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PERSPECTIVE

The Fundamental Tradeoff between the Timing Benefits and Timing Costs of Accrual Accounting

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SYNOPSIS: Since all accruals reverse, their effect on the recognition of income is, by definition, temporary and temporal. Exploring the implications of this key property, this paper argues that both the benefits *and the costs* of accrual accounting largely lie in the temporal domain and that they are inextricably linked by the nature of the accrual process. For example, it is impossible to have the benefit of early accruals for long-term obligations, such as pensions, without the noise in income introduced by the deviation of long-term pension estimates from their corresponding realizations. Thus, the fundamental tradeoff of timing benefits and timing costs lies at the heart of accrual accounting and critically shapes its characteristics and function. Although some of these core properties of accrual accounting have been long known, this paper argues that they are not fully appreciated and discusses a number of possible implications for standard setting and academic research.

Keywords: accruals; timing benefits; timing costs.

I. INTRODUCTION

This paper explores the fundamental tradeoff between the timing benefits and costs of accrual accounting. The emphasis is on the effects of the accrual process on income, because income seems to be by far the most important output of financial reporting (Graham, Harvey, and Rajgopal 2005). Under cash flow accounting, income is defined as net nonequity cash flows. Under accrual accounting, income is equal to net nonequity cash flows plus net accruals. Since all accruals reverse, however, cash flow income and accrual income converge to each other over time. Thus, the key function and effect of accruals is to create temporary and temporal differences between cash flow income and accrual income. The differences are temporary because they disappear after the reversal of the relevant accruals. They are temporal because they concern the allocation of the same total value over different time periods.

Since the difference between cash flow income and accrual income largely lies in the temporal domain, the main argument of this paper is that the benefits and the costs of accrual accounting versus cash flow accounting largely belong in the temporal domain as well. The timing benefits of accrual accounting are better known and appreciated. For example, Dechow (1994) posits that accruals resolve "timing and mismatching problems" in the underlying cash flows, e.g., booking a credit sale as revenue at the time of the sale is an earlier and better signal of the success of delivering goods or services to a willing customer.

In contrast, the nature and function of the timing costs of accrual accounting seem to be not as well understood. The point is that the use of accruals unavoidably creates timing costs. The timing costs of accounting arise because the application of accruals relies on the use of a large variety of estimates—e.g., depreciable lives and salvage values, collectability of receivables, percentage of contract completion—and these estimates differ from their corresponding realizations, producing noise in accrual income. In essence, these differences between estimates and realizations represent accrual timing errors, nuisance pieces of income that obscure real firm performance. For example, booking a credit sale as revenue at the time of the sale requires the use of an accounts receivable accrual, which is an estimate of future cash

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collections from customers. But if this accounts receivable estimate is larger than the eventual realized cash collections from customers, the firm will have to record a write-off of the associated receivable at some point later on, which will appear as a loss on the income statement. Thus, the initial revenue was overstated and subsequent income is understated, eroding the role of accrual income as a gauge of firm performance.

The main body of the paper develops these ideas in more detail, placing the tradeoff of timing benefits and costs at the heart of accrual accounting. Because of its central role, a clear understanding of this fundamental tradeoff provides an organizing focus and insight into the manifold problems of everyday accrual accounting. Specifically, the paper discusses two broad areas of possible applications. The first one is standard setting, where the paper argues that a lot of existing rules already embody the timing benefit/cost framework proposed in this paper. In addition, the paper provides some examples of how this framework can be used to assess other existing or proposed rules. The second area of application is academic research. The paper argues that there are a number of possible directions here, but what looks especially promising is some estimation of the magnitude of the timing/estimation errors and how their magnitude varies by industry, type of accruals, and the horizon of accruals.

To be clear from the beginning, a lot of what the paper discusses has been around for a while, and perhaps even most of it, in bits and pieces and bigger chunks in various places. In this sense, the paper does not strive so much for originality in the components but seeks instead for a new big-picture synthesis of the whole. In addition, to make the main argument lean and tractable, the paper tries to avoid digressions into exceptions and details. Finally, the paper can be likened to a Swiss cheese. Those who are looking for holes are likely to find them. The hope is that those who are looking for nourishment are likely to find it as well.

