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Explaining accruals quality over time[☆]

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ABSTRACT

We provide evidence that accruals quality in the U.S. has generally improved since 2000, following a decade of decline during the 1990s. Our results indicate that both the initial decline in accruals quality and the subsequent reversal can be explained by an inverse relation with operating cash flow volatility. Moreover, even though patterns of cash flow volatility and accruals quality vary in different regions of the world and relative to the U.S., we find evidence of an inverse relation between accruals quality and cash flow volatility globally. We corroborate our main results in a battery of additional tests, which also indicate that our results are not attributable to other explanations. Overall, our evidence challenges conventional wisdom and suggests that concerns about a sustained decline in accruals quality over time are unwarranted.

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1. Introduction

The process of recording accruals requires estimates and assumptions both when an accrual originates as well as when it reverses. The ability of accruals to capture underlying business fundamentals likely varies over time with the volatility of the firm's operating environment (e.g., [Palepu et al., 2000](#)). During volatile periods, measurement error and noise are more likely to disturb the mapping of accruals into cash flows, thus reducing the quality of accruals relative to less volatile periods. Although [Dechow and Dichev \(2002\)](#), hereafter DD, formalize this intuition in a model of current accruals quality that is widely used in the accounting literature, there is little evidence on how this measure evolves over time.¹ [Rajgopal and Venkatachalam \(2011\)](#) find that current accruals quality declines through the end of their sample period in 2001, but subsequent research does not extend this evidence to more recent time periods or examine *why* current accruals quality varies

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¹ Management's intentional manipulation of accruals will also disturb the mapping of accruals into cash flows, but as DD discuss, these effects are likely to be idiosyncratic and sporadic. Nevertheless, their measure of accruals quality captures both intentional bias and unintentional errors in current accruals.

over time. Therefore, our first research question investigates the pattern of current accruals quality over a three-decade period from 1990 to 2019, and whether this pattern is related to cash flow volatility.²

We find that accruals quality declines in the U.S. throughout the 1990s. However, this trend reverses in 2000, and, except for a brief window around the financial crisis from 2007 to 2009, steadily improves through 2016. Accruals quality declines again from 2017 through 2019, but it is too soon to determine whether this decline is temporary or the start of a longer trend. Importantly, the evidence of improving accruals quality after 2000 challenges conventional wisdom that accruals quality is declining over time. Moreover, our sample encompasses periods of both increasing and decreasing accruals quality, providing intertemporal variation to investigate whether trends in cash flow volatility provide a robust explanation for this pattern.

Consistent with our expectations, we find that periods of declining accruals quality are associated with increasing cash flow volatility, while periods of improving accruals quality are associated with decreasing volatility. In other words, accruals quality and cash flow volatility are inversely related over time. We provide statistical corroboration for this relation using vector autoregression and impulse response functions (e.g., [Stock and Watson, 2001](#); [Love and Zicchino, 2006](#); [Kottimukkalur et al., 2022](#)). We also validate our inferences using three samples of international firms, which, despite different patterns over time than those in the U.S., also exhibit an inverse relation between accruals quality and cash flow volatility.

Notably, the results for our first research question run counter to the views of regulators (e.g., [Levitt, 1998](#)) and academic research (e.g., [Dichev and Tang, 2008](#); [Donelson et al., 2011](#); [Srivastava, 2014](#); [Bushman et al., 2016](#)) suggesting a sustained decline in various properties associated with high-quality earnings beginning as early as the 1960s. On a fundamental level, we question whether a long-term decline is realistic given changing economic conditions over time. However, much of the evidence of a decline occurs prior to 2000, which marks the start of improving accruals quality in our sample. As a result, it is unclear whether the theories developed in prior research to explain a decline in various earnings properties can explain not only the initial decline in accruals quality but also the subsequent improvement. Thus, our second research question exploits the intertemporal variation in accruals quality over our sample period to investigate potential explanations for our results other than cash flow volatility.

First, we examine whether the pattern in accruals quality is related to changes in sample composition. The characteristics of firms entering the market may change over time, which could explain the intertemporal trends we observe in both accruals quality and cash flow volatility. For example, [Srivastava \(2014\)](#) finds that each successive cohort of newly-listed firms from the 1970s through the 2000s exhibits higher earnings volatility and lower earnings relevance and matching, trends that he attributes to increasing intangibles intensity. Although we find poorer accruals quality for each successive cohort, we also find that *within* each cohort, accruals quality and cash flow volatility follow the intertemporal pattern in our main results. In other words, while we find a cohort effect in the overall *level* of accruals quality, this theory does not explain the intertemporal *pattern* of accruals quality, especially the improvement beginning in the 2000s.

We also examine whether a wave of public company delistings beginning in the late 1990s ([Doidge et al., 2017](#)) explains our results. If delisting firms have poorer accruals quality, on average, then our evidence of an overall improvement in accruals quality after 2000 could be attributable to market exit rather than a decline in cash flow volatility. Although we find that accruals quality generally declines in the years preceding a firm's delisting, the peak exit years occur *prior* to the improvement in accruals quality beginning in 2000. Moreover, surviving firms exhibit the same intertemporal pattern of accruals quality as exiting firms, and this pattern is inversely related to cash flow volatility. Overall, our results indicate that neither market entry nor market exit explain the intertemporal pattern of accruals quality and its inverse relation to cash flow volatility.

A second category of other potential explanations relates to regulatory and standard-setting changes. These changes can influence accounting practices and conventions, which could in turn explain the trend in accruals quality over our sample period. For example, [Cohen et al. \(2008\)](#) suggest that increased regulatory oversight following the Sarbanes-Oxley Act (SOX) of 2002 led to a decline in accruals-based earnings management. Consistent with this theory, they find that the absolute value of abnormal total accruals increases from 1987 to 2000, then declines from 2001 to 2005. However, the primary disciplining effects of SOX likely occurred within a few years of its enactment, and thus this regulatory change is unlikely to explain our evidence of a long-term trend of improving accruals quality. Moreover, separating abnormal total accruals and accruals quality into their respective innate and discretionary components following [Francis et al. \(2005\)](#), we find that the intertemporal pattern in both measures primarily reflects innate factors, including cash flow volatility, while discretionary factors, such as earnings management, play a minor role.

[Dichev and Tang \(2008\)](#) attribute an increase in earnings volatility and decreases in earnings persistence and the contemporaneous correlation between revenues and expenses (matching) from 1967 to 2003 to a shift in accounting standards away from the matching concept toward fair value accounting. However, accounting standards continue to shift toward fair value through the end of our sample period, suggesting that this theory is unlikely to explain either our evidence of an increase in accruals quality in the U.S. since 2000 or the patterns we observe in our international samples, which also adopted fair value accounting conventions at different points in time. Moreover, a shift toward fair value accounting is unlikely to have a first-order effect on cash flow volatility, which we find to be highly correlated with patterns in accruals quality over time.

² For brevity, we subsequently refer to current accruals quality as accruals quality, following DD. We explicitly note when we refer to other measures of accruals, such as total accruals, in some tests.

A final category of other explanations relates to an increase in accruals for special items. Because these items are often unrelated to cash flows, they could explain the decline in accruals quality during the 1990s. For example, [Donelson et al. \(2011\)](#) conclude that evidence of a declining trend in earnings properties is primarily attributable to an increase in the frequency of large special items through 2005. However, we find that large special items continue to increase in frequency through the end of our sample period, and thus cannot explain our evidence of a reversal and improving accruals quality since 2000. Similarly, [Bushman et al. \(2016\)](#) suggest that one-time and nonoperating items are responsible for a significant decline in the explanatory power of cash flows for total accruals over time. However, we find that their empirical measure of these items is relatively flat since 1990, which cannot explain our evidence.

Overall, we find new evidence indicating that accruals quality began to improve in 2000 following a decade of decline. This intertemporal pattern in accruals quality is inconsistent with conventional wisdom and prior evidence that various earnings properties have continuously deteriorated over time. Further, we find that trends in cash flow volatility provide the most likely explanation for *both* the initial decline and subsequent improvement in accruals quality. This inverse relation between accruals quality and cash flow volatility applies to both U.S. and non-U.S. samples, indicating the robustness of our results worldwide. Collectively, our evidence suggests a reset to the way researchers, regulators, and standard-setters view accruals quality, both in terms of its pattern over time and the factors contributing to this pattern. We conclude that concerns about a continuous decline in accruals quality may be overstated.

2. Research design

2.1. Empirical methodology

DD conceptualize accruals quality as the extent to which accruals map into cash flow realizations. To make their model more tractable, they focus on current accruals because the associated cash flow realizations generally occur in the contemporaneous or immediately adjacent periods. Specifically, the DD model regresses current accruals (CA_t) on prior year (CFO_{t-1}), current year (CFO_t), and next year (CFO_{t+1}) operating cash flows.³ In her discussion of DD, [McNichols \(2002\)](#) proposes an augmented version of the model including sales growth (ΔRev) and gross property, plant, and equipment (PPE) as additional economic determinants of the level of current accruals. Thus, the modified DD model is as follows:

$$CA_{i,t} = \varphi_0 + \varphi_1 CFO_{i,t-1} + \varphi_2 CFO_{i,t} + \varphi_3 CFO_{i,t+1} + \varphi_4 \Delta Rev_{i,t} + \varphi_5 PPE_{i,t} + u_{i,t} \quad (1)$$

We follow prior research (e.g., [Francis et al., 2005](#); [Doyle et al., 2007](#); [Core et al., 2008](#); [Biddle et al., 2009](#); [Rajgopal and Venkatachalam, 2011](#); [Ogneva, 2012](#)) in estimating Eq. (1) cross-sectionally by industry-year. Accruals quality (AQ) is the standard deviation of firm i 's residuals, calculated over years $t-4$ to t . Smaller standard deviations (lower AQ) indicate less measurement error in accruals and better accruals quality.

We expect an inverse intertemporal relation between accruals quality and volatility in the operating environment, measured using cash flow volatility (σCFO).⁴ The DD model considers operating cash flows, and hence cash flow volatility, to be primitive and exogenous to the accrual accounting system. This approach is consistent with the notion that accrual accounting recognizes economic events in the periods in which they occur regardless of the timing of the associated cash flows. However, prior research suggests that information quality, of which accruals quality is a component, facilitates efficient capital allocation and investment ([Roychowdhury et al., 2019](#)), and thus accruals quality could reduce cash flow volatility. Nevertheless, we believe it is more plausible that cash flow volatility affects accruals quality rather than vice-versa.

