to warrant a meaningful estimation during the estimation period (Subramanyam, 1996). As a result, researchers, beginning with DeFond and Jiambalvo (1994), turned to a cross-sectional version of the model by estimating it separately for each industry defined by a common two-digit SIC code. This estimation procedure has become standard practice. The assumption underlying this estimation procedure is that each two-digit group is homogeneous in its AGP (see discussions in Bartov et al., 2000, pp. 427-428).

The implied assumption of a uniform AGP within an industry, as defined by a two-digit SIC code, suggests that the relationship between sales changes and accruals is identical for all firms in an industry. This assumption is a limitation of the cross-sectional estimation approach. If it is violated, then the estimated coefficients could be biased in unpredictable directions.

Accrual Determinants

Accrual models rely mainly on the shock to sales to describe the generation of accruals. However, accruals do not depend solely on the shock to sales. Certain firm-specific characteristics, *together with the shock to sales*, determine the levels of accruals. For example, consider two firms that are identical in all respects except their credit policies. Firm A does not grant any credit to its customers whereas Firm B grants credit. It is evident that for any given shock to sales, Firm B will not generate any accruals related to accounts receivables but Firm B

will. In addition to credit policies, other firm characteristics, such as inventory policies and credit terms granted by the firm's suppliers, interact with the shock to sales in affecting accruals.

The intuition underlying the effect of firm policies and strategies on accruals is modeled explicitly in Dechow et al. (1998). They develop an algebraic model that describes the behavior of accruals absent any managerial intervention. In the Dechow et al. model, each of the accrual characteristics is summarized by a parameter in the model, which we label the ''accrual determinants.''[3] These determinants include the receivable turnover (α), the payable turnover (β), the inventory turnover (γ_1), and the profit margin (π).

Dechow et al. (1998) make several assumptions about the sales process and obtain an equation describing working-capital accruals (WCA) as a function of both the shock to sales and accrual determinants, which interact with the shock to sales. Hence, unlike the empirical accrual models' parsimonious representation of the interaction between the shock to sales and accruals, the Dechow et al. model describes a more complex relationship.

The Uniform AGP Assumption

The specification of the typical accrual model suggests that the relationship between sales changes and accruals can be summarized by a single coefficient (μ_1), which is assumed to be stable across firms in the same industry. We propose to evaluate the empirical validity of the uniform AGP assumption using the more fundamental components of the relationship between sales changes and accruals. As μ_1 collapses the impact of all accrual determinants on the relationship between sales changes and accruals, the uniform AGP assumption implies a high degree of homogeneity in accrual determinants, which are the building blocks of the AGP.

It is important to note that the underlying assumption is about the homogeneity of the AGP within a specific industry. Currently, the industry measure used in the literature is the classification based on two-digit SIC codes. This measure is weak on two dimensions. First, two firms with different business environments could still belong to the same industry. For example, Bernard and Skinner (1996) mention that makers of heavy equipment for the oil and gas industry, producers of video games, manufacturers of lawn mowers, and makers of personal computers, all have the same two-digit SIC code.

Second, it is possible that two firms, which operate in the same business environment, have different AGPs as a result of pursuing different business strategies. To illustrate this, we plot in Figure 1 three accrual determinants of four firms that belong to a common two-digit SIC code (53): Walmart, Target, Kohl's, and Nordstrom. The variation of the accrual determinants of these firms across time as well as within the industry is striking.[4] For example, Target's receivable turnover (α) has decreased from about .15 to about .05 during the first 25 years in the sample and has increased to about .13 since 2002. Such large changes are also observed in Nordstrom's receivable turnover. More importantly, at a specific point in time, we observe a large variation of receivable turnover (α) across the four firms. Similar patterns emerge in the other two accrual determinants. For example, the accounts payable turnover (β) at the end of the sample period ranges from around .06 for Kohl's to about .12 for Target. The time-series variation in the payable turnover seems less volatile than it is for receivable turnover.

Overall, these figures show that even firms that operate in a similar business environment and belong to the same two-digit SIC code have strikingly different accrual determinants. Thus, these firms are expected to have different AGPs. Models estimating their

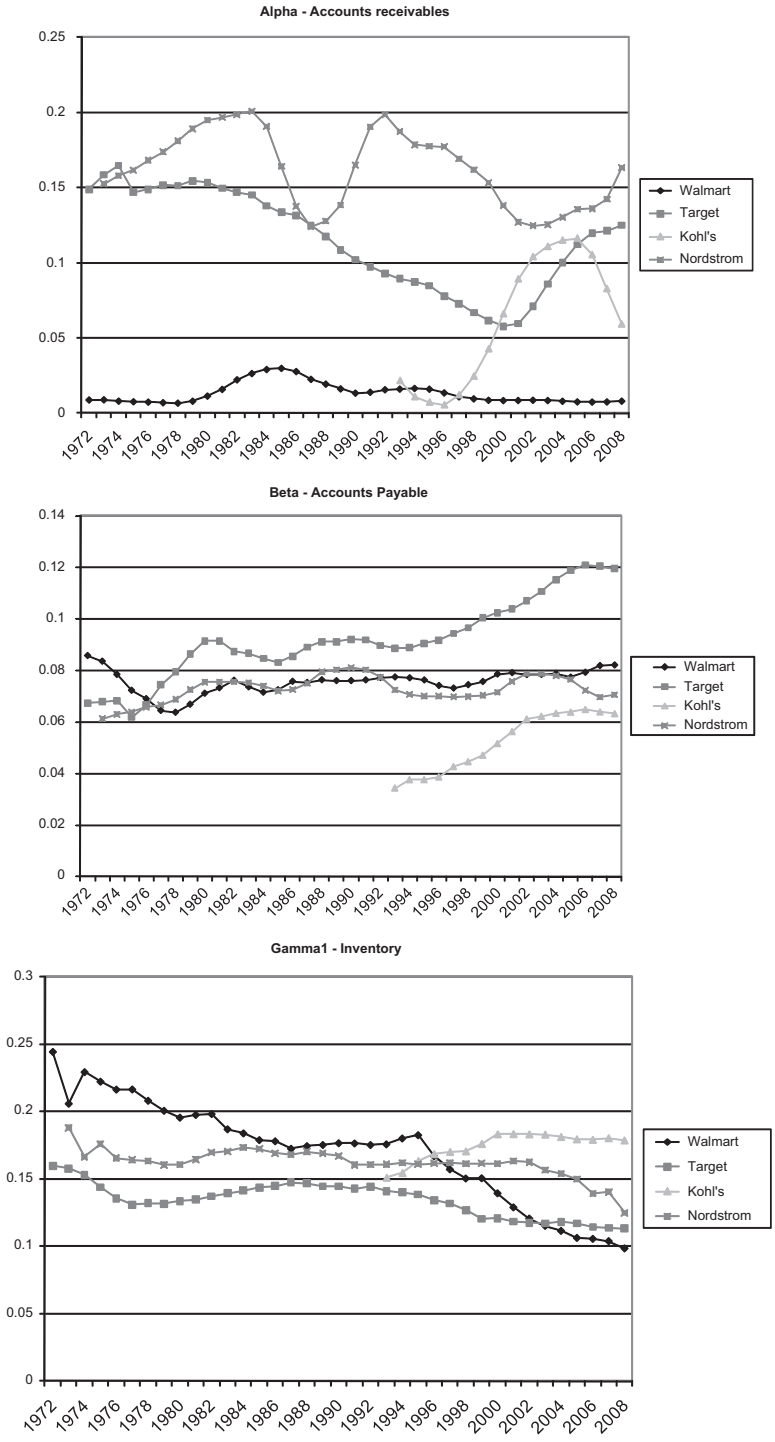

Figure 1. Accrual determinants of four firms in the retail industry (SIC code = 53)

Note: α is the accounts receivable turnover calculated as $(AR_t + AR_{t-1}) / 2 \times SALES_t$; β is the accounts payable turnover calculated as $(AP_t + AP_{t-1}) / 2 \times SALES_t \times (1 - \pi)$; γ_1 is the inventory turnover and is calculated as $g_1 / (1 - \pi)$ truncated above at 1 and below at -1; g_1 is obtained from the following regression $INV_t = g_1 \times SALES_t + g_2 \times \Delta SALES_t + \varepsilon_t$; $\pi = NI_t / SALES_t$.

abnormal accruals are likely to contain error stemming from the apparent difference in these firms' AGPs. Also, the figure suggests that accrual determinants of the same firm vary over time. These changes are likely to affect time-series versions of accrual models.