II. THE MAIN ARGUMENT

Consider the expression

$$Accrual\ Income = Associated\ Cash\ Flows + Associated\ Accruals \tag{1}$$

which can be considered the fundamental relation of accrual accounting since it is a succinct representation of several key relations. For example, it reveals that the link between accrual income and cash flow income is the accruals. It also provides the links between the three primary financial statements and their components, where the left-hand side represents the income statement and the right-hand side terms represent the cash flow statement and (changes in) the balance sheet accounts.

This expression is, of course, familiar to accounting professionals, and variations of it appear in many forms. The particular version in Expression (1) includes the qualifier "associated" to emphasize that this relation refers to apples-to-apples definitions of *Accrual Income* versus *Associated Cash Flows* versus *Associated Accruals*. Otherwise, the expression is very general, and it applies to pretty much any definition of accrual income and all its components. For example, if the income-related concept is revenue, the associated cash flows is cash collections from customers and the associated accruals are usually the changes in accounts receivable and deferred revenue.[1] If the accrual income-related item is insurance expense, the associated cash flow is cash paid for insurance and the associated accruals would be changes in prepaid insurance or insurance payable. It is also clear that Expression (1) applies over all possible time horizons as long as the apples-to-apples condition holds. For example, a quarterly specification of Expression (1) will refer to quarterly income and cash flow items and accruals that are defined as corresponding quarterly balance sheet account changes.

Summing up the terms in Expression (1) over time yields

$$\sum Accrual\ Income = \sum Associated\ Cash\ Flows + \sum Associated\ Accruals \tag{2}$$

As widely known, all accruals reverse over the life of the relevant transaction, e.g., Dechow, Hutton, Kim, and Sloan (2012).[2] For example, the opening accrual for an accounts receivable reverses with the collection of that receivable,

[1] Consistent with Richardson, Sloan, Soliman, and Tuna (2005), the definition of accruals adopted in this study is that for any given period accruals are represented by the changes in noncash assets and liabilities. For example, the accounts receivable accrual for a given year is the change in the accounts receivable account for that year.

[2] Although all accruals reverse over the life of the relevant transaction, note that this is not necessarily true at the level of the firm. For example, the accounts receivable accrual at the firm level will actually keep growing while the firm is growing. Of course, why this happens is because, although at the beginning of the period, accounts receivable are collected, even more accounts receivable are originated by the end of the period for a growing firm. (Ultimately, though, even aggregate-level accruals reverse over the life of the firm, i.e., all assets and liabilities are wound down to zero at the end of the firm's life.) Note also that the statement "all accruals reverse" is really a convenience shorthand for the more precise "all opening accruals reverse with their associated closing accruals." To illustrate, the depreciation accrual itself does not reverse—but it represents the closing and the reversal of the associated opening PPE capitalization accrual.

the opening accrual for inventory reverses with the sale of that inventory, the opening accrual for PPE (with no salvage value) reverses with a series of depreciation accruals, and so on. The only question is about the horizon for these reversals, which is usually within a year for current assets and liabilities but can be quite long for long-lived assets and liabilities, such as PPE and pension benefit obligations. Since accruals reverse, over the life of the relevant transaction, $\Sigma Associated\ Accruals = 0$, which yields

$$\sum Accrual\ Income = \sum Associated\ Cash\ Flows \tag{3}$$

Although Expression (3) is simple, its implications are far reaching. One implication of Expression (3) is that, over the life of any transaction, the effects on income of cash flow accounting versus accrual accounting are the same. Again, the only question is about the horizon of the relevant transaction, which specifies the horizon over which Expression (3) applies. Cash flow revenue booked as cash collections from customers tracks accrual revenue from booking short-term trade receivables with only a short delay, typically just a few weeks to a few months. The correspondence between cash spent on PPE and subsequent depreciation, however, could take many years to complete. This property of accrual accounting is sometimes known as "the accrual results truing up to the cash flows."[3]

Note that the result in Expression (3) applies regardless of what particular accrual accounting model is chosen. Whether the relevant accrual choices are relatively minor, such as in electing straight-line versus accelerated depreciation, or extend to major differences, such as historical cost accounting versus fair value accounting, the same basic result holds because the discipline of accrual reversals applies to all accruals. In other words, one of the major properties of the accrual process is that, by design, the bottom-line results from all possible accrual accounting treatments and the bottom line from cash flow accounting are the same over the life of the relevant transaction. One way to formalize this intuition is to note that, for any accrual accounting alternatives A and B, over the life of the relevant transaction,

$$\sum Accrual\ Income_A = \sum Accrual\ Income_B = \sum Associated\ Cash\ Flows \tag{4}$$

Since Expressions (3) and (4) apply to any possible transaction, they also apply to any possible bundle of transactions, including bundling of similar-type transactions across time and bundling across firm activities, up to and including the firm itself.