The theoretical relation between cash flow volatility and accruals quality does not imply that Eq. (1) should control for σCFO . In other words, we do not expect an association between cash flow volatility and the *level* of a firm's current accruals (the dependent variable in Eq. (1)). In untabulated results, we find an insignificant coefficient on σCFO when it is included in the estimation, and an insignificant correlation between the firm-year residuals from Eq. (1) and σCFO . These results indicate that the model as originally formulated in Eq. (1) without σCFO is appropriate.

We first investigate the intertemporal pattern of accruals quality from 1990 to 2019. This sample period is not only of contemporary relevance, but also allows us to consistently measure accruals and operating cash flows using statement of cash flows data. Specifically, our sample begins in 1990 because Eq. (1) requires lagged operating cash flows, and the statement of cash flows was not broadly adopted until 1989.⁵ Next, we examine whether accruals quality varies inversely over time with cash flow volatility (σCFO). To test the statistical significance of the intertemporal relation, we use vector autoregression and orthogonalized impulse response functions (e.g., [Stock and Watson, 2001](#); [Love and Zicchino, 2006](#); [Kottimukkalur et al., 2022](#)). We discuss this methodology in [Appendix B](#).

³ [Appendix A](#) provides variable definitions. We winsorize extreme values to the 1st and 99th percentiles. Inferences are unchanged if we winsorize extreme values annually.

⁴ Because the model constructs AQ as an inverse measure of accruals quality, we expect the variables AQ and σCFO to be positively related. To avoid confusion, we generally use the descriptive term 'accruals quality' when discussing the interpretation of our results.

⁵ Beginning the sample before 1990 would require estimating accruals from changes in balance sheet accounts and deriving operating cash flows as the difference between net income and estimated accruals. [Hribar and Collins \(2002\)](#) find that this balance sheet approach measures accruals and hence operating cash flows with error.

2.2. Sample selection and descriptive statistics

Table 1, Panel A summarizes our sample selection process. We identify 172,840 firm-year observations from 1990 to 2019 with the requisite data to calculate the variables in Eq. (1). From this initial sample, we exclude firm-years with sales less than \$10 million. Although DD do not explicitly state that they impose this size criterion, this sample screen aligns our descriptive data more closely with theirs, as we discuss in footnote 7. We also require 20 observations per two-digit SIC-year to estimate Eq. (1) at the industry-year level. Finally, we delete observations without at least two years of residuals over years $t-4$ to t to calculate AQ and all financial institutions because the nature of their accruals differs from those of non-financial firms.⁶ Applying these selection criteria results in a final sample of 95,839 firm-year observations.

Panel B of Table 1 reports mean coefficient estimates from estimating Eq. (1). Consistent with prior research, we find a negative coefficient estimate on contemporaneous cash flows, and positive estimates on cash flows of the immediately adjacent periods. Further, ΔRev (PPE) is positively (negatively) associated with the level of current accruals (McNichols, 2002). Panel C presents descriptive statistics comparing the variables of interest across the three decades of our sample period. Our results are generally consistent with DD's during their 1990s sample period. For example, mean CA (CFO) is 0.019 (0.069), compared to 0.015 (0.075) in the DD sample, while mean AQ (σCFO) is 0.039 (0.064), compared to 0.028 (0.060) in the DD sample. We also find that mean AQ is 0.039, 0.040, and 0.032, respectively, across the three decades, suggesting that average accruals quality is generally better in the 2010s relative to the previous two decades. Similarly, mean σCFO is 0.064, 0.067, and 0.055, respectively, suggesting a parallel pattern in cash flow volatility. Finally, the correlations in Panel D are consistent with

Table 1
Sample selection and descriptive statistics.

Panel A: Sample selection (1990–2019)						
Criteria			Missing			Obs.
Firms-years with available data to measure Eq. (1) variables						172,840
Less: Firm-years with sales less than \$10 million			(39,525)			133,315
Firm-years missing SIC			(7787)			125,528
Firm-years with less than 20 observations per 2-digit SIC-year			(8414)			117,114
Firm-years missing AQ			(14,575)			102,539
Financial firm-years (SIC 6000–6999)			(6700)			95,839
Panel B: Mean coefficient estimates from the estimation of Eq. (1)						
	<i>Intercept</i>	<i>CFO_{t-1}</i>	<i>CFO_t</i>	<i>CFO_{t+1}</i>	<i>ΔRev</i>	<i>PPE</i>
Mean coeff. estimate	0.017	0.226	-0.479	0.133	0.069	-0.003
(t-statistic)	(20.86)	(41.99)	(-76.50)	(29.63)	(32.39)	(-2.82)
Mean adj. R ²	0.45					
Panel C: Descriptive statistics						
Variable	1990–1999		2000–2009		2010–2019	
	N	Mean	N	Mean	N	Mean
<i>CFO</i>	34,107	0.069	34,739	0.066	26,993	0.066
<i>CA</i>	34,107	0.019	34,739	0.008	26,993	0.009
<i>ΔRev</i>	34,107	0.132	34,739	0.073	26,993	0.061
<i>PPE</i>	34,107	0.594	34,739	0.541	26,993	0.551
<i>AQ</i>	34,107	0.039	34,739	0.040	26,993	0.032
<i>σCFO</i>	34,107	0.064	34,739	0.067	26,993	0.055
Panel D: Correlations for accruals quality model variables						
	<i>CFO_{t-1}</i>	<i>CFO</i>	<i>CFO_{t+1}</i>	<i>CA</i>	<i>ΔRev</i>	<i>PPE</i>
<i>CFO_{t-1}</i>		0.634	0.531	0.000	-0.035	0.218
<i>CFO</i>	0.587		0.640	-0.325	0.091	0.207
<i>CFO_{t+1}</i>	0.513	0.611		0.006	0.131	0.182
<i>CA</i>	-0.016	-0.334	0.016		0.283	-0.069
<i>ΔRev</i>	-0.038	0.137	0.197	0.255		-0.095
<i>PPE</i>	0.240	0.216	0.195	-0.067	-0.113	

This table summarizes the sample selection process (Panel A), and presents the average coefficient estimates and t-statistics from the industry-year estimations of Eq. (1) (Panel B), descriptive statistics for our main variables of interest over the three decades of our sample period (Panel C), and Pearson (above diagonal) and Spearman (below diagonal) correlations (Panel D). Insignificant correlations in Panel D are shown in italics; all other correlations are significant at the 5% level or below. We define the variables in Appendix A.

⁶ To be consistent with DD, we include utilities that report current accruals, although some utilities may not if the operating cycle is longer than one year. The calculation of CA only requires observations to have non-missing values for accounts receivable and inventory (see Appendix A). There are 5768 utility firm-year observations eliminated for this reason and 5570 remaining in the final sample.

evidence from prior research.⁷ Moreover, the pooled cross-sectional correlation between AQ and σCFO is 0.537 (untabulated), consistent with overall better accruals quality when cash flow volatility is lower.

3. Accruals quality and cash flow volatility over time

3.1. How has accruals quality evolved over time and is this pattern related to cash flow volatility?

Fig. 1. Panel A plots AQ over our thirty-year sample period. Our evidence indicates an increase in AQ , or, in other words, a decline in accruals quality, during the 1990s. However, this trend reverses beginning in 2000, and except for a short window following the 2007 financial crisis, accruals quality improves through 2016. Interestingly, we find that accruals quality again deteriorates in the final three years of our sample period. Whether this trend will continue remains to be seen. However, the overall pattern of accruals quality, and especially the general improvement since 2000, stands in striking contrast to conventional wisdom and prior research suggesting a sustained decline in various earnings properties over this period.

We leverage the intertemporal variation in accruals quality to examine whether volatility in the operating environment, as proxied by σCFO , explains both the initial decline and subsequent reversal in accruals quality. The plot of σCFO in **Fig. 1**, Panel B indicates that AQ and σCFO mirror each other over our sample period. In other words, during the 1990s when accruals quality is declining, cash flow volatility is increasing. Both patterns switch course beginning in 2000, with accruals quality improving and cash flow volatility diminishing, only briefly interrupted by the financial crisis and in the last three years of our sample period. Overall, the visual evidence is consistent with an inverse relation between accruals quality and cash flow volatility.

We use vector autoregression (VAR) to provide statistical corroboration of the relation between AQ and σCFO in **Fig. 1**. Specifically, we estimate the orthogonalized impulse response function (IRF) indicating how accruals quality changes over time in response to an unexpected change in cash flow volatility.⁸ **Table 2** presents the results of this analysis. The evidence in Panel A indicates that the association between accruals quality (δAQ_t) and lagged cash flow volatility ($\delta \sigma CFO_{t-1}$) is significantly positive (t -stat = 1.81) while the reverse association is insignificant (t -stat = 1.11), consistent with DD's modeling of cash flows as exogenous to the accrual accounting system.⁹ Panel B maps the IRF and the associated 90% confidence interval for the response of current and future δAQ (from t through $t + k$) to an unexpected increase in $\delta \sigma CFO_{t-1}$. A confidence interval above zero indicates a significant response. We find that accruals quality declines in response to an unexpected orthogonal increase in cash flow volatility, and that this response remains significant for approximately three years. This result provides evidence of a statistical relation between the time series of accruals quality and cash flow volatility.

In sum, our evidence provides two new insights to the literature. First, we find that although accruals quality declined in the 1990s, this downward trend reversed beginning in 2000. This evidence refutes the commonly held belief of a continuous deterioration over time. Second, exploiting periods of increasing and decreasing accruals quality in our sample, we find that the intertemporal pattern in accruals quality is a response to cash flow volatility. Notably, these intertemporal patterns are for U.S. firms. However, economic trends vary across countries. Thus, we do not necessarily expect to observe the same intertemporal patterns in international samples. Regardless of the specific patterns, however, we expect accruals quality and cash flow volatility to be inversely related over time.