A more formal examination of the validity of the uniform AGP assumption requires an understanding of the primitives that capture the relationship between accruals and sales changes. Moreover, such primitives must have a relationship to the empirical estimation of the accrual models.

Our first objective is to examine whether there is a link between accrual determinants and the estimated coefficient (μ_1) in the Jones model. This link is a necessary first step in evaluating the merits of these models. This leads to our first testable hypothesis:

Hypothesis 1 (H1): Accrual determinants related to receivable turnover (α), inventory turnover (γ_1), and profit margin (π) are positively associated with the estimated coefficient on sales changes μ_1. As increases in payables reduce net accruals, the accrual determinant related to payable turnover (β) is expected to be negatively associated with μ_1.

To evaluate whether violating the uniform AGP assumption affects the empirical estimation of accrual models, we examine the relationship between the estimation quality of the accrual models and the homogeneity of AGP in an industry. To assess estimation quality of accrual models, we examine whether the μ_1 coefficient is statistically significant. We assume that the homogeneity of AGP is decreasing in the within-industry dispersion of accrual determinants. Thus, we hypothesize that the uniform AGP assumption is more likely to be violated in industries that exhibit a high degree of variation in accrual determinants, as reflected in the standard deviations of each accrual determinant within that industry. More formally, we test the following hypothesis:

Hypothesis 2 (H2): The frequency with which μ_1 is statistically significant is related to the within-industry variation in the accrual determinants.

Consequences of Violating the Uniform AGP Assumption

When accrual models are estimated, the resulting coefficient on sales changes (μ_1) could be measured with error, relative to the ''true'' firm-specific coefficient. This could be due to econometric problems, such as the violation of classical assumptions of the linear regression model. Notwithstanding this econometric bias, if the assumption of a uniform AGP is violated, the estimated coefficient (μ_1) will contain noise with respect to the true ''firm-specific'' coefficient. The error in an accrual model's coefficient is the difference between the estimated coefficient, which could be viewed as an ''average'' coefficient of the industry and the true firm-specific coefficient.[5] The latter, of course, is not observable. However, this is the important coefficient researchers would like to employ when estimating *firm-specific* abnormal accruals. As Bartov et al. (2000) state, ''if . . . sample firms are not much different than the average firm in their industry, the fact that the cross-sectional version forces the coefficients to be the same for all firms in the industry should not represent a serious problem'' (p. 428). When the AGP in an industry is uniform, the ''average'' estimated industry coefficient is a good proxy for each of the actual firm coefficients. However, when the

industry is heterogeneous with respect to the AGP, the estimated coefficients deviate from the true coefficients, and noise is injected into the residuals of the models.

Thus, we hypothesize that the coefficients of firms that belong to heterogeneous industries contain a larger noise component than those of firms that belong to more homogeneous industries. In turn, these large noise components in the coefficients translate into large noise components in abnormal accruals. As these errors could be positive or negative, we expect a positive association between proxies for the degree of heterogeneity in the AGP and *the absolute value* of abnormal accruals.

Hypothesis 3 (H3): The heterogeneity of the AGP in a particular industry, captured by the standard deviation of accrual determinants, is positively associated with the absolute value of abnormal accruals.

Data

We obtain the data necessary for our study from COMPUSTAT's files available through Wharton Research Data Services (WRDS) during 1972 to 2008. We include all firms with available data to estimate the accrual models but exclude firms in the financial services industries (SIC codes 6000-6999).

Accrual determinants. To calculate the accrual determinants we follow the procedures outlined below. These procedures are similar to those used by Dechow et al. (1998).

α:	AR = Accounts receivable	$(AR_t + AR_{t-1}) / 2 \times SALES_t$
β:	AP = Accounts payable	$(AP_t + AP_{t-1}) / 2 \times SALES_t \times (1 - \pi)$
γ_1:	Target inventory	$g_1 / (1 - \pi)$; truncated above at 1 and below at -1
g_1:	Regression coefficient	$INV_t = g_1 \times SALES_t + g_2 \times \Delta SALES_t + \varepsilon_t$
π:	Profit margin	$NI_t / SALES_t$

As the accrual determinants themselves can be affected by managerial intervention, we calculate the accrual determinants for Year t as the 5-year average of that determinant, including the current year (t) and the previous 4 years. This reduces the effect of distortions in the value of the accrual determinant in any one year.

To obtain industry statistics at the level of two-digit SIC codes, we compute the average and standard deviation of accrual determinants based on an individual firm's 5-year average of each accrual determinant. We consider all firms belonging to an industry in a particular year.[6]

Accrual models' estimation. We estimate four versions of accrual models. The first is the traditional Jones model:

$$TA_i = \alpha + \mu_1 \times Ch\_Sales_i + \mu_2 \times PPE_i + \varepsilon_i, \quad (2)$$

where

TA =	total accruals calculated from the balance sheets as follows: Δ(Current Assets) $-$ ΔCash $-$ Δ(Current Liabilities) $+$ (current portion of LT debt) – Depreciation and Amortization[7].
Ch_Sales =	the change in sales in Year t $(SALES_t - SALES_{t-1}) / ASSETS_{t-1}$
PPE =	Property, Plant, and Equipment.

We also estimate the modified-Jones model where we subtract the change in receivables from the change in sales (Dechow et al., 1995).

$$TA_i = \alpha + \mu_1 \times (Ch\_Sales_i - Ch\_REC_i) + \mu_2 \times PPE_i + \varepsilon_i. \quad (3)$$

Finally, we estimate a reduced form of the above models, wherein we include only *WCA* as the dependent variable, and we drop *PPE* as an explanatory variable. We do so because the accrual determinants from the Dechow et al. (1998) model apply to *WCA*. The reduced-form models are

$$WCA_i = \alpha + \mu_1 \times Ch\_Sales_i + \varepsilon_i, \quad (4)$$

$$WCA_i = \alpha + \mu_1 \times (Ch\_Sales_i - Ch\_REC_i) + \varepsilon_i, \quad (5)$$

where

WCA = Working-capital accruals calculated from the balance sheets as follows: Δ(Accounts receivables) − Δ(Inventories) − Δ(Accounts payable).

When estimating accrual models, we exclude observations with the extreme 1% (from each side) of each variable in Models 2 through 5.