What then is the difference between (the various versions of) accrual accounting and cash flow accounting? The difference lies in the *timing* of the recognition of the relevant revenues and expenses. For example, booking an accounts receivable in period t and collecting it in period t+1 results in moving the recognition of revenue from period t+1 (under cash flow accounting) to period t (under accrual accounting). Again, the same general point about timing applies to differences resulting from various accrual accounting choices. For example, this same transaction may be booked as revenue not in period t but in period $t-1$ or $t-2$, depending on the interpretation and application of the revenue recognition rules for this particular transaction.

Since accrual and cash flow accounting do not differ in terms of total magnitude of income recognized over time and only differ in the pattern of temporal recognition, it follows that the benefits and costs of accrual versus cash flow accounting have to be somehow related to the temporal domain as well. Note that cash flow accounting is the natural primitive and benchmark in this comparison because cash flow accounting is much simpler and more objective than accrual accounting. Without getting into details, under "pure" cash flow accounting, all nonequity cash inflows are revenue, all nonequity cash outflows are expenses, and the net nonequity cash flow is income. As is probably clear, a cash flow accounting system based on these principles of recognition is rather simple and easy to operate.

In contrast, the implementation of accrual accounting is much more complicated and burdensome. These implementation difficulties are evidenced, for example, by the thousands of pages of rules produced by FASB and IASB, the long and rigorous education required to practice accounting, the considerable cost of the accounting function in most companies, and the trouble that outside observers often have in understanding a company's accrual results. Most importantly, observing such large difficulties and costs suggests that the commensurate benefits of accrual accounting must be even larger.

The Timing Benefits of Accrual Accounting

Since all that accrual accounting does with respect to the determination of income is to move the recognition of revenues, expenses, and income across time, the benefits of accrual accounting apparently have to do with the temporal

[3] In practice, not all accruals true up to the corresponding cash flows, e.g., some components of stock option compensation affect earnings but do not true up to the corresponding cash flows. In addition, Expression (3) assumes that the clean surplus relation holds.

dimension as well. Intuitively, it would only make sense to abandon the simplicity and objectivity of cash flow accounting if accrual revenues and expenses are somehow "better" than their cash flow counterparts and that "betterness" is somehow tied to the timing of their recognition as components of accrual income. This general intuition has been made more specific in existing accounting research, perhaps most prominently in Dechow (1994), which argues that accrual accounting resolves "timing" and "mismatching" problems in the underlying cash flows.

For example, consider the pattern of monthly revenue and expense recognition for a wholesaler during the Christmas season. Assume that the wholesaler purchases a lot of inventory for cash in November, makes a lot of credit sales in December, and collects on its receivables in January. Cash flow accounting would show large cash expenses in November and large cash revenues in January, whereas accrual accounting would show a surge in sales in December accompanied by the concurrent recognition of cost of goods sold with no associated revenue and expenses in November and January.

It is easy to see why the proponents of accrual accounting would argue that the accrual recognition of revenues and expenses in this example results in "better" performance numbers. Since the goal of the firm can be defined as "providing goods and services to willing customers at prices that yield a competitive rate of profit," the recognition of revenue in December reflects the fact that the decisive part of delivering these particular Christmas goods was accomplished in December. In addition, the recognition of revenue in December is a more timely signal of successful performance—in the language of Dechow (1994), it resolves a timing problem in the recognition of revenue at the time of the cash receipt. The recognition of cost of goods sold in December correctly aligns the costs and benefits of December sales, i.e., it resolves a mismatching problem in the Dechow (1994) framework. In contrast, the results of cash flow accounting appear to show large expenses and losses in November, with large windfall-like revenues and profits in January, without making the crucial causal connection between these two events.