3.2. Is the intertemporal relation robust outside of the U.S.?

To provide additional evidence on the intertemporal relation between accruals quality and cash flow volatility, we select a broad sample of international firms from Compustat Global. This dataset is sparsely populated in the 1990s, limiting our international sample to the period from 2000 to 2019. To have sufficient observations to estimate Eq. (1), we examine three regional groupings: (i) European Union (EU) firms, (ii) Asian firms, and (iii) firms in all other countries except the U.S. (Other). For each region, we impose the same sample selection requirements as in our main analyses.¹⁰ **Fig. 2** plots AQ (Panel A) and σCFO (Panel B) for each region, and reveals that the intertemporal patterns vary across the three regions and relative to the U.S. sample in **Fig. 1**. Despite differences in patterns across the regions, AQ and σCFO mirror each other within each region,

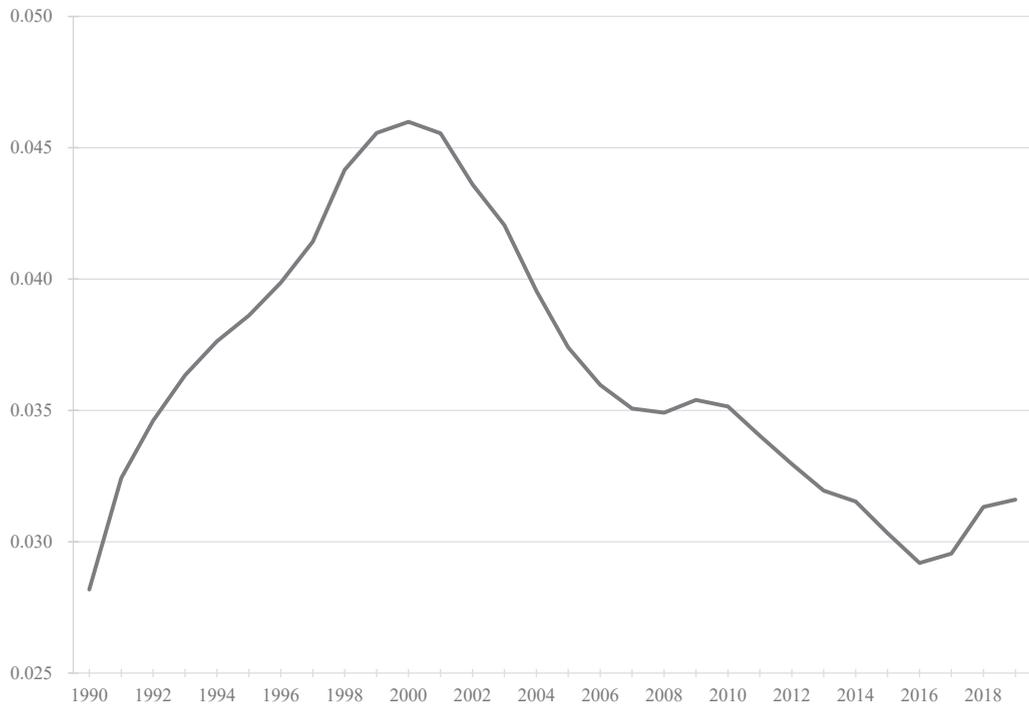
⁷ Without the \$10 million sales screen discussed previously, we find that the Pearson correlation between CFO and CA is significantly positive (untabulated) in contrast to the negative correlations reported by DD and in Panel D.

⁸ See **Appendix B** for a discussion of the methodology. VAR assumes that the variable time series are stationary, which **Fig. 1** indicates is not the case for either AQ or σCFO . Thus, we first difference both variables (indicated by the prefix δ) to ensure that the means and standard deviations of the first differenced variables are stationary. Our relatively short time series of 28 years for these tests could bias against finding statistically significant results.

⁹ Although this result indicates that cash flow volatility Granger-causes accruals quality, Granger causality only tests whether one time series has predictive value for another time series, not whether changes in one variable cause changes in another. Accordingly, the economics literature focuses on the IRF because it provides stronger evidence of the relation between two time series (e.g. **Love and Zicchino, 2006**).

¹⁰ We make some modifications to the calculation of CA for the international sample because of differences in how countries report the statement of cash flows. Specifically, for domestic firms, the Compustat variable APALCH includes both accounts payable and accrued liabilities. For international firms, we use the sum of APCH (accounts payable) and ACLLI (accrued liabilities – cash flow). Further, we exclude taxes (i.e., TXACH) as there is no similar variable in Compustat Global. To assess the validity of these changes, we compare the resulting CA variable to Compustat Global's change in working capital variable (WCAPCH), noting a correlation coefficient of 0.999.

Panel A: Accruals quality (AQ).



Panel B: Cash flow volatility (σ_{CFO}).

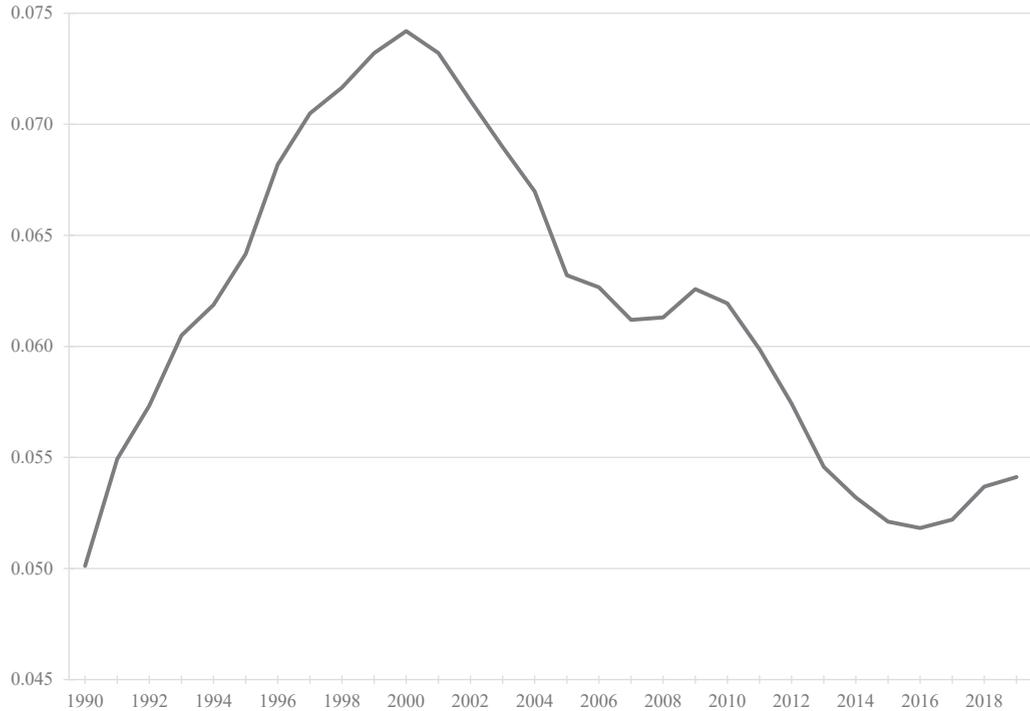


Fig. 1. Intertemporal patterns in accruals quality (Panel A) and cash flow volatility (Panel B) from 1990 to 2019 for U.S. firms. We define all variables in Appendix A.

Table 2
Vector autoregression analysis of accruals quality (AQ) and cash flow volatility (σCFO).

Panel A: Vector autoregression (VAR) results				
Dependent variable	(1) $\delta\sigma CFO_t = \beta_0 + \beta_1\delta\sigma CFO_{t-1} + \beta_2\delta AQ_{t-1} + \varepsilon_{1t}$ (2) $\delta AQ_t = \alpha_0 + \alpha_1\delta AQ_{t-1} + \alpha_2\delta\sigma CFO_{t-1} + \varepsilon_{2t}$			R ²
	Intercept	$\delta\sigma CFO_{t-1}$	δAQ_{t-1}	
	Coeff. (t-stat.)	Coeff. (t-stat.)	Coeff. (t-stat.)	
(1) $\delta\sigma CFO_t$	0.000 (-0.54)	0.460* (1.85)	0.370 (1.11)	0.62
(2) δAQ_t	0.000 (-0.73)	0.279* (1.81)	0.382* (1.85)	0.72

Panel B: Impulse response function (IRF) of δAQ_{t+k} to a change in $\delta\sigma CFO_{t=0}$	

This table presents the results of vector autoregression (VAR) analysis using first-differenced accruals quality (δAQ) and cash flow volatility ($\delta\sigma CFO$) (Panel A) and the related impulse response function (IRF) and associated 90% confidence interval (shaded), where a confidence interval above zero indicates a significant response (Panel B). We define the variables in [Appendix A](#). ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

consistent with our U.S. evidence.¹¹ This figure provides important corroboration for the generalizability and robustness of our theory that accruals quality is inversely related to cash flow volatility over time.

4. Other potential explanations for the intertemporal pattern in accruals quality

Prior research examines various properties of U.S. firms' earnings over time and generally concludes that there has been a sustained decline in these properties. Thus, while these studies seek to explain a decline over time, it is not clear if their conclusions can explain our evidence of not only an initial decline in accruals quality but also the subsequent improvement beginning in 2000. Therefore, we explore whether we can rule out these other potential explanations for the intertemporal pattern in accruals quality.

4.1. Is the pattern in accruals quality and cash flow volatility affected by sample composition?

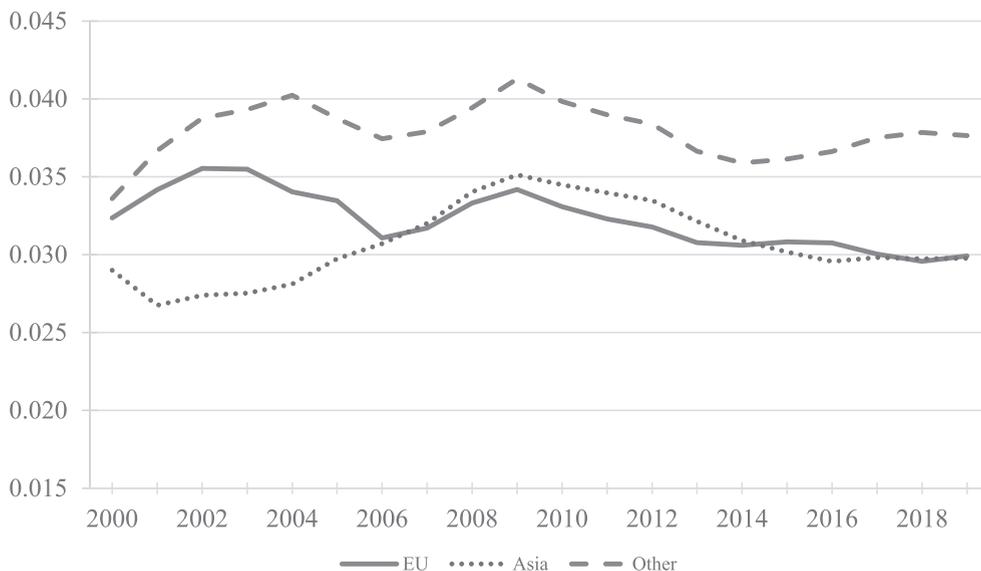
The number of U.S. publicly-listed firms has changed dramatically over time, increasing from the 1970s through the dot-com era in the 1990s, before declining over the next two decades ([Doidge et al., 2017](#)). The remaining public firms are older, larger, and more intangible intensive ([Kahle and Stulz, 2017](#)). Because changes in the characteristics of public firms may contribute to trends in accruals quality and cash flow volatility over time, we examine market entry and market exit as possible explanations for our evidence.