Results

Summary Statistics

In panel A of Table 1, we report some descriptive statistics of the four main accrual determinants. The mean (median) receivable turnover (α) in our sample is .205 (0.166), which translates to a receivable cycle of about 75 (60) days. The mean (median) payable turnover (β) is .106 (0.080), which is equivalent to 39 (28) days in payables. The inventory turnover's (γ_1) mean (median) is 0.130 (0.110), which translates into an inventory cycle of about 45 days. Finally, the median profit margin (π) is 2.4%. The mean net profit margin (−0.322) is affected by very extreme negative observations. In general, these values (especially medians) are in line with those reported in Dechow et al. (1998). It is worth noting that there is substantial variation in each of the parameters. For example, the receivable turnover's interquartile range is 0.114 to 0.235. All of the other accrual determinants in panel A display similar or greater levels of variation.

In panel B of Table 1, we report some correlations between the accrual determinants. The receivable turnover is positively correlated with the payable turnover (.43) and negatively correlated with the inventory turnover (−.07) and the net margin (−.03).

In Table 2, we provide additional summary statistics on the various accrual determinants, broken down into different subgroups based on four firm characteristics: (a) BM ratio, (b) market capitalization, (c) return on assets (ROA), and (d) sales changes. Some of the determinants vary substantially across different quartiles. For example, the inventory turnover's (γ_1) mean in the lowest BM quartile is 0.056, but it monotonically increases to 0.147 in the top quartile. A similar variation is evident in the ROA quartiles but not in the market capitalization and changes in sales quartiles.

Table 1. Summary Statistics and Correlations of Accrual Determinants

Panel A

	M	*SD*	Max	q3	Median	q1	Min
Receivable turnover (α)	0.205	0.201	4.190	0.235	0.166	0.114	0.003
Payable turnover (β)	0.106	0.097	1.102	0.121	0.080	0.054	0.009
Inventory turnover (γ_1)	0.130	0.133	1.000	0.195	0.110	0.030	−6.881
Profit margin (π)	−0.322	1.986	0.358	0.061	0.024	−0.032	−49.615

Panel B

	Receivable turnover (α)	Payable turnover (β)	Inventory turnover (γ_1)
Receivable turnover (α)			
Payable turnover (β)	0.4287***		
Inventory turnover (γ_1)	−0.0679***	−0.0510***	
Profit margin (π)	−0.0305***	−0.0808***	0.1312***

Note: This table presents summary statistics of and correlations between the accrual determinants. For each year, we calculate and report the 5-year averages of each determinant. If the firm does not have a 5-year history, we use the maximum number of past years for which there is data as of Year *t*.
*, ** and *** indicate significance at the 10%, 5% and 1% level respectively.
Variable description:
Receivable turnover (α) = $(AR_t + AR_{t-1}) / 2 \times SALES_t$
Payable turnover (β) = $(AP_t + AP_{t-1}) / 2 \times SALES_t \times (1 - \pi)$
Inventory turnover (γ_1) = $g_1 / (1 - \pi)$ truncated above at 1 and below at −1; g_1 is obtained from the following regression $INV_t = g_1 \times SALES_t + g_2 \times \Delta SALES_t + \varepsilon_t$
Profit margin (π) = $NI_t / SALES_t$

The Relationship Between Accrual Determinants and Accrual Models

In this section, we test our first hypothesis, which focuses on the relationship between the empirical estimation of accrual models and accrual determinants. In effect, the relationship between accruals and sales changes depends on a black box, which consists of the interactions between accrual determinants and sales changes. In the Jones (1991) model, this black box is summarized by μ_1, the coefficient on the sales change, which can be viewed as a parsimonious measure of the underlying AGP.

To test H1, we estimate the following regression, at the industry (two-digit SIC code) level:

$$\mu_{1,it} = C + a_1 \times \alpha_{it-1} + a_2 \times \beta_{it-1} + a_3 \times \gamma_{1,it-1} + a_4 \times \pi_{it-1} + \varepsilon_{it}, \quad (6)$$

where the dependent variable, μ_1, is the industry coefficient on sales changes from the accrual models. The estimated μ_1 is derived from cross-sectional implementations of the accrual models within an industry, consisting of all firms belonging to a common two-digit SIC code group.[8] The independent variables are the industry averages of accrual determinants: receivable turnover (α), payable turnover (β), inventory turnover (γ_1), and profit margin (π). The industry averages are calculated in the year prior to the year for which the accrual models are estimated, based on firm-specific accrual determinants. Recall that firm-specific determinants are time-series averages calculated over up to 5 prior years. We employ four regression models, each based on a different accrual model, as described in the section titled ''Data.''

The results from estimating regression (Equation 6) are reported in Table 3. The *t* statistics in the table are based on industry-clustered standard errors (Petersen, 2009; Rogers,

Table 2. Summary Statistics of Accrual Determinants Stratified by Different Firm Characteristics

	1	2	3	4
Panel A: Book-to-market ratio				
Receivable turnover (α)	0.194	0.175	0.163	0.159
Payable turnover (β)	0.089	0.080	0.078	0.075
Inventory turnover (γ_1)	0.056	0.106	0.123	0.147
Profit margin (π)	−0.054	0.039	0.036	0.023
Panel B: Market capitalization				
Receivable turnover (α)	0.179	0.179	0.171	0.159
Payable turnover (β)	0.085	0.078	0.076	0.080
Inventory turnover (γ_1)	0.113	0.121	0.111	0.102
Profit margin (π)	−0.010	0.018	0.034	0.053
Panel C: Return on assets				
Receivable turnover (α)	0.210	0.167	0.152	0.158
Payable turnover (β)	0.096	0.084	0.078	0.069
Inventory turnover (γ_1)	0.062	0.109	0.115	0.128
Profit margin (π)	−0.131	0.019	0.040	0.053
Panel D: Changes in sales				
Receivable turnover (α)	0.175	0.165	0.167	0.160
Payable turnover (β)	0.084	0.085	0.077	0.077
Inventory turnover (γ_1)	0.106	0.069	0.120	0.119
Profit margin (π)	0.007	0.039	0.036	0.023

Note: This table presents medians of the accrual determinants calculated separately for quartiles of BM, market capitalization, return on assets, and changes in sales. For each year, we calculate and report the 5-year averages of each determinant. If the firm does not have a 5-year history, we use the maximum number of past years for which there are data as of Year *t*.

Variable description:

Receivable turnover (α) = $(AR_t + AR_{t-1}) / 2 \times SALES_t$

Payable turnover (β) = $(AP_t + AP_{t-1})/2 \times SALES_t \times (1 - \pi)$

Inventory turnover (γ_1) = $g_1 / (1 - \pi)$ truncated above at 1 and below at −1; g_1 is obtained from the following regression $INV_t = g_1 \times SALES_t + g_2 \times \Delta SALES_t + \varepsilon_t$

Profit margin (π) = $NI_t / SALES_t$

1993). Regardless of the type of accrual model used for the estimation of μ_1 (Jones or modified Jones, full or reduced), we find strong evidence that all four accrual determinants are significantly associated with μ_1, in the predicted directions. The receivable turnover (represented by α), the inventory turnover (γ_1), and the profit margin (π) are positively and significantly associated with the coefficient on sales (*t* statistics of 7.23, 6.07, and 2.11, respectively, in the regular Jones model). However, the payable turnover (β) is significantly negatively associated with μ_1 (*t* statistic of −2.77), consistent with the fact that its effect is to reduce overall accruals when sales increase.

It is worth noting that the reduced-form models, which use *WCA* as their dependent variable and exclude *PPE* as an independent variable, have slightly higher explanatory power. This is expected because the accrual determinants we examine only pertain to *WCA*. We report the results of our subsequent tests mainly based on the reduced-form models.