Notice also that identifying and correcting "mismatching problems" is really just a version of identifying and correcting "timing problems." In the example above, the problem of delayed cash flow revenue is corrected by moving the revenue recognition from January to December, and the problem of mismatched cost of goods sold is solved by moving the expense recognition from November to December. It is clear that both the problems and the solutions in this example are related to time. In summary, the key benefit of accrual accounting is that it moves the recognition of cash flows across time, which results in "better" measures of firm performance.

The devil, of course, is in the details because, in many cases, it is far from clear what accruals would produce "better" measures of performance. For example, accounting may appeal to concepts such as "completion of the performance obligation" to trigger the recognition of revenue or "asset impairment" to recognize some expenses. The actual application of these concepts, however, quickly leads to a maze of detailed rules and prescriptions and requires the vast apparatus of a well-developed accounting profession for practical implementation.

The Timing Costs of Accrual Accounting

Some of the costs of accrual accounting are easy to see. As mentioned above, cash flow accounting is relatively straightforward because it is essentially just the counting and ordering of cash flows, which are mostly objective events backed by transaction documentation. Thus, running a cash flow accounting system is a fairly lean affair in terms of resources and personnel. In contrast, the implementation of accrual accounting is much more costly in terms of staff education and expertise, investment in systems, keeping up with the rules, more involved auditing, and so on. Although the totality of these costs may be difficult to actually trace and tally up, conceptually, at least, they are not hard to define and include all costs of running the operations of the accounting system. For the purposes of this paper, I call such costs "the operating costs of accrual accounting."

Although the operating costs of accrual accounting are fairly visible and clear, in this paper, I want to draw attention to another type of cost of using accrual accounting, which is less visible and is not as well understood. I would call such costs "the timing costs of accrual accounting." These timing costs arise from the same process that produces the timing benefits of accrual accounting, i.e., moving the recognition of cash flows as accrual revenues and expenses across time periods. The point is again that actual cash flows are objective and verifiable,[4] but moving the recognition of them across time periods is much more subjective and less verifiable. Thus, the products of the accrual process are subject to problems that are absent in cash flow accounting.

[4] To be clear, the fact that cash flows are objective and verifiable does not mean that they are immutable. *Once the cash flows have occurred*, it is fairly easy to verify that they have occurred and to determine the magnitude and sign at which they have occurred. *Ex ante*, though, cash flows are of course subject to discretion and even manipulation. For example, the firm can offer a sales discount or not, and that surely affects the cash flows from customers.

To provide an example of these timing costs, consider again the Christmas wholesaler example. The cash collections on sales are in January, but accrual accounting moves their recognition to December, booking them as credit revenues. What happens if the firm overestimates the collectability of the associated receivables and so the actual cash collections in January are less than the credit sales booked in December? The answer is that the uncollectable receivables will be written off, which will be a negative hit to income. Note that this "cost of accruing sales early" hit to income will occur in a period different from when the sales were recorded in December, which leads to a deterioration of the matching between revenues and expenses. Notice also that this hit to income has little to do with actual firm performance in January, i.e., with actual new sales and cost of goods sold in that period. It is essentially an estimation/timing error, a nuisance piece of income that obscures the reporting on company results in January.

To recap, the company recorded "too much" revenue in December (more than the eventual cash collections from customers), corrected by a corresponding negative adjustment to income in January. In other words, the benefit of recording revenue before cash collections was achieved at the cost of recording a slice of "too much income" in December and then a slice of "negative income" in January. Thus, the timing benefit of revenue was achieved at a timing cost. The "better" accrual of revenue in December was achieved at the cost of overstating income in December and understating income in January.

Similar considerations and conclusions apply on the expense side. For example, in accrual accounting, the cash cost of inventory is capitalized and deferred to be matched against the corresponding revenues, producing a better measure of performance. But a write-down of inventory can produce a negative hit to income that has little to do with the success of concurrent real operations. Similar arguments apply to all kinds of asset write-downs and write-offs, e.g., depreciating PPE "too slowly" leads to a big write-off later on.