4.1.1. Does market entry explain the pattern in accruals quality and cash flow volatility?

[Srivastava \(2014\)](#) posits that high intangible intensity increases the volatility of underlying economic fundamentals, leading to lower earnings quality. Because each successive cohort of newly listed firms is more intangible intensive than previous cohorts, earnings quality is expected to exhibit a declining trend over time. Consistent with this explanation, he finds higher earnings volatility and lower earnings relevance and matching in each listing cohort from the 1970s through the 2000s

¹¹ We corroborate the significantly positive impulse response of δAQ to $\delta\sigma CFO$ for each region in untabulated tests.

Panel A: AQ for European Union, Asian, and other firms.



Panel B: Cash flow volatility for European Union, Asian, and other firms.

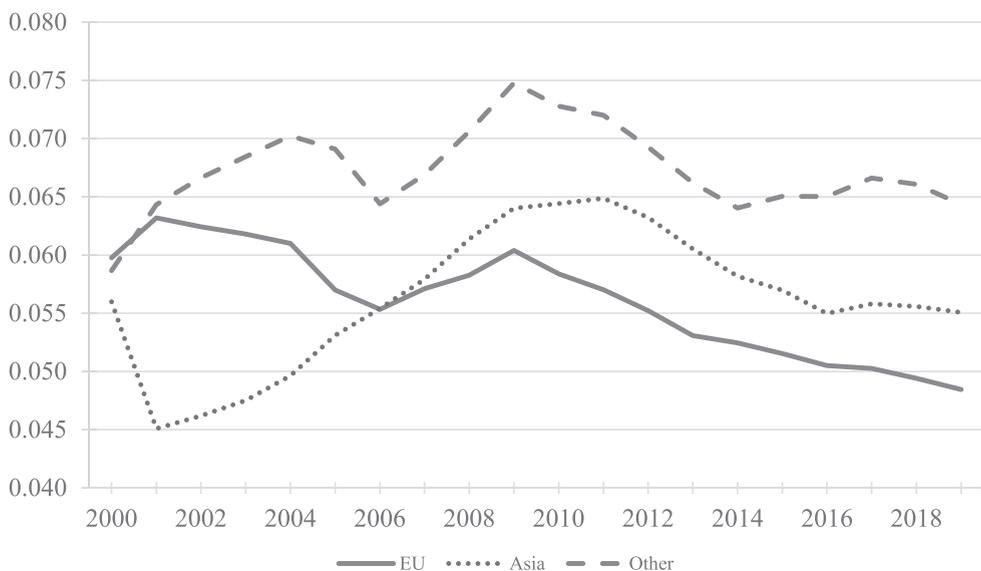


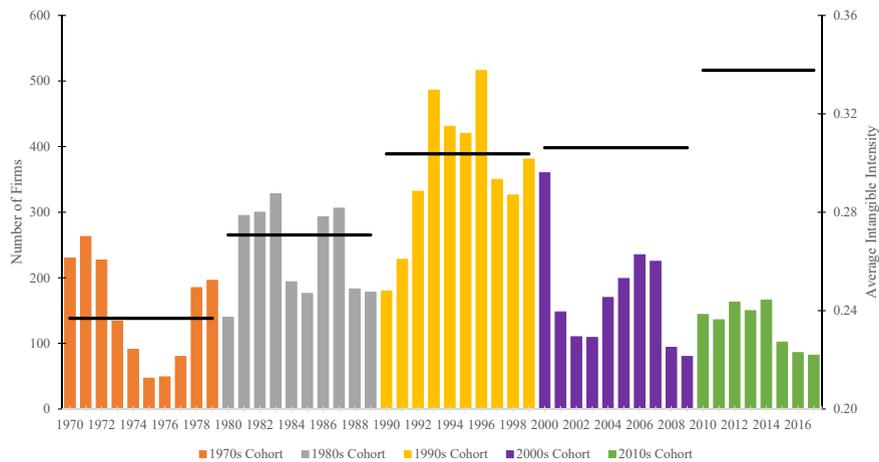
Fig. 2. Intertemporal patterns in accruals quality (Panel A) and cash flow volatility (Panel B) from 2000 to 2019 for three regional groupings of international firms: (i) European Union (EU) firms, (ii) Asian firms, and (iii) firms in all other countries except the U.S. (Other). We define all variables in [Appendix A](#).

relative to seasoned firms listed before 1970.¹² We extend this analysis to examine whether new firms entering the market explain not only the level of accruals quality *across* cohorts, but also the pattern of accruals quality *within* cohorts over time.

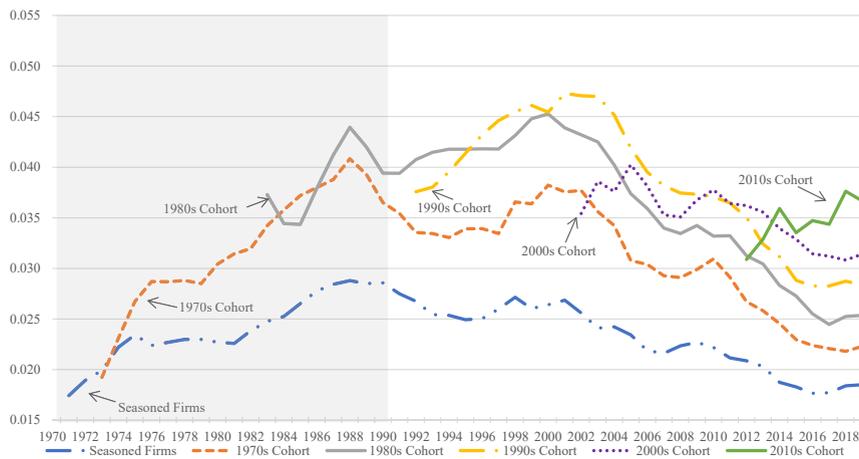
We begin by revisiting our primary tests by listing cohort. Following [Srivastava \(2014\)](#), our sample starts in 1970 and uses the balance sheet approach, as discussed in footnote 5, to derive operating cash flows for fiscal years ending prior to 1988. For fiscal years ending in 1988 and later, we follow our main analysis to define accruals and cash flows using data from the statement of cash flows. [Fig. 3](#), Panel A plots the number of newly listed firms each year and the average intangible intensity of

¹² [Srivastava \(2014\)](#) also finds that more than 95% of the increase in average earnings volatility over time is attributable to an increase in average cash flow volatility. We examine this evidence in [Table 3](#), Panel C.

Panel A: Number of firms entering the market and average intangible intensity by listing cohort.



Panel B: AQ by listing cohort.



Panel C: Cash flow volatility by listing cohort.

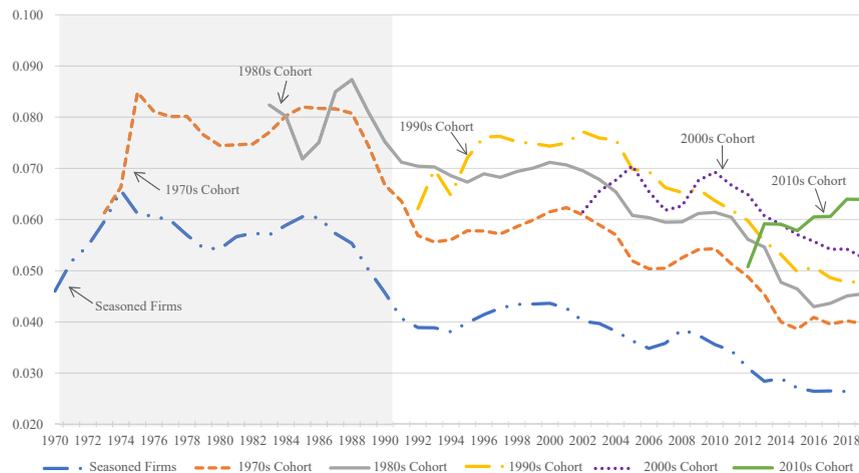


Fig. 3. The effect of new listing cohorts (Panel A) on intertemporal patterns in accruals quality (Panel B) and cash flow volatility (Panel C) by cohort-decade. Following [Srivastava \(2014\)](#), the sample starts in 1970 and for fiscal years ending prior to 1988 estimates accruals from changes in balance sheet accounts and operating cash flows as the difference between net income and estimated accruals (shaded region in Panels B and C). For fiscal years ending in 1988 and later, we define accruals and cash flows using data from the statement of cash flows. We define all variables in [Appendix A](#).

Table 3
Accruals quality (AQ) and cash flow volatility (σCFO) by new listing cohort.

Panel A: AQ by cohort-decade						
	Seasoned Firms	1970s Cohort	1980s Cohort	1990s Cohort	2000s Cohort	2010s Cohort
1970s	0.021	0.026				
1980s	0.026	0.036	0.039			
1990s	0.026	0.035	0.042	0.042		
2000s	0.024	0.033	0.039	0.043	0.037	
2010s	0.019	0.025	0.028	0.031	0.034	0.035
Mean	0.023	0.031	0.037	0.039	0.035	0.035
Panel B: σCFO by cohort-decade						
	Seasoned Firms	1970s Cohort	1980s Cohort	1990s Cohort	2000s Cohort	2010s Cohort
1970s	0.057	0.076				
1980s	0.057	0.078	0.080			
1990s	0.042	0.059	0.070	0.071		
2000s	0.039	0.056	0.065	0.071	0.065	
2010s	0.030	0.044	0.050	0.054	0.059	0.059
Mean	0.045	0.063	0.066	0.066	0.062	0.059
Panel C: σCFO calculated using the balance sheet approach to estimate operating cash flows						
	Seasoned Firms	1970s Cohort	1980s Cohort	1990s Cohort	2000s Cohort	2010s Cohort
Srivastava (2014), Table 4	0.060	0.100	0.180	0.170	0.380	
Replication	0.067	0.094	0.176	0.195	0.334	0.428

This table presents AQ (Panel A) and σCFO (Panel B) by cohort-decade. In these panels, we estimate accruals for fiscal years ending prior to 1988 from changes in balance sheet accounts and operating cash flows as the difference between net income and estimated accruals. For fiscal years ending in 1988 and later, we define accruals and cash flows using data from the statement of cash flows. Panel C presents σCFO reported in Table 4, Panel A of Srivastava (2014) and our replication of his results. Following Srivastava (2014), in this panel we estimate accruals for all fiscal years from changes in balance sheet accounts and operating cash flows as the difference between net income and estimated accruals. We define the variables in Appendix A.

each new listing cohort.¹³ Consistent with Doidge et al. (2017), we find that the number of new listings peaks in 1996. However, while the pace of new listings slows over the next two decades, the average intangible intensity of each new listing cohort, indicated by the solid horizontal lines, continues to increase.