Table 3. The Relationship Between Jones's Coefficients and Accrual Determinants

	Regular (based on total accruals)		Reduced form (based on working-capital accruals)	
	Jones	Modified Jones	Jones	Modified Jones
Intercept	−0.0231	−0.0340	0.0479**	0.0487**
	(−0.91)	(−1.15)	(2.60)	(2.48)
α	0.481***	0.467***	0.540***	0.521***
	(7.23)	(6.44)	(9.25)	(8.87)
β	−0.644***	−0.653**	−0.719***	−0.766***
	(−2.77)	(−2.48)	(−4.79)	(−5.22)
γ_1	0.592***	0.632***	0.446***	0.432***
	(6.07)	(5.45)	(5.83)	(4.77)
π	0.0276**	0.0375***	0.0226***	0.0357***
	(2.11)	(2.75)	(2.99)	(4.69)
n	1927	1697	1927	1697
Adjusted R^2	.1931	.1625	.2407	.1886

Note: The table reports results of estimating the following regression models:

$$\mu_{1,it} = C + a_1 \times \alpha_{it-1} + a_2 \times \beta_{it-1} + a_3 \times \gamma_{1,it-1} + a_4 \times \pi_{it-1} + \varepsilon_{it}.$$

μ_1 is the actual coefficient on changes in sales resulting from estimating several versions of empirical accrual models such as the Jones and modified Jones. We estimate the regular version of each model as well as a reduced form in which the dependent variable is working-capital accruals. Each μ_1 coefficient corresponds to a specific industry-year where an industry is comprised of all firms that belong to a specific two-digit SIC code. The explanatory variables—α, β, γ_1, and π—are the average accrual determinants for a particular industry-year based on firm-specific accrual determinants that are calculated based on Dechow et al. (1998) over a 5-year period starting in Year $t - 5$ and ending in Year $t - 1$. Each determinant is computed based on the description below. *t* statistics are reported in parentheses and are based on Rogers (1993) clustered standard errors grouped by firm (see, Petersen 2009). *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Variable description:

Receivable turnover (α) = $(AR_t + AR_{t-1}) / 2 \times SALES_t$

Payable turnover (β) = $(AP_t + AP_{t-1}) / 2 \times SALES_t \times (1 - \pi)$

Inventory turnover (γ_1) = $g_1 / (1 - \pi)$ truncated above at 1 and below at −1; g_1 is obtained from the following regression $INV_t = g_1 \times SALES_t + g_2 \times \Delta SALES_t + \varepsilon_t$

Profit margin (π) = $NI_t / SALES_t$

In summary, the results in Table 3 support our first hypothesis that there is a relationship between accrual determinants and the accrual models. The results demonstrate that the accrual models do, in fact, capture some of the relationship between changes in sales and accruals, as reflected by the accrual determinants' association with the accrual models' coefficients. In other words, the accrual models' coefficients summarize, at least to some extent, the AGP. However, as the AGP depends on the accrual determinants, the relationship between sales changes and accruals is more complex than what a simple parsimonious coefficient could capture. To examine the validity of the assumption of a uniform AGP, it is imperative to examine the homogeneity of accrual determinants in a specific industry.

Industry Heterogeneity and Accrual Models

In the previous section, we established a link between μ_1 and accrual determinants. Our second hypothesis posits that the quality of empirical accrual models depends on the extent to which the assumption of a uniform AGP is valid. This, in turn, depends on the degree of variation in accrual determinants within the industry in which the model is estimated.

We argue that the estimation quality of accrual models is inferior when the uniform AGP assumption is not valid. As a proxy for the estimation quality of accrual models, we examine whether μ_1 is statistically significant in a particular industry and year. The rationale is that because μ_1 summarizes the AGP, a uniform AGP leads to increased precision and decreased standard errors for μ_1. To proxy for the degree of homogeneity in accrual determinants within an industry, we use the standard deviation of the accrual determinant.

We investigate the relationship between the estimation quality of μ_1 and the dispersion in accrual determinants by estimating the following logistic model:

$$SIG_{it} = C + a_1 \times STD(\alpha)_{i,t-1} + a_2 \times STD(\beta)_{it-1} + a_3 \times STD(\gamma)_{it-1} + a_4 \times STD(\pi)_{it-1} + NOBS + \varepsilon_{it}. \quad (7)$$

The dependent variable (*SIG*) is an indicator variable which equals to 1 if μ_1 is significant (at the 5% level) in a particular industry-year. We use the standard deviation of accrual determinants in a two-digit SIC code group to proxy for the within-industry variation in the accrual determinants. To avoid a mechanical relationship between our constructs, we measure this variation in the year before the estimation of the accrual models. We also include, as an explanatory variable, the number of observations (*NOBS*) used in the cross-sectional accrual models because a larger number of observations leads to smaller standard errors and a more accurate estimation of μ_1.

The estimation results of regression (Equation 7) are reported in Table 4. We report results for dependent variables that are based on reduced forms of either the Jones model (panel A) or the modified-Jones model (panel B).[9] In each panel, we first estimate the models separately for each independent variable (Models 1-4) and then report results when including all the independent variables (Model 5). First, as expected, the number of observations in an industry in which an accrual model is estimated (*NOBS*) is positively related to the significance of μ_1. Second, our findings indicate that when the measures of dispersion in accrual determinants are included separately, there is a negative association between the significance of μ_1 and the dispersion of three of the four accrual determinants. For example, the dispersion in the receivable turnover (*STD*_α) is negatively associated with the likelihood of obtaining a significant μ_1 (t statistic of -2.22). Similar results are observed for the standard deviations in the payable turnover (*STD*_β) and the profit margin (*STD*_π). The standard deviation of the inventory turnover (*STD*_γ_1) is positively associated (at the 10% level) with the significance of μ_1. When we include all dispersion measures together, in Model 5, we find that the standard deviations of both the payable turnover (*STD*_β) and the profit margin (π) are negatively associated with the dependent variable, whereas the standard deviation of inventory turnover (*STD*_γ_1) is positively associated with it. The estimation results in panel B, where μ_1 is derived from the modified-Jones model, are similar.

The evidence in Table 4 suggests that variables associated with the violation of the uniform AGP assumption are related to the quality of estimation of accrual models. The quality of estimation, in turn, is one consequence of the assumption's violation. However, because we examine each determinant separately, it is not clear whether the overall AGP is heterogeneous. In Table 5, we report the correlations between the standard deviations of each determinant across all industry-years. We find that the variabilities of accrual determinants are positively correlated. For example, the variability of the receivable turnover (*STD*_α) is positively correlated with the variability of the payable turnover, *STD*_β (correlation of .565), as well as with the variability of the inventory turnover (*STD*_γ_1) and of