The main point of the above examples is that, unlike the objectivity of cash flow accounting, the application of accrual accounting requires the use of *estimates*, and even with best efforts, estimates are likely to differ from realizations. In the Christmas wholesaler example, the estimate of cash collections turned out to be lower than actual cash collections. An estimate of depreciable life and salvage value can differ from actual useful life and salvage value. The estimates used in deriving pension costs can radically differ from their actual realizations. Note that at least some of these timing errors are unavoidable because estimates about the future are by definition uncertain, and so, even with best and most honest managerial efforts, there is no way to avoid differences between *ex ante* estimates and *ex post* realizations. It is exactly these differences that produce the timing costs of accrual accounting. The timing cost of accrual accounting is essentially the generation of income noise, i.e., pieces of income allocated to the wrong periods, injecting noise in the use of income as a measure of firm performance.[5]

Finally, because all accruals reverse over time, the timing errors of estimation are corrected over time. For the Christmas wholesaler example, the timing cost of first overestimating revenue is corrected by the write-off of the uncollectible receivable sometime later, leaving the aggregate income results over time unaffected. Thus, the timing costs of accrual accounting shrink and disappear over time, and as income is more and more aggregated over time, it has fewer and fewer timing errors. This is not a free lunch, however, because the timing benefits of accrual accounting also disappear over time for the very same reasons.

Because of the property of reversing and canceling over time, I refer to accrual estimating errors as "timing errors" to distinguish them from other, more common types of estimation errors. For example, forecasting weather produces estimation errors because there are differences between temperature forecasts and realizations. But such weather forecasting errors are never reversed or canceled over time. In other words, accrual estimation errors are estimation errors of a special kind, where the effect of the estimation errors is only temporary and temporal and it is reversed and canceled over time. Thus, the labels adopted in this paper, "timing errors" or "estimation/timing errors" serve to remind us of this fundamental property of accrual estimation errors.

In summary, the timing benefits and timing costs of accruals are inextricably connected to each other, so the use of accruals unavoidably faces a fundamental tradeoff between them. This fundamental tradeoff is likely a central driving force of designing and running effective accrual accounting. Essentially, effective accounting would use accruals that maximize the timing benefits of accruals while minimizing their timing costs. This is far from easy, however, because the magnitudes of timing benefits and costs are intrinsically related to each other by the nature of the accrual process. For example, if one wants the large and long-horizon timing benefits of accruing pension costs at the time they are earned, it

[5] Note that the timing costs of accrual accounting can be exacerbated by managerial opportunism and poor accounting rules, where the effect of these forces plays out similarly to the effect of best-efforts differences between estimates and realizations. For example, credit revenues can be inflated because of either an honest estimation error or because of management manipulation to maximize proceeds from stock issues. In terms of timing errors and costs, however, these two possibilities play out exactly the same—revenues and income are overstated in the relevant period and receivables are written down and income is understated in some future period.

is largely unavoidable to incur the huge timing costs from great differences between pension long-term estimates and their realizations.

The trick then is to find workable equilibria of timing benefits and costs, where the benefits clearly exceed the costs. Note that such equilibria are likely dynamic and critically depend on the nature and characteristics of the underlying transactions and setting. For example, most credit sales are booked as revenue at the time of the sale, which suggests that the timing benefits of early booking exceed the timing costs of possible divergence between collectability estimates and actual collections. But if collectability problems become acute, e.g., in the presence of marginal/new customers or highly speculative deals, optimal revenue recognition could switch to the installment method, which is essentially cash flow accounting for revenue.

III. IMPLICATIONS

Implications for Standard Setting

The framework outlined in this paper speaks to the core of accrual accounting and can thus be useful in a number of capacities, including for accounting standard-setting bodies, chiefly the FASB and the IASB. The guiding idea is that a major tradeoff in crafting accrual accounting rules is between moving revenues and expenses to periods that better reflect firm performance and the need to use estimates, which produces nuisance pieces of income that obscure firm performance.[6]

Starting with the more modest and obvious implications, it would be good to have rules that more cleanly delineate between income that reflects real performance versus "timing noise" income. Current accounting for such noise income is haphazard. Estimates of noise income can appear as separate line items on the income statement, sometimes they can be gleaned from the footnotes, or they can be completely buried in aggregate accounts without even a hint of their existence. A write-off of inventory, for example, can appear as a separate line on the income statement or can be buried in cost of goods sold, with adequate footnote disclosure or not. A revaluation of the warranty liability is typically not found on the income statement itself but is sometimes included as a separate line in the warranty liability reconciliation in the footnotes or can be simply included as an offset to the warranty provision without any separate presentation or disclosure.[7]