We examine the effect of these new listing waves on accruals quality over time in Fig. 3, Panel B, which plots AQ by listing cohort, shading the years prior to the start of our primary sample period in 1990. We summarize the data by cohort-decade in Table 3, Panel A.¹⁴ The visual and tabular evidence reveals that average accruals quality declines in each new listing cohort through the 1990s. Specifically, the average AQ is 0.023 for seasoned firms, 0.031 for the 1970s cohort, 0.037 for the 1980s cohort, and 0.039 for the 1990s cohort. However, we also find that the average AQ is 0.035 for the 2000s cohort, and remains at this level for the 2010s cohort. Thus, we find that average accruals quality and intangible intensity diverge beginning in the 2000s cohort, with accruals quality improving even though intangibles intensity continues to increase.

We also find that the intertemporal pattern in accruals quality exists not only on average for each listing cohort, but also *within* each cohort. For example, accruals quality deteriorates for seasoned firms from the 1970s (AQ = 0.021) through the 1990s (AQ = 0.026) before improving in the 2000s (AQ = 0.024) through 2010s (AQ = 0.019). Because the seasoned cohort firms were all listed prior to 1970, this result provides strong evidence that the intertemporal pattern in accruals quality is not attributable to changes in sample composition. The pattern is similar for each cohort in our sample except the 2010s cohort, which exhibits declining accruals quality in Fig. 3, Panel B compared to improving accruals quality over this decade in all other cohorts. Thus, the overall downturn in accruals quality at the end of our sample period (Fig. 1, Panel A) is mostly attributable to new listings during this decade. One possible explanation for this result is that new listings have poorer initial accruals quality. Consistent with this explanation, we find a similar effect in the 2000s cohort where there is an initial decline in

¹³ Following Srivastava (2014), we identify the listing year as the first year in which a firm has non-missing total assets (AT), earnings (IB), sales (SALE), and stock price (PRCC_F). Similarly, we measure intangible intensity as selling, general, and administrative expenses (XSGA), scaled by total expenses. Because we require at least two years of data to calculate AQ, which is a prerequisite for a new listing to be included in our sample, firms must have listed in 2017 or earlier. Thus, the plot of new listings in Fig. 3, Panel A ends in 2017. The remaining panels of Fig. 3 include all firm-years in a cohort rather than only new listings, and thus continue through the end of our sample period.

¹⁴ The first year of data for each wave begins in the fourth year of each decade (e.g., 1973 for the 1970s wave) because estimating Eq. (1) requires lagged values to calculate CFO (i.e., lagged cash flows from operations and lagged average assets). Specifically, we lose the first year of each wave because CFO_{t-1} is not available for the first year a firm appears in Compustat (e.g., there are no valid observations for 1970 for the 1970s wave). We lose the second year of each wave because CFO_{t-1} is unavailable since this variable requires lagged values to calculate accruals (for pre-1988 years) or average assets (for post-1987 years) (e.g., there are no valid observations for 1971 for the 1970s wave). Finally, we lose the third year of each wave because AQ is a standard deviation measure requiring at least two years of data (e.g., there are no valid observations for 1972 for the 1970s wave).

accruals quality even though accruals quality is improving in all other cohorts during this decade. In sum, our evidence suggests that overall increasing intangible intensity associated with changes in sample composition does not provide a robust general explanation for the intertemporal pattern in accruals quality.

We plot cash flow volatility by listing cohort in Fig. 3, Panel C and tabulate the data by cohort-decade in Table 3, Panel B. Similar to the pattern in accruals quality, we find that average σ_{CFO} increases from 0.045 for seasoned firms, to 0.063 for the 1970s cohort, and 0.066 for the 1980s and 1990s cohorts, before declining to 0.062 in the 2000s cohort and 0.059 in the 2010s cohort.¹⁵ Further mirroring our evidence for accruals quality, we also find that σ_{CFO} generally increases over time in the 2010s cohort, even though all other cohorts exhibit generally declining volatility over this decade. Thus, the overall increase in σ_{CFO} at the end of our sample period (Fig. 1, Panel B) is mostly attributable to new listings in the 2010s. In sum, this evidence is inconsistent with higher intangible intensity of new listings as the primary cause of increasing economic volatility and decreasing accruals quality over time.

Finally, we also note that the pattern of cash flow volatility in our results contrasts with Srivastava's (2014) evidence of an increase in cash flow volatility over time. Specifically, as we summarize in Table 3, Panel C, he reports that cash flow volatility more than doubles between the 1990s cohort (0.170) and the 2000s cohort (0.380). However, he uses the balance sheet method to estimate operating cash flows in all years, while we use cash flow statement data beginning in 1988. The evidence in the last row of Table 3, Panel C uses the balance sheet method for all years in our sample and closely replicates Srivastava's results for his sample through the 2000s cohort. Moreover, extending the sample to include the 2010s cohort, we find that cash flow volatility measured in this manner continues to increase to 0.428. A comparison of these results to our primary results in Panel B indicates that the balance sheet method overstates cash flow volatility.¹⁶ These results complement and extend Hribar and Collins' (2002) evidence that the balance sheet approach produces biased estimates of accruals. We find that this bias also affects the measurement of operating cash flows and hence cash flow volatility. Although recent research typically uses cash flow statement data to derive accruals and operating cash flows, our results illustrate how measurement issues in the balance sheet approach adversely affect research examining long-run intertemporal patterns related to these variables.

4.1.2. Does market exit explain the pattern in accruals quality and cash flow volatility?

Another trend potentially affecting our results is the exodus of publicly-listed firms that began in the late 1990s (Doidge et al., 2017). If exiting firms generally have worse accruals quality and higher cash flow volatility, this de-listing phenomenon could explain the reversal we observe beginning in 2000. To investigate this possibility, we return to our primary sample from 1990 to 2019, and identify the final year in the sample for all firms exiting prior to 2019. In untabulated results, we find that the number of firms exiting the market peaked in 1999, and that most of these de-listings were firms that had entered the market earlier in the 1990s. Moreover, we find that accruals quality generally decreases as firms approach their final year in the sample. All else equal, this evidence suggests that market exit could contribute to an improvement in accruals quality. However, because the peak exit years occurred in the 1990s, prior to the trend of improving accruals quality, market exit is unlikely to explain the overall pattern of accruals quality.

To investigate the effect of market exit on accruals quality, Fig. 4, Panel A plots AQ for firms that survived through the end of the sample period in 2019 (surviving cohort) compared to firms that exited from 2010 to 2019 (2010s exit cohort) and firms that exited from 2000 to 2009 (2000s exit cohort). We summarize the data by cohort-decade in Table 4. The results indicate that the level of accruals quality is better for surviving firms ($AQ = 0.031$) compared to the 2010s exit cohort ($AQ = 0.037$) and the 2000s exit cohort ($AQ = 0.044$). However, all three cohorts exhibit the same pattern of accruals quality over time, with accruals quality deteriorating from 1990 to about 2000 and then reversing trend. Similar to the results reported previously, we also find a downturn in accruals quality around the financial crisis and in the last few years of our sample period. This overall intertemporal pattern cannot be explained by market attrition, particularly for the surviving cohort, which, by definition, did not exit the market.

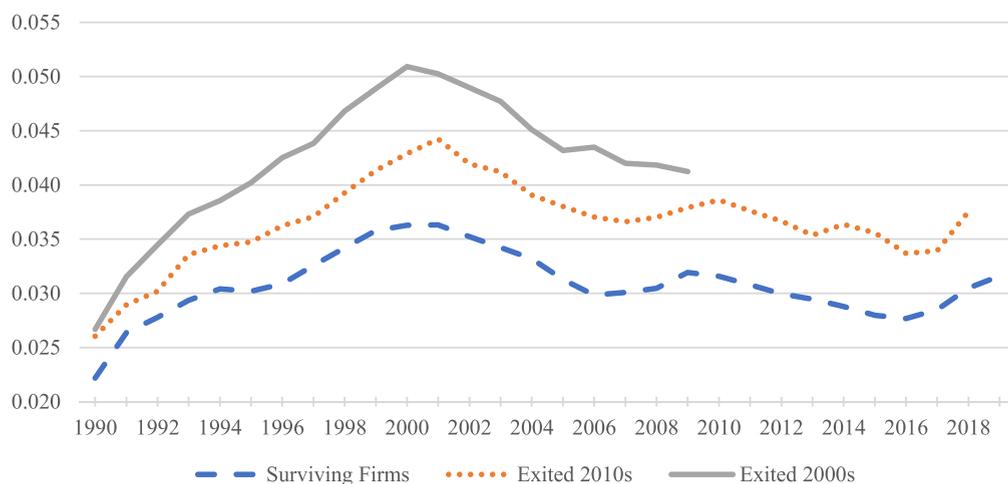
Fig. 4, Panel B plots cash flow volatility over the sample period for the three cohorts. The relative level and intertemporal pattern of σ_{CFO} in the three cohorts mirrors the evidence for AQ in Panel A, consistent with cash flow volatility playing a key role in the intertemporal pattern of accruals quality over time, regardless of market exit.¹⁷ Note that seasoned firms (Fig. 3) and surviving firms (Fig. 4) have generally better accruals quality and lower cash flow volatility than firms entering or exiting

¹⁵ Following our main results, we examine the impulse response function of accruals quality to an unexpected change in cash flow volatility for each listing cohort (untabulated). Because of the measurement issues using the balance sheet approach, we limit this analysis to our sample period, 1990–2019. We find a significantly positive response in all cohorts. We exclude the 2010s cohort because of the limited time series for this estimation.