Table 4. The Relationship Between Dispersion in Accrual Determinants and Estimation of Accrual Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Panel A: Jones model (reduced form)					
Intercept	−0.0958	0.152	−0.891***	−0.306	−0.404
	(−0.35)	(0.57)	(−2.91)	(−1.39)	(−1.13)
*STD_*α	−2.720**				0.187
	(−2.22)				(0.18)
*STD_*β		−9.211***			−8.201***
		(−3.20)			(−3.27)
*STD_*γ_1			4.727*		5.923**
			(1.85)		(2.27)
*STD_*π				−0.349***	−0.277***
				(−3.06)	(−3.02)
NOBS	0.00474**	0.00502**	0.00431**	0.00565**	0.00593***
	(2.31)	(2.41)	(2.13)	(2.44)	(2.68)
N	1927	1927	1927	1927	1927
Pseudo R^2	.0570	.0671	.0571	.0677	.0957
Panel B: Modified-Jones model (reduced form)					
Intercept	−0.393*	−0.205	−1.128***	−0.574***	−0.703**
	(−1.74)	(−0.87)	(−4.42)	(−3.14)	(−2.28)
*STD_*α	−2.598**				−0.0315
	(−2.17)				(−0.03)
*STD_*β		−7.836***			−6.232**
		(−2.59)			(−2.28)
*STD_*γ_1			4.285**		5.456**
			(2.00)		(2.48)
*STD_*π				−0.357***	−0.304***
				(−3.36)	(−3.22)
NOBS	0.00425***	0.00437***	0.00375**	0.00526***	0.00544***
	(2.77)	(2.88)	(2.54)	(2.90)	(3.26)
N	1699	1699	1699	1699	1699
Pseudo R^2	.0520	.0571	.0513	.0645	.0856

Note: This table reports the estimation results of logistic models of the following form:

$$SIG_{it} = C + a_1 \times STD(\alpha)_{i,t-1} + a_2 \times STD(\beta)_{it-1} + a_3 \times STD(\gamma)_{it-1} + a_4 \times STD(\pi)_{it-1} + NOBS + \varepsilon_{it}.$$

The dependent variable (*SIG*) equals 1 if the coefficient μ_1, generated by the reduced-form accrual model, for that industry-year (Year *t*) is significant at the 5% level. The independent variables are standard deviation of each accrual determinant in the specific industry-year in the Year $t - 1$. Each determinant is computed based on the description in previous tables. In addition, the number of observations (*NOBS*) in each accrual regression model in each industry-year is included as an independent variable. *Z* statistics are reported in parentheses and are based on Rogers (1993) clustered standard errors grouped by industry (see, Petersen 2009). *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

the profit margin (*STD_*π). This suggests that the degree of variability in any one determinant is likely to be positively correlated with the overall variability in the AGP.

In summary, results in Table 4 support our second hypothesis. They suggest that in more heterogeneous industries, it is more difficult to capture the relationship between sales changes and accruals. Collectively, the results in both Tables 4 and 5 confirm that the variation of accrual determinants across industries is important in assessing the empirical validity of the

Table 5. Correlations Between Variability Measures of Accrual Determinants

	*STD_*α	*STD_*β	*STD_*γ_1
*STD_*α			
*STD_*β	0.565***		
*STD_*γ_1	0.188***	0.101***	
*STD_*π	0.601***	0.323***	0.051**

Note: This table reports Pearson correlations between the standard deviations of each accrual determinants across all industries. The accrual determinants are calculated based on the description below. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.
Variable descriptions:
Receivable turnover (α) = $(AR_t + AR_{t-1})/2 \times SALES_t$
Payable turnover (β) = $(AP_t + AP_{t-1})/2 \times SALES_t \times (1 - \pi)$
Inventory turnover (γ_1) = $g_1 / (1 - \pi)$ truncated above at 1 and below at -1; g_1 is obtained from the following regression $INV_t = g_1 \times SALES_t + g_2 \times \Delta SALES_t + \varepsilon_t$
Profit margin (π) = $NI_t / SALES_t$

assumption of a uniform AGP. This assumption is more likely to be violated when the degree of accrual determinants' dispersion in the industry is high. In these cases, the coefficients of the accrual models are measured with considerable noise. Using these coefficients to calculate abnormal accruals may inject that noise into these abnormal accruals.

The effect on regression coefficients of the degree of variation in the process that governs the relationship between a dependent variable and an independent variable is very intuitive. It is important to note that our contribution is in pointing out the *identity* of the candidates for high variation. Thus, in industries with low variation in accrual determinants, that is, a relatively homogeneous AGP, we expect the accrual models to perform better. However, we expect the accrual models to be of limited use in industries in which the AGP is heterogeneous, that is, industries in which accrual determinants exhibit high variation.

Industry Characteristics

Having established the close relationship between the uniform AGP assumption and the degree of homogeneity in an industry with respect to accrual determinants, we now examine the characteristics of industries with high variation in their AGP. This evidence will provide researchers with warning signs regarding industries in which using abnormal accruals from popular accrual models may be problematic.

Table 6 reports medians of various firm characteristics across different industries based on the variation in accrual determinants within these industries. For example, in panel A we report the medians of (a) BM ratio, (b) market capitalization (SIZE), (c) ROA, and (d) sales changes, separately for industries with low and high variation in the receivable turnover (α). We find that industries with low variation in receivable turnover have a median BM ratio of 0.85, which is significantly higher (Z statistic of 92.7) than industries with high variation in receivable turnover, which have a median BM ratio of 0.40. In general, the results in Table 6 suggest that industries with high variation in accrual determinants contain firms with lower BM ratios, firms with lower ROAs, and firms with lower rates of change in sales.

Firms in industries with high variation in accrual determinants contain a larger noise component in abnormal accruals, leading to larger absolute abnormal accruals. Thus, firms with lower BM ratios are expected to have larger noise in their abnormal accruals and higher levels of absolute abnormal accruals. To a large extent, these expectations are

Table 6. Medians of Firm Characteristics by Different Dispersion Levels of Accrual Determinants

	STD	BM ratio	SIZE	ROA	Sales changes
Panel A: Receivable turnover (α)					
Low	0.056	0.85	66.6	4.32%	10.4%
Q2	0.080	0.81	43.6	4.47%	12.7%
Q3	0.125	0.62	63.1	3.78%	7.8%
Q4	0.169	0.50	63.4	2.88%	8.3%
High	0.259	0.40	60.8	−0.01%	5.0%
Z statistics		92.7	6.4	82.8	29.5
Panel B: Payable turnover (β)					
Low	0.034	0.90	41.7	4.74%	14.4%
Q2	0.047	0.81	45.1	4.59%	11.6%
Q3	0.065	0.55	69.3	3.36%	8.0%
Q4	0.080	0.47	80.8	2.16%	6.1%
High	0.129	0.44	53.1	0.01%	5.7%
		85.2	7.4	73.5	33.6
Panel C: Inventory turnover (γ_1)					
Low	0.046	0.56	148.7	3.25%	5.8%
Q2	0.067	0.56	83.0	3.02%	7.3%
Q3	0.094	0.54	60.1	2.88%	8.5%
Q4	0.110	0.53	44.9	3.11%	9.4%
High	0.136	0.60	39.2	2.81%	8.8%
		12.6	62.3	4.5	9.1
Panel D: Profit margin (π)					
Low	0.041	0.99	44.6	4.71%	14.7%
Q2	0.076	0.88	48.2	4.34%	9.8%
Q3	0.241	0.67	55.1	4.24%	10.4%
Q4	0.718	0.56	55.1	3.18%	7.6%
High	2.482	0.40	72.3	0.00%	5.5%
		111.9	20.2	87.7	47.1

Note: This table reports medians of various firm characteristics stratified by quintiles of industry-years based on the standard deviations of accrual determinants within an industry. Each panel stratifies industry-years into quintiles of a different accrual determinant. The firm characteristics reported are the BM ratio, market capitalization in millions of dollars (Size), return on assets (ROA), and the annual change in sales (Sales changes). Also, *STD* reports the average standard deviation of the accrual determinant in each quintile. In each panel, the table reports the *Z* statistics from a Wilcoxon's test of differences in the medians of each variable between the high and low quintile of accrual determinants dispersion.

consistent with the results reported by Hribar and Nichols (2007). Our article sheds light on one potential source of Hribar and Nichols's findings. Although they attribute the high level of absolute abnormal accruals to firms with certain innate characteristics, we suggest that at least some of the absolute abnormal accruals *originate from the estimation procedure itself* and is related to industry characteristics.