¹⁶ This measurement issue (i.e., changing from balance sheet to cash flow statement measurement) also contributes to the relatively large downward shift in σ_{CFO} around 1990 in the seasoned (0.057–0.042), 1970s (0.078–0.059), and 1980s (0.080–0.070) cohorts that is visible in Fig. 3, Panel C.

¹⁷ Consistent with this inference, we find a significantly positive impulse response of AQ to an unexpected change in cash flow volatility in all three cohorts in Fig. 4 (untabulated).

Panel A: AQ by exit cohort.



Panel B: Cash flow volatility by exit cohort.

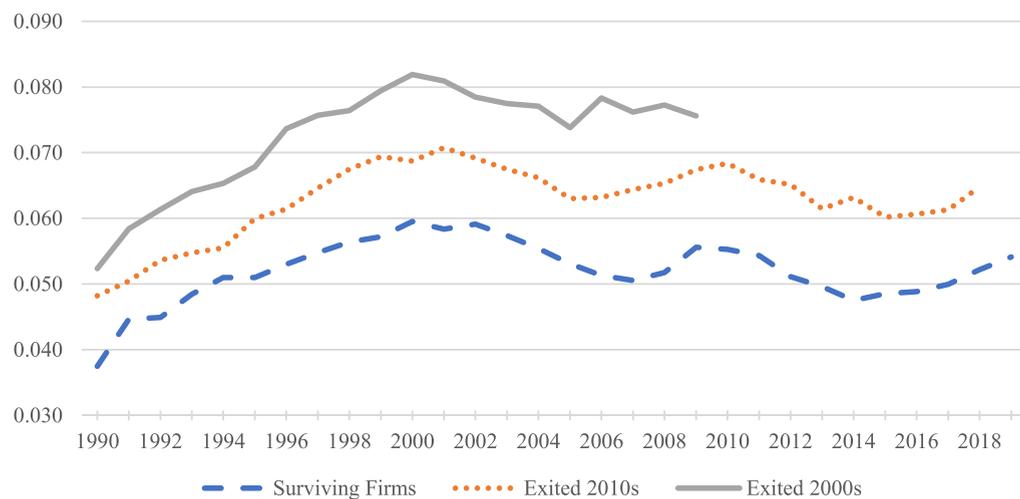


Fig. 4. The effect of market exit on intertemporal patterns in accruals quality (Panel A) and cash flow volatility (Panel B) for firms that survived through the end of the sample period in 2019 (surviving firms), firms that exited from 2010 to 2019 (2010s exit cohort), and firms that exited from 2000 to 2009 (2000s exit cohort). We define all variables in [Appendix A](#).

the market. Thus, while changes in sample composition influence the *level* of these variables, we conclude that market entry and exit are not responsible for the intertemporal *pattern* of accruals quality and its association with cash flow volatility.¹⁸

4.2. Do regulation and accounting standards explain the intertemporal pattern in accruals quality?

The financial reporting environment changes over time, which may affect managers' accounting practices and thereby the pattern of accruals quality. For example, [Cohen et al. \(2008\)](#) suggest that increased scrutiny of firms' accounting practices after the passage of SOX in 2002 resulted in less accruals-based earnings management. They find that the absolute value of abnormal total accruals ($|AA|$), estimated using the modified Jones model ([Dechow et al., 1995](#)), increases steadily from 1987

¹⁸ In untabulated analysis, we restrict the 2000s and 2010s exit cohorts to firms listed for at least ten years prior to exit (i.e., listed prior to 1990 for the 2000s cohort and prior to 2000 for the 2010s cohort). The intertemporal pattern of AQ is similar to [Fig. 4, Panel A](#), although the level of AQ in the 2000s exit cohort is closer to the 2010s exit cohort. These results suggest that short-lived firms entering the market in the 1990s explain the overall lower accruals quality in the 2000s exit cohort. Along with the evidence in [Fig. 3, Panel B](#) suggesting an initial increase in AQ of newly-listed firms, this result suggests that further research on the relation between accruals quality and firm life-cycle may be fruitful.

Table 4
Accruals quality (AQ) and cash flow volatility (σCFO) by exit cohort.

Decade	AQ			σCFO		
	(1)	(2)	(3)	(4)	(5)	(6)
	Surviving Firms	Exited 2010s	Exited 2000s	Surviving Firms	Exited 2010s	Exited 2000s
1990–1999	0.031	0.036	0.042	0.051	0.061	0.071
2000–2009	0.033	0.039	0.047	0.055	0.066	0.079
2010–2019	0.030	0.036		0.051	0.064	
Mean	0.031	0.037	0.044	0.052	0.064	0.075

This table presents the data for average AQ and σCFO by decade, corresponding to Fig. 4. Columns (1) and (4) present the data for firms surviving through the end of our sample period. Columns (2) and (5) present the data for firms that exited the sample during 2010–2019. Columns (3) and (6) present the data for firms that exited the sample during 2000–2009. We define the variables in Appendix A.

to a peak in 2000, before declining from 2001 to 2005. Although researchers commonly use |AA| to capture discretionary accruals, Francis et al. (2006) argue that it should be viewed as a measure of overall accruals quality because, similar to AQ, it varies substantially with innate factors related to the business model and operating environment. Consistent with this conjecture, we find that the five-year rolling average of |AA| follows a pattern very similar to the pattern of AQ in Fig. 1 (untabulated). As a result, it is possible that SOX-induced changes in discretionary behavior, rather than a shift in cash flow volatility, explain the pattern we observe in AQ around 2000.

To provide evidence on this possible explanation, we decompose AQ into innate and discretionary components, following Francis et al. (2005):

$$AQ_{i,t} = \lambda_0 + \lambda_1 \sigma CFO_{i,t} + \lambda_2 \sigma Sales_{i,t} + \lambda_3 Size_{i,t} + \lambda_4 OperCycle_{i,t} + \lambda_5 NegEarn_{i,t} + \mu_{i,t} \quad (2)$$

The predicted values from estimating Eq. (2) provide a measure of the innate portion of firm-specific accruals quality attributable to underlying firm fundamentals. The residuals capture the estimated discretionary component. We estimate Eq. (2) annually, and for consistency with our main tests, calculate each firm's average innate and discretionary accruals quality over five-year rolling windows. Consistent with Francis et al. (2005), the results in Table 5, Panel A indicate that smaller firms with more volatile operations, longer operating cycles, and losses have poorer accruals quality. Of these innate factors, σCFO explains 28% of the cross-sectional variation in accruals quality (column 1), while all five factors together explain 40% (column 2).¹⁹

Table 5 also provides plots of the innate (Panel B) and discretionary (Panel C) components of AQ over the sample period. We find that the innate component maps closely to total AQ illustrated in Fig. 1, while the discretionary component is relatively small and flat over time. Further, in untabulated tests we find that the response of innate (discretionary) AQ to an unexpected change in σCFO is significant (insignificant). We find similar results decomposing |AA| into innate and discretionary components. The evidence that the discretionary component of AQ (and |AA|) is essentially flat over our sample period is sufficient to rule out changes in accruals-based earnings management (whether attributable to SOX or other factors) as an explanation for our results.

Overall, our evidence suggests that the intertemporal pattern in accruals quality is primarily attributable to innate factors, specifically the volatility of cash flows. Although accruals-based earnings management around SOX may partially explain the discretionary component of accruals quality, its magnitude is small relative to the innate component. Moreover, the largest effect of SOX likely occurred within a few years following its adoption. It is unlikely that SOX would result in continued improvement in accruals quality for more than a decade. Thus, we conclude that this regulatory change does not explain the long-run intertemporal pattern in accruals quality.

Dichev and Tang (2008) suggest that an increase in earnings volatility and a decrease in earnings persistence and matching from 1967 to 2003 is attributable to accounting standards moving toward fair value principles. We find an increase in earnings and sales volatilities through about 2000, but, similar to cash flow volatility, these trends reverse shortly thereafter (untabulated). Moreover, a shift toward fair value accounting is unlikely to have a first-order effect on cash flow volatility, which we find is significantly related to the intertemporal pattern of accruals quality.²⁰ Overall, we conclude that the initial decline and subsequent improvement in accruals quality that we observe is not attributable to changes in the regulatory environment or accounting standards.

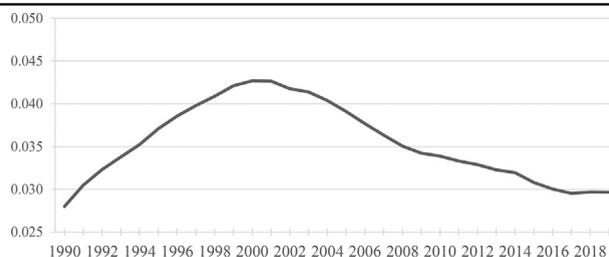
¹⁹ The sample including all five innate factors has 14,390 fewer observations because the calculation of *OperCycle* requires a non-zero value of inventory. However, calculating innate and discretionary AQ with the full sample based on the model in column 1 with σCFO as the only explanatory variable produces very similar plots of innate and discretionary AQ to those in Table 5, Panels B and C, respectively.

²⁰ Our international tests in section 3.2 also inform the conclusions in Dichev and Tang (2008). The EU adopted IFRS in 2005, increasing the use of fair value accounting (Armstrong et al., 2010; Ball et al., 2015). If a shift to fair value accounting reduces accruals quality, then we would expect to see a steady decline in accruals quality for EU firms after 2005. However, our evidence does not corroborate this inference.

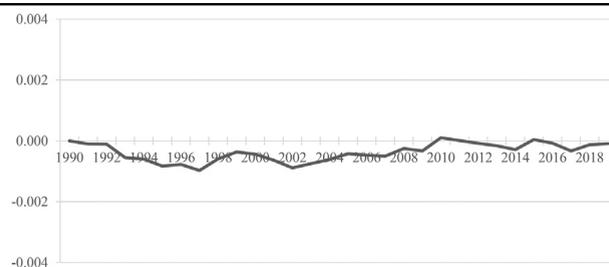
Table 5
Intertemporal patterns in innate and discretionary accruals quality (AQ).

Panel A: Mean coefficient estimates from the estimation of Eq. (2)				
Variable	(1)		(2)	
	Coeff. Est.	t-statistic	Coeff. Est.	t-statistic
Intercept	0.0177	35.11	0.0149	16.54***
σ_{CFO}	0.3019	51.21***	0.1696	35.88***
σ_{Sales}			0.0261	32.34***
NegEarn			0.0255	21.34***
OperCycle			0.0035	16.96***
Size			-0.0024	-36.20***
Adjusted R ²	0.28		0.40	
N	95,839		81,449	

Panel B: Innate AQ



Panel C: Discretionary AQ



This table presents the average coefficient estimates and t-statistics from the annual estimations of Eq. (2) (Panel A). We use the predicted values from the model in Column (2) to plot innate AQ (Panel B) and the residuals to plot discretionary AQ (Panel C). We define the variables in Appendix A. ***, **, * indicate significance at the one percent, five percent, and ten percent levels respectively.

4.3. Do special and nonoperating items explain the intertemporal pattern in accruals quality?

Donelson et al. (2011) suggest that evidence of a declining trend in earnings properties is primarily attributable to an increase in the frequency of large special items over time rather than a shift toward fair value accounting standards. To the extent that special items affect current accruals, such as write-downs or write-offs of receivables, they have the potential to influence the estimation of Eq. (1), and hence AQ. However, many special items affect noncurrent accruals, such as goodwill impairments, asset write-downs, or restructuring charges, and thus will not affect AQ. Compustat only provides the total amount of special items, and thus we cannot separately examine the items affecting current accruals. Nevertheless, in untabulated analyses, we find that the frequency of large special items increases throughout our sample period, punctuated by spikes in 2000 and again during the financial crisis in 2008. This trend cannot explain the pattern in accruals quality over time, and in particular the improvement in accruals quality beginning in 2000.

Similarly, Bushman et al. (2016) conclude that one-time and nonoperating items, which they label as non-timing-related accruals, explain most of their observed decline in the explanatory power of operating cash flows for total accruals. We find that their measure of non-timing-related accruals, equal to the cross-sectional standard deviation of the difference between operating income after depreciation and pretax income, is relatively flat since the beginning of our sample period in 1990 (untabulated), and thus also cannot explain our results. Because most of the decline in the explanatory power of their total accruals model occurs prior to 1990, it is possible that their results are attributable to earlier years. Alternatively, the non-timing-related accruals they investigate could be more likely to affect total rather than current accruals.

5. Additional robustness tests

To provide further evidence on the robustness of our results, we explore whether the pattern in accruals quality in Fig. 1 is sensitive to alternative research designs in estimating Eq. (1). First, we explore the use of total accruals instead of current accruals as the dependent variable in Eq. (1). Second, we consider the effect of the two additional explanatory variables, ΔRev and PPE , suggested by McNichols (2002). Third, we estimate the model cross-sectionally by year, rather than by industry-year. We focus on these three issues because they represent the key differences between Eq. (1) and Bushman et al.'s (2016) model since they reach a different conclusion about the pattern of accruals quality over time.

Fig. 5, Panel A plots accruals quality from our estimation of Eq. (1) compared to models which sequentially implement each of these three research design differences. We summarize the data by decade for the alternative model specifications in Panel C. Importantly, the intertemporal pattern in accruals quality is similar across all specifications and is consistent with an inverse relation with cash flow volatility from Fig. 1, Panel B. This evidence indicates that our results are robust to the alternative research design choices. However, the plot also reveals substantially poorer accruals quality when calculated using the residuals from each of the three alternative models. These differences are primarily attributable to the use of total accruals rather than current accruals (v2). There are only minor incremental effects associated with the other two research design differences (v3 and v4). This evidence corroborates DD's and McNichols' (2002) view that a model including only one year of lead and lag cash flows is unsuitable for noncurrent accruals that necessitate a longer series of cash flow leads/lags.

While the accruals quality pattern over time is generally the same, the models produce different residuals and therefore different measures of accruals quality. Francis et al. (2005) note that in a better-specified expectations model (evaluated by the adjusted R^2), the stream of residuals, and hence the standard deviation of those residuals, provides a better assessment of the estimation error in accruals and hence accruals quality. Thus, we examine the adjusted R^2 from each of these models in Fig. 5, Panel B to further assess the effects of the research design choices on the residuals used to calculate accruals quality. We find that the adjusted R^2 decreases monotonically as we implement each research design difference. Importantly, the adjusted R^2 from Eq. (1) is highest across all years of the sample, consistent with the stream of residuals from this model providing a better measure of accruals quality.²¹ In sum, the analyses in Fig. 5 suggest that the pattern in accruals quality is not sensitive to alternative research design choices, and corroborates that accruals quality is generally improving since about 2000. However, the research design most common in prior research (Eq. (1)) produces a better-specified stream of residuals relative to the other design choices.

6. Discussion and conclusion

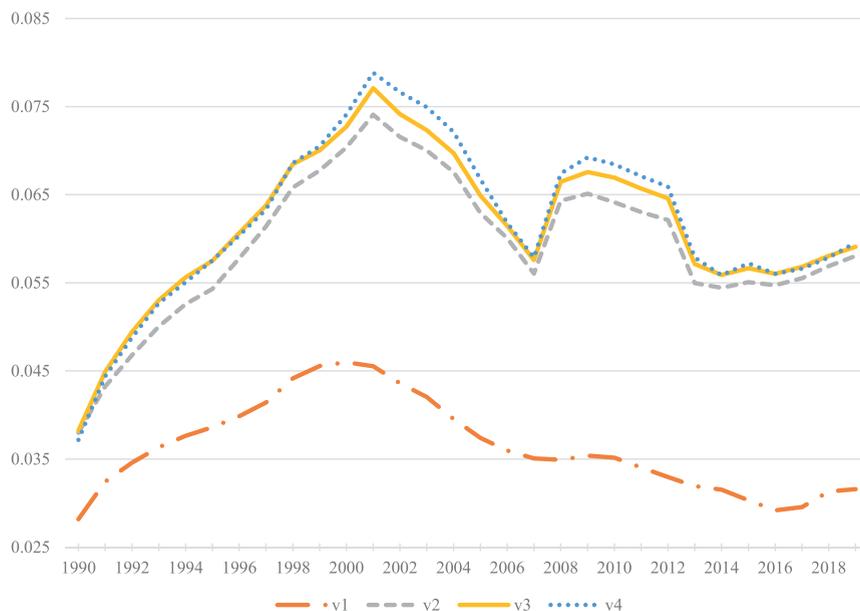
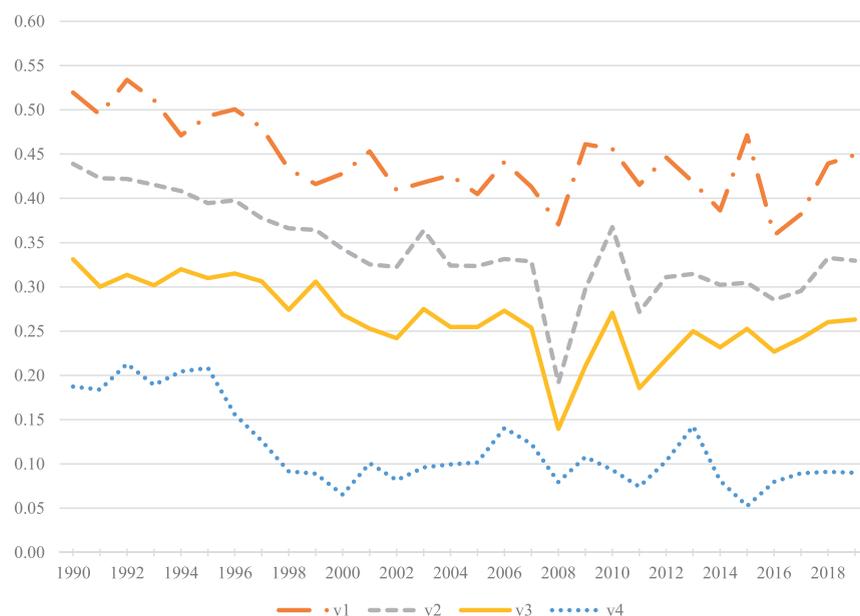
We examine how accruals quality evolves over the past three decades and explore potential explanations for the pattern. Using the Dechow and Dichev (2002) measure of current accruals quality popular in the accounting literature, we find a decline in accruals quality throughout the 1990s. However, beginning in 2000, accruals quality generally improves except for a brief period following the financial crisis in 2007 and the final three years of the sample, 2016 to 2019. Overall, this evidence is contrary to conventional wisdom and prior research suggesting sustained deterioration in various earnings properties over time.

We exploit the intertemporal variation in accruals quality to explore potential explanations for our results. We provide compelling evidence that the intertemporal pattern in accruals quality is best explained by firms' cash flow volatility, both in the U.S. and for international samples which exhibit different intertemporal patterns relative to the U.S. Specifically, periods of declining accruals quality are marked by increasing cash flow volatility, while periods of improving accruals quality are associated with decreasing volatility. We find that other potential explanations do not offer a robust description for both the decline and improvement in accruals quality over time.

The extant literature does not provide a definitive answer regarding why cash flow volatility exhibits the intertemporal patterns we observe in the U.S. and internationally. However, several studies find economic shifts that occur around 2000, similar to timing of the reversal in cash flow volatility in our U.S. evidence. For example, Campbell et al. (2001) find a significant increase in idiosyncratic return volatility from 1962 to 1997. Subsequent research proposes several explanations for this trend, including increased institutional ownership, more volatile firm fundamentals, firms listing earlier in their life cycle, and increasing competition in product markets. However, Brandt et al. (2010) find that this trend began to reverse around 2000, which they attribute not to these factors but to trading by retail investors. Although these studies do not agree on an explanation for this trend, the change in idiosyncratic volatility is consistent with a fundamental shift in the U.S. economy around 2000. More recently, Campbell et al. (2020) suggest a change in inflation dynamics in the early 2000s, resulting in a shift in the correlation between inflation and the output gap from negative to positive. Kottimukkalur et al. (2022) find that this shift explains a change in the association between aggregate earnings and future inflation, suggesting that inflation has

²¹ This analysis also reveals that in the estimation including all three design differences (v4), the adjusted R^2 averages 16.5% in the 1990s, 10.0% in the 2000s, and 9.0% in the 2010s (Panel C). These values are nearly identical to the averages in Bushman et al. (2016) for each of these decades. Thus, much of the difference in their comparison of DD's reported adjusted R^2 of 47% for the 1990s to 10% in the last decade of their sample period is attributable to research design differences, not to a dramatic decline in explanatory power of the model.

Panel A: Accruals quality (AQ).

Panel B: Adjusted R^2 .Panel C: AQ and adjusted R^2 by decade.