Table 7. Summary Statistics of Discretionary Accruals

	n	*M*	Median	*SD*	Q1	Q3	Minimum	Maximum
Panel A: Absolute value of abnormal accruals scaled by lagged total assets								
Jones	189,193	0.0798	0.0465	0.1137	0.0197	0.0968	0.0000	2.6992
Modified Jones	162,716	0.0856	0.0491	0.1215	0.0208	0.1033	0.0000	2.6925
Panel B: Abnormal accruals scaled by income before extraordinary items								
	Income BEI > 0				Income BEI < 0			
	n	Q1	Median	Q3	*n*	Q1	Median	Q3
Jones > 0	70,067	0.2656	0.6463	1.5488	26,640	−1.4978	−0.4481	−0.1411
Jones < 0	56,655	−1.4198	−0.5834	−0.2331	34,054	0.1636	0.4512	1.1299
Modified Jones > 0	58,152	0.2745	0.6795	1.6395	24,191	−1.4347	−0.4355	−0.1369
Modified Jones < 0	46,221	−1.4732	−0.5949	−0.2372	32,669	0.1625	0.4568	1.1247

Note: The table provides summary statistics on abnormal accruals estimated using the Jones or modified-Jones models. In panel A, summary statistics are provided for the absolute value of abnormal accruals scaled by lagged total assets. In panel B, summary statistics are provided for abnormal accruals scaled by net income before extraordinary items. We provide summary statistics separately for positive and negative abnormal accruals and for positive and negative cases of the different income measures.

Consequences of Violating the Uniform AGP Assumption

One consequence of violating the uniform AGP assumption is that the estimated coefficients in the accrual models deviate from the theoretical firm-specific coefficients for which they proxy. As the estimated coefficients are used in calculating normal and abnormal accruals, noise that is contained in these coefficients translates into noise that is embedded in abnormal accruals.

To provide a sense of the potential magnitude of such noise, we present evidence regarding the magnitudes of abnormal accruals. In Panel A of Table 7, we report the average absolute value of abnormal accruals, scaled by total assets, across all firms during our sample period. Scaling by total assets is normal practice in the literature. Similar to other studies, we find that the absolute value of abnormal accruals is about 7% to 9% of total assets, depending on the model that is used to estimate abnormal accruals. The cross-sectional distribution of abnormal accruals is skewed. The median values of the absolute value of abnormal accruals are about 4% to 5% of total assets.

It is interesting to assess the magnitude of abnormal accruals relative to several measures of profitability. Gaining insight about the magnitude of abnormal accruals relative to income will enable researchers to assess the impact of potential noise that exists in abnormal accruals. Panel B of Table 7 reports the magnitude of abnormal accruals scaled by income before extraordinary items. We report statistics separately for positive and negative measures of income and positive and negative abnormal accruals based on the Jones and modified-Jones models. We note that for positive income and positive abnormal accruals, the median abnormal accrual constitutes 64.6% of income in the Jones model and 68.0% of income in the modified-Jones model. More than 25% of the firms have abnormal accruals that are at least 150% of income before extraordinary items. A similar picture emerges when income is negative. The abnormal accruals (both positive and negative) are about 45% of income.

The magnitudes of average abnormal accruals as a percentage of income or total assets seem quite large, especially when compared with known cases of accounting fraud. For example, the largest restatement in U.S. history accounted for approximately 9% of total assets. It is not plausible to assume that the *average* magnitudes of discretionary accruals obtained using accrual models (7%-9% of total assets) represent solely accounting discretion. The size of abnormal accruals exceeds any level of materiality and would surely raise red flags for auditors. Also, note that the reported statistics are medians and therefore they are not affected by outliers. The results reported in Table 7 suggest that there is substantial noise in measuring abnormal accruals. Our analyses indicate that one factor contributing to this noise is the violation of the uniform AGP assumption.

To test our third hypothesis and to establish a more direct link between the noise in abnormal accruals and the degree of heterogeneity in an industry with respect to accrual determinants, we estimate the following industry-level regression using a truncated regression model (Greene, 2008):

$$ABS\_ACC_{it} = C + a_1 \times STD(\alpha)_{i,t-1} + a_2 \times STD(\beta)_{it-1} + a_3 \times STD(\gamma)_{it-1} + a_4 \times STD(\pi)_{it-1} + \varepsilon_{it}. \quad (8)$$

Table 8. Cross-sectional Regressions

	Regular		Reduced form	
	Jones	Modified Jones	Jones	Modified Jones
Intercept	0.0431***	0.0422***	0.0349***	0.0345***
	(8.72)	(7.34)	(9.33)	(7.72)
*STD_*α	0.0481*	0.0500*	0.0339	0.0383
	(1.83)	(1.77)	(1.63)	(1.63)
*STD_*β	0.0576	0.0639	0.0054	0.0126
	(0.95)	(1.01)	(0.13)	(0.26)
*STD_*γ_1	0.0775***	0.0860***	0.128***	0.137***
	(2.85)	(2.65)	(6.19)	(5.80)
*STD_*π	0.0051**	0.0049**	0.0013	0.0015
	(2.30)	(2.00)	(1.06)	(0.96)
n	1965	1795	1965	1795
Adjusted R^2	.1758	.1527	.1519	.1282

Note: This table reports regressions results of the following model, estimated using a truncated regression:

$$ABS\_ACC_{it} = C + a_1 \times STD(\alpha)_{i,t-1} + a_2 \times STD(\beta)_{it-1} + a_3 \times STD(\gamma)_{it-1} + a_4 \times STD(\pi)_{it-1} + \varepsilon_{it}.$$

The dependent variable is the average absolute value of abnormal accruals in a particular industry-year. In each column, the absolute value of abnormal accrual is calculated based on a different accrual model. The independent variables are the industry-level measures of dispersion in the accrual determinants, measured as the standard deviation of each accrual determinant in a particular industry-year, where the year is that prior to the estimation of abnormal accruals. Each determinant is computed based on the description below. *Z* statistics are reported in parentheses and are based on Rogers (1993) clustered standard errors grouped by industry (see Petersen, 2009). *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Variable descriptions:

Receivable turnover (α) = $(AR_t + AR_{t-1}) / 2 \times SALES_t$

Payable turnover (β) = $(AP_t + AP_{t-1}) / 2 \times SALES_t \times (1 - \pi)$

Inventory turnover (γ_1) = $g_1 / (1 - \pi)$ truncated above at 1 and below at −1; g_1 is obtained from the following regression $INV_t = g_1 \times SALES_t + g_2 \times \Delta SALES_t + \varepsilon_t$

Profit margin (π) = $NI_t / SALES_t$

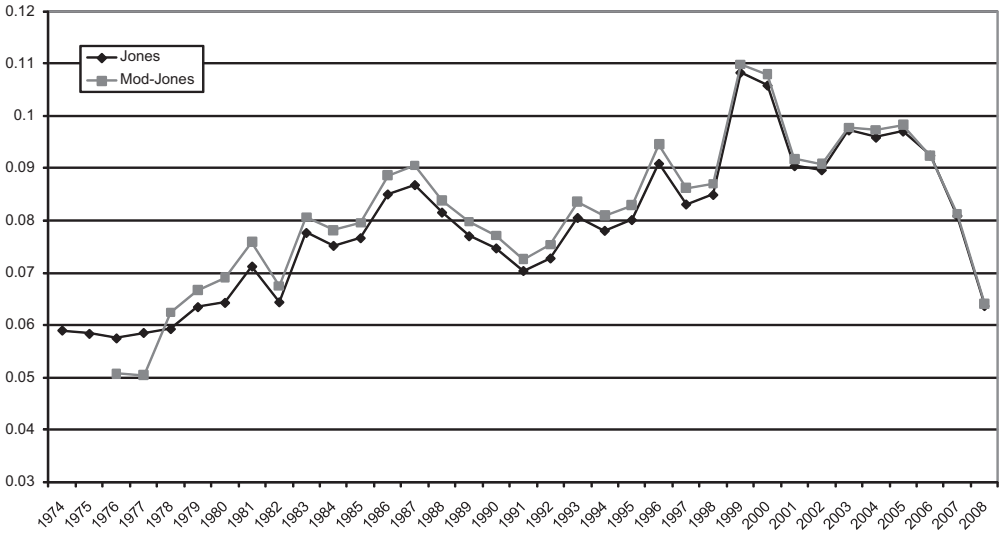

Figure 2a. Time-series pattern in the absolute value of abnormal accruals

The dependent variable, *ABS_ACC*, is the average absolute value of abnormal accruals for Industry i in Year t. The independent variables are the standard deviations of each accrual determinant for Industry i in Year $t - 1$. If the absolute value of abnormal accruals contains a noise component, resulting from the violation of the uniform AGP assumption, we expect it to be correlated with variables proxying for the degree of dispersion in accrual determinants.

We report the results from estimating regression (Equation 8) in Table 8. As in Table 3, we estimate four different models to accommodate abnormal accruals from both the Jones and modified-Jones models as well as from their reduced forms. The standard deviations of the receivable turnover (STD_α) are weakly positively associated (at the 10% level) with the absolute value of abnormal accruals in the regular model but not in the reduced-form model. The coefficient on inventory turnover variability (STD_γ_1) is significantly positive in all models (Z statistic varies from 2.65 to 6.19). The standard deviation of the profit margin (STD_π) is only significant in the full models but not in the reduced-form models. In unreported regressions, in which we include only one of each of the independent variables, we find that the dispersions in all four determinants are significantly associated with the magnitude of absolute abnormal accruals. The standard deviations of accrual determinants explain between 10% and 20% of the cross-industry variation in the magnitude of abnormal accruals. Thus, this evidence suggests that a significant portion of the outputs of the accrual models are related to the lack of uniformity in the AGP across firms within the same industry.

As a final test of the link between the absolute value of abnormal accruals and dispersion of accrual determinants in an industry, we examine the time-series pattern of the absolute level of abnormal accruals. Several studies (e.g., Bergstresser & Philippon, 2006; Cohen, Dey, & Lys, 2008) have noted an increase in the magnitude of absolute abnormal accruals over time. In Figure 2a, we plot the average level of the absolute value of abnormal accruals during our sample period. Note that the average level of absolute abnormal accruals has been increasing steadily since the 1970s from about 5% to 6% of total assets to 11% of total assets in the late 1990s. The increasing trend is interpreted by some as evidence of deteriorating accrual quality (Bergstresser & Philippon, 2006). The figure also

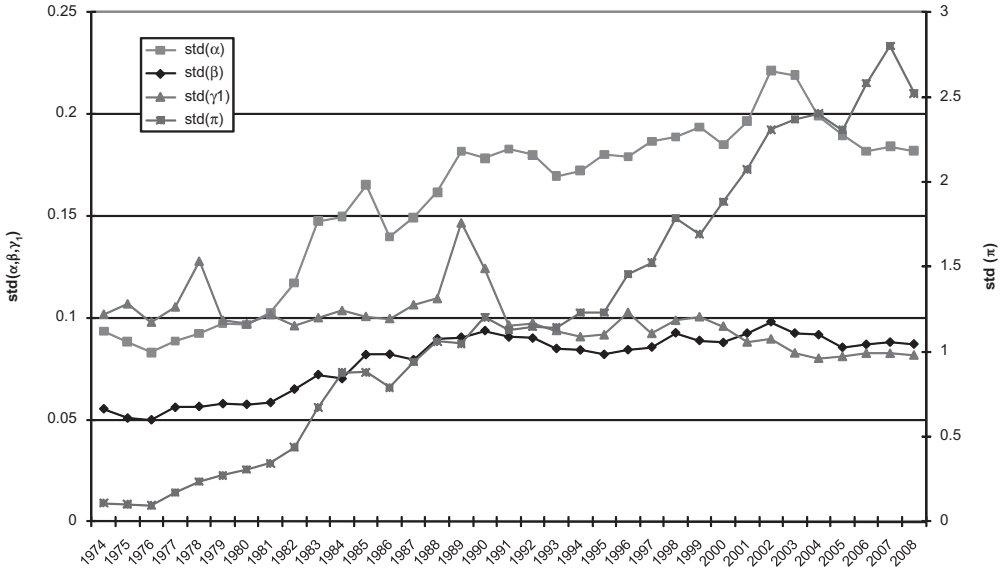

Figure 2b. Time-series pattern in the standard deviation of accrual determinants across industries

plots a considerable decline in the absolute level of abnormal accruals since 2001. Cohen et al. (2008) attribute this decline to the passage of the Sarbanes–Oxley Act.

Because one cause for large absolute abnormal accruals is the noise associated with industry heterogeneity, we plot in Figure 2b the time trend of the average, across industries of the standard deviation of the four accrual determinants. The figure illustrates that there has been a substantial increase in the average level of dispersion, within an industry, in two of the four accrual determinants—the accounts receivable turnover (α) and the accounts payable turnover (β). The increase in the profit margin (π) dispersion has been steady until 1990. The only accrual determinants whose dispersion does not show an increasing trend is inventory turnover (γ_1). Such increasing trends in the heterogeneity within an industry with respect to accrual determinants could explain the increasing trend in the absolute value of abnormal accruals depicted in Figure 2a.

To more formally test the time-series association, we estimate a time-series regression of the annual average absolute abnormal accruals on the annual average standard deviation of each accrual determinant. We report the results in Table 9. For the accrual determinants related to receivable turnover, payable turnover, and profit margin, the results indicate a significant positive relationship, across time, between the average level of absolute accruals and the degree of heterogeneity of industries with respect to these determinants. The coefficient on the standard deviation of the inventory turnover is negative and significant at the 10% level. Because of the strong collinearity between the independent variables, a model that includes all four variables together does not yield significant results on any one of them.[10]

Collectively, the results in Tables 8 and 9 suggest that abnormal accruals contain a noise component that is associated with the standard deviations of accrual determinants. These standard deviations reflect the heterogeneity in the AGP across firms within the same industry. Such an association indicates that at least part of the cross-sectional and time-series variation in the level of absolute abnormal accruals is attributed to the violation of the uniform AGP assumption underlying the empirical accrual models.