	AQ				Adjusted R^2			
	1990s	2000s	2010s	Average	1990s	2000s	2010s	Average
v1	0.038	0.040	0.032	0.036	0.485	0.423	0.422	0.443
v2	0.054	0.066	0.058	0.059	0.401	0.315	0.312	0.342
v3	0.056	0.068	0.060	0.061	0.308	0.243	0.240	0.263
v4	0.056	0.070	0.060	0.062	0.165	0.100	0.090	0.118

Fig. 5. The effect of alternative research designs on intertemporal patterns in accruals quality (Panel A) and model adjusted R^2 (Panel B). The data in Panels A and B are summarized by decade and for the full sample period in Panel C. We define all variables in Appendix A. The versions are as follows: v1: The model specified in Eq. (1). v2: Same as version 1, except using total accruals as the dependent variable. v3: Same as version 2, except excluding ΔRev and PPE . v4: Same as version 3, except estimating the model cross-sectionally by year.

the potential to influence cash flows and accounting information. The reversal in the inflation–output gap correlation suggests that managers' operating decisions in response to inflation changed during this period, which could affect firms' cash flow volatilities.

Regardless of the reason for the initial increase and subsequent decline in cash flow volatility, our purpose is to examine the effect of this intertemporal change on the accounting system, and specifically on accruals quality. Importantly for our research question, the general trend of decreasing cash flow volatility since 2000 is inconsistent with the conclusion in prior research of a prolonged and continuous decline in key properties of accrual accounting earnings. Relative to most prior research, we examine not only a more recent time period but also one that encompasses periods of both increasing and decreasing volatility. This intertemporal variation allows us to provide new evidence on patterns in accruals quality over time and extend our understanding of factors contributing to these patterns. Specifically, we find that intertemporal patterns in accruals quality are likely attributable to intertemporal variation in operating cash flow volatility.

Appendix A. Variable definitions

Accruals quality variables:	
<i>AQ</i>	Accruals quality, equal to the standard deviation of the residuals from the following regression estimated cross-sectionally for each 2-digit SIC industry-year: $CA_{i,t} = \varphi_0 + \varphi_1 CFO_{i,t-1} + \varphi_2 CFO_{i,t} + \varphi_3 CFO_{i,t+1} + \varphi_4 \Delta Rev_{i,t} + \varphi_5 PPE_{i,t} + v_{i,t}$ The standard deviation is calculated over a rolling 5-year window ($t-4$ to t) for firms with data for a minimum of any two years in the window.
<i>Innate AQ</i>	Innate accruals quality, equal to the average over rolling 5-year windows ($t-4$ to t) of the predicted values from the following regression estimated annually: $AQ_{i,t} = \lambda_0 + \lambda_1 \sigma CFO_{i,t} + \lambda_2 \sigma Sales_{i,t} + \lambda_3 Size_{i,t} + \lambda_4 OperCycle_{i,t} + \lambda_5 NegEarn_{i,t} + \mu_{i,t}$
<i>Discr AQ</i>	Discretionary accruals quality, equal to the average over 5-year rolling windows ($t-4$ to t) of the residual values from the <i>Innate AQ</i> regression.
Variables to estimate AQ:	
<i>CA</i>	Current accruals, equal to the sum of the changes in accounts receivable, inventory, accounts payable, taxes payable, and other assets ($-1 \times (RECCH + INVCH + APALCH + TXACH + AOLOCH)$) from the statement of cash flows, scaled by average total assets (AT). Following Dechow and Dichev (2002) , we require firms to have non-missing RECCH and INVCH.
<i>CFO</i>	Cash flows from operations (OANCF) scaled by average total assets (AT).
ΔRev	The change in revenue (SALE), scaled by average total assets (AT).
<i>PPE</i>	Property, plant, and equipment (PPEGT), scaled by average total assets (AT).
Firm characteristics:	
σCFO	The standard deviation of <i>CFO</i> , measured over a rolling 5-year window ($t-4$ to t) for firms with data for a minimum of any two years in the window.
$\sigma Sales$	The standard deviation of sales (SALE), measured over a rolling 5-year window ($t-4$ to t) for firms with data for a minimum of any two years in the window.
<i>NegEarn</i>	The proportion of earnings ($CFO + CA$) less than zero over the prior 5 years ($t-4$ to t).
<i>OperCycle</i>	The firm's operating cycle, measured as $[360/(SALE/average\ RECT)] + [360/(COGS/average\ INVT)]$, averaged over a rolling 5-year window ($t-4$ to t) for firms with data for a minimum of any two years in the window.
<i>Size</i>	The natural log of total assets (AT), averaged over a rolling 5-year window ($t-4$ to t), requiring a firm to have data for a minimum of any two years in the window.

Appendix B. Vector autoregression and impulse response functions

We use vector autoregression (VAR) to examine the statistical relation between the time series of *AQ* and σCFO . The VAR system of equations specifies how a vector of variables evolves over time by regressing each variable on lags of itself and lags of the other variables in the system. Because the results of lag-order selection tests (e.g., Akaike's information criterion; likelihood ratios) recommend one lag in our system, we estimate the following system of equations:²²

$$\delta \sigma CFO_t = \alpha_0 + \alpha_1 \delta \sigma CFO_{t-1} + \alpha_2 \delta AQ_{t-1} + \varepsilon_{1t} \quad (B1)$$

$$\delta AQ_t = \beta_0 + \beta_1 \delta \sigma CFO_{t-1} + \beta_2 \delta AQ_{t-1} + \varepsilon_{2t} \quad (B2)$$

The regression results obtained from estimating Eqs. (B1) and (B2) provide insight on whether one time series has predictive value for another time series. For example, a statistically significant β_1 suggests that lagged cash flow volatility helps to predict accruals quality: higher operating uncertainty in $t-1$ should result in lower quality accruals in t . When operations are more uncertain in $t-1$ (i.e., σCFO_{t-1} is high), the accruals recorded at $t-1$ are also more uncertain, which we expect to result in more estimation error that will be revealed once future cash flows are realized. DD emphasize that each accrual is recorded as

²² While VAR assumes that the variable time series are stationary, our evidence indicates that this assumption does not hold for either *AQ* (Fig. 1, Panel A) or σCFO (Fig. 1, Panel B). Thus, we first difference all variables (indicated by the prefix δ) to ensure that the means and standard deviations of the first differenced variables are stationary. We lose one year of our sample period because of first differencing and an additional year for the lagged variables, leaving 28 time series observations over the period 1992–2019 for this analysis.

both an opening accrual (i.e., the estimate of the future cash flow, recorded at $t-1$) and a closing accrual (i.e., the reversal of the opening accrual recorded when the future cash flow is realized, e.g., at t). Thus, we expect higher operating uncertainty to increase estimation error and lower accruals quality at both $t-1$ and t .

VAR captures the future, but not contemporaneous, effect of cash flow volatility on AQ. To gain insight into the relation between the variables' time series beyond simple predictive power, we use the results from estimating the system of equations to calculate the orthogonalized impulse response function (IRF). The IRF reveals the current and future response of one variable to an unexpected change in another variable, measured by the error terms (Stock and Watson, 2001). For example, in estimating the system of equations represented by Eqs. (B1) and (B2), the error term ε_{1t} captures the portion of current period cash flow volatility (σCFO_t) that is unexplained by lagged cash flow volatility (σCFO_{t-1}) and lagged accruals quality (AQ_{t-1}), holding all other errors constant. The orthogonalized IRF then illustrates the response of current and future values of AQ (from t through $t+k$) to an unexpected increase in cash flow volatility at t .

For the shock to cash flow volatility to be exogenous, the error terms ε_{1t} and ε_{2t} cannot be contemporaneously correlated. To ensure that this is the case, additional assumptions must be made about the flow of contemporaneous causality between the variables in the system.²³ Variables that are ordered earlier in the system are considered more exogenous than variables ordered later in the system, which are considered more endogenous (Love and Zicchino, 2006). Specifically, the first variable in the system is considered to have a contemporaneous effect on later variables in the system. However, by design, later variables cannot have contemporaneous effects on earlier variables (although they can have lagged effects). It is plausible to assume that cash flow volatility is more exogenous and therefore more likely to cause a change in accruals quality than the opposite. This assumption is consistent with the assumptions of the Dechow and Dichev (2002) accruals quality model, which considers operating cash flows, and hence cash flow variability, as primitive and exogenous.

It is important to clarify the windows over which AQ and σCFO are measured in the VAR and IRF analyses given their rolling window construction. For example, Eq. (B2) estimates the effect of one lag of cash flow volatility (σCFO_{t-1}) and one lag of accruals quality (AQ_{t-1}) on current AQ_t .²⁴ As illustrated in the subsequent table, σCFO_{t-1} is the standard deviation of CFO over $t-5$ to $t-1$, while AQ_t is the standard deviation of the residuals (v_{it}) from Eq. (1) over $t-4$ to t . Each variable is measured at the firm-year level, then averaged by year.

σCFO_{t-1}	AQ_t
CFO_{t-1}	v_t
CFO_{t-2}	v_{t-1}
CFO_{t-3}	v_{t-2}
CFO_{t-4}	v_{t-3}
CFO_{t-5}	v_{t-4}

The residuals used to calculate AQ_t are derived from Eq. (1), which includes CFO_{t-1} , CFO_t , and CFO_{t+1} as explanatory variables. Thus, by construction, AQ_t is orthogonal to CFO in the following periods, mitigating the overlap between the variables in the VAR analysis.

AQ_t	Orthogonal to CFO
v_t	$t-1, t, t+1$
v_{t-1}	$t-2, t-1, t$
v_{t-2}	$t-3, t-2, t-1$
v_{t-3}	$t-4, t-3, t-2$
v_{t-4}	$t-5, t-4, t-3$

The orthogonalized IRF traces the effect of an unexpected change in σCFO at time t (i.e., ε_{1t}) on current and future values of AQ. A shock to cash flow volatility disturbs the mapping of present and future cash flows into accruals, thereby decreasing accruals quality. For example, Table 2, Panel B indicates that an unexpected increase in cash flow volatility produces a significantly positive response in AQ (lower accruals quality) in the current and subsequent three years.

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²³ Specifically, the orthogonalized IRF option ("oirf") in Stata uses a Cholesky decomposition to ensure the error terms are orthogonal (see the Stata manual at <https://www.stata.com/manuals/tsvarintro.pdf>).

²⁴ For ease of exposition, this discussion abstracts from first-differencing the variables in the VAR analysis, as discussed previously.

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