Table 9. Time-Series Regressions

	Model 1	Model 2	Model 3	Model 4
Intercept	0.0359***	0.0220***	0.115***	0.0629***
	(9.20)	(3.22)	(5.50)	(19.14)
$\overline{STD}(\alpha)$	0.270***			
	(8.54)			
$\overline{STD}(\beta)$		0.717***		
		(6.59)		
$\overline{STD}(\gamma)$			−0.374*	
			(−1.76)	
$\overline{STD}(\pi)$				0.0126***
				(3.93)
N	36	36	36	36
R^2	.645	.582	.139	.553

Note: This table reports results from the following time-series regressions:

$$ABS\_ACC_t = C + a_1 \times \overline{STD}(\alpha)_{t-1} + a_2 \times \overline{STD}(\beta)_{t-1} + a_3 \times \overline{STD}(\gamma)_{t-1} + a_4 \times \overline{STD}(\pi)_{t-1} + \varepsilon_t.$$

The dependent variable is the annual average of the absolute value of abnormal accruals, calculated based on the regular Jones model, averaged across all firms in a particular year. The independent variables are the weighted-average (by the number of firms in the industry) of annual standard deviations of each accrual determinants across all industries in a particular year. Each determinant is computed based on the description below. *t* statistics are reported in parentheses and are based on Newey–West standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Variable description:

Receivable turnover (α) = $(AR_t + AR_{t-1}) / 2 \times SALES_t$

Payable turnover (β) = $(AP_t + AP_{t-1}) / 2 \times SALES_t \times (1 - \pi)$

Inventory turnover (γ_1) = $g_1 / (1 - \pi)$ truncated above at 1 and below at −1; g_1 is obtained from the following regression $INV_t = g_1 \times SALES_t + g_2 \times \Delta SALES_t + \varepsilon_t$

Profit margin (π) = $NI_t / SALES_t$

Conclusion

In this article, we study the factors affecting the AGP and their relationship to empirical accrual models, such as the Jones and modified-Jones models. We examine accrual models' underlying assumption of a uniform AGP across firms in the same two-digit SIC code group. The evaluation of this assumption is important because the residuals from the accrual models are used extensively in the literature to make inferences about earnings management or as proxies for earnings quality.

We first explore the relationship between accrual models and various fundamental accrual determinants related to accounts receivable, accounts payable, inventory, and profit margins. We document that the coefficient on sales changes (μ_1) derived in accrual models captures some of the relationship between sales changes and accrual determinants. The four accrual determinants in our study are associated with μ_1 in the predicted direction. However, this suggests that the relationship between sales changes and accruals is more complex than often modeled in the literature. To evaluate the validity of the assumption regarding a uniform AGP, we examine the variation in accrual determinants within industries.

We study the impact of the degree of homogeneity of accrual determinants in an industry on the estimation quality of accrual models. Using multivariate regressions, we find that the degree of homogeneity in accrual determinants is related to the significance of μ_1 in accrual models. The within-industry variation in three of the four determinants is negatively

associated with the likelihood that μ_1 is significant. Therefore, we conclude that assessing the variation in the accrual determinants within an industry is equivalent to evaluating the uniform AGP assumption and is important in assessing results from the accrual models.

Finally, we find that the absolute value of abnormal accruals, which includes a measurement error resulting from the violation of the uniform AGP assumption, is negatively associated with the degree of within-industry homogeneity in accrual determinants. This is true both across industries in a cross-sectional specification as well as over time in a time-series specification.

We conclude that the interaction between sales changes and accrual determinants is important for estimating accrual models, and those accrual determinants summarize the AGP. The assumption of a homogeneous AGP is not descriptive of many industries but is central to estimates of abnormal accruals because it affects the measurement of the accrual models' coefficients. We show that some of the measurement error in abnormal accruals is related to the violation of this assumption.

Our study has implications for the findings of most studies that use a measure of abnormal accruals computed using an accrual model. Any researcher who uses abnormal accruals should be interested in understanding the effect of our results on popular abnormal accrual measures. We believe that the implications of these results are mostly for studies that use the absolute value of abnormal accruals.[11] For these studies, our results highlight the relationship between the industry in which the accrual models are estimated and abnormal accruals. Abnormal accruals that are a result of coefficient mismeasurement will be present in industries that have a large variation in their AGPs. The noise (or measurement error) in abnormal accruals that is due to violation of the uniform AGP assumption directly affects any study that investigates the absolute value of abnormal accruals or uses it to investigate a separate issue. Thus, to understand whether a particular study is exposed to such bias, researchers need to ask whether the study draws on firms from industries with high variation in AGP due to heterogeneity in accrual determinants. The inclusion of such firms biases upward the average measures of absolute abnormal accruals. Our evidence in Table 6 regarding the relationship between variation in the accrual determinants and several firm characteristics can help direct researchers in the appropriate direction.

Conceptually, an accrual model does not have to group firm-years, either across an industry or over time, if the relationship between the accruals and their determinants is fully modeled. Absent such a complete model, we believe that to reduce measurement errors in abnormal accruals, researchers need to focus on estimating the accrual models in groups that are as homogeneous as possible with respect to their AGP. Although we do not explicitly recommend an alternate model for eliminating the noise in abnormal accruals, our study provides a better understanding of at least one source for the measurement error in abnormal accruals. We think that a better understanding of existing models is necessary, before attempting to develop a new model. Our study provides a foundation for future studies to design a more appropriate model for estimating abnormal accruals.

Authors' Notes

The views expressed in this article are those of the authors and do not necessarily reflect those of Mellon Capital Management.

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Notes

1. In this article, the term accrual models encompasses the wide range of empirical accrual models in the literature that are based on the original Jones (1991) model.
2. Examples include Frankel et al. (2002); Klein (2002); Ashbaugh, LaFond, and Mayhew (2003); Myers, Myers, and Omer (2003); Larcker and Richardson (2004); Francis et al. (2005); Jiang, Petroni, and Wang (2010); and Gul, Fung, and Jaggi (2009).
3. Technically, the theoretical determinants are firms' policies with respect to credit, inventory, and so on The parameters we label as ''accrual determinants'' are empirical reflections of these policies and could be viewed as proxies for the true determinants.
4. The accrual determinants we plot are the accounts receivable turnover (α), the accounts payable turnover (β), and a measure related to inventory turnover (γ_1). For a complete description of the variables, please refer to section titled ''Data.''
5. In a time-series application, the estimated coefficient is a time-series ''average'' coefficient of the firm. The ''true'' coefficient is the coefficient for the year for which we calculate abnormal accruals.
6. We run all our tests using alternative measures of industry-level accrual determinants, which exclude firm-years that underwent mergers. The inferences based on these results, which are available on request, are unchanged relative to the results reported in the article.
7. To reduce the effects of distortions in accruals resulting from mergers and acquisitions, we also conduct all our tests using accruals that are calculated using the statement of cash flows. Unless specified, these results do not materially differ from the reported results. These results are available on request from the authors.
8. In unreported results, we also regress μ_1 coefficients from a time-series version of the Jones model on firm-specific accrual determinants. The conclusions are similar.
9. Estimates from full models yield identical inferences and we omit them for brevity.
10. For example, the time-series correlation between the standard deviations of the receivable and payable turnovers is .97, between the receivable and inventory turnover is $-.40$, and between the receivable turnover and the profit margin is .88.
11. Our study does not outline its direct implications on research that utilizes signed abnormal accruals. However, our study provides insights that future research can utilize to investigate this issue. For example, suppose researchers examine the correlation between the average abnormal accruals in the sample and some variable X. In typical earnings management studies, X is also

referred as the partitioning variable (McNichols & Wilson, 1988). In this study, we show that abnormal accruals are correlated with industries that have a high variation in the AGP. One also needs to show that the partitioning variable, *X*, is correlated with the firms in these industries that are likely to have positive (or negative) abnormal accruals. Future research can examine the factors that are associated with such firms or the factors that determine whether biased abnormal accruals will be positive or negative.

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