The point is that a recognition of the conceptual kinship of noise income components—which result from pretty much all aspects of firm activities and affect pretty much all lines on the income statement—is largely absent in the present rules of financial reporting. To provide a big-picture feel for the importance of the noise income issue, let us ponder some simple questions: what is the proportion of noise income to total income for the average U.S. firm? Is it on the magnitude of 5 percent, 10 percent, or 20 percent? How does this proportion vary as a function of industry membership, horizon of estimation, and macroeconomic cycles? I believe that most of us do not have a good answer to these questions, and perhaps most importantly, it would be hard to provide a good estimate of this proportion under the existing rules of financial reporting.

Rules that are easy to implement within the existing framework of financial reporting could be a useful first step in exploring the benefits of highlighting noise income. For example, a required component of the Management Discussion and Analysis section in U.S.-filed financial reports is "Critical Accounting Estimates," where companies are required to discuss their most important accounting estimates. This disclosure could be much improved by a requirement to provide an explicit reconciliation of the relevant accounts, including the effect of changes in estimates. For example, if for some company the most important accounting estimate is the provision for environmental remediation, there would be a reconciliation of the beginning and ending environmental obligation, including new provisions and especially the change in the obligation due to changes in the estimates to derive the obligation. Examples of comparable notions and disclosure already exist. For example, the line item "actuarial gains and losses" in the reconciliation of the Pension Benefit Obligation (PBO) is the effect on pension liabilities due to changes in actuarial estimates, such as employee turnover and longevity.

A more ambitious form of implementation would be along the lines of clean separation and delineation of noise components from other income on the face of the income statement. Such separation of noise components would be of clear interest to users, both in conceptual and in practical terms. For example, it is clear that noise components are likely to be much less persistent than income from ongoing regular operations. In addition, the income of firms with large

[6] Note that this idea is very general and applies to pretty much all types of accruals and their associated cash flows.
[7] Materiality concerns definitely apply to such presentation decisions, of course, as some of these noise income effects can be negligible.

noise components is likely to be more volatile, with higher negative autocorrelations in earnings changes (Dichev and Tang 2008).

The framework of this paper can also be used as a broad guide to working on new rules of financial reporting or reassessing existing ones, where the main idea is that the benefits of the rules have to be balanced against their noise income costs. The good news is that existing rules suggest that these tradeoffs are already being considered. Take, for example, the problem of R&D capitalization. There is little doubt that R&D expenditures produce future benefits, and therefore, some form of matching consideration would argue for capitalizing R&D expenditures and amortizing them against the anticipated duration of such benefits. The problem is that R&D activities are by nature quite uncertain (Kothari, Laguerre, and Leone 2002), and so estimates and realizations of R&D benefits are likely to have substantial differences. Thus, in the language of this paper, capitalization of R&D expenditures is likely to produce significant timing errors and therefore significant noise in income.

Faced with this situation, the FASB decided on mostly disallowing R&D capitalization, essentially keeping to the objectivity and simplicity of cash flow accounting for R&D expenditures. In other words, the FASB R&D rule can be interpreted as deciding that the income noise cost of R&D capitalization (plus other operating costs of implementation) is too high given the possible benefits. Faced with this same situation, the IASB decided to distinguish between research expenditures, which are more speculative and therefore expensed, and development expenditures, which are more reliable in terms of future benefits and therefore allowed to be capitalized. Overall, the experience with R&D accounting conforms well with the idea of balancing the timing benefits and timing costs of accrual accounting.

Booking credit sales at the point of sale versus under the installment method is another illustration that existing rules already impound the fundamental tradeoff of timing benefits and costs. Such illustrations suggest that the consideration of this fundamental tradeoff is a useful way to systematically think about existing or potential new rules. This is especially true on the timing costs side, which is currently less well appreciated. The questions to ask in such considerations could be as follows: "What are the most important accrual estimates in implementing this rule?," "What is the level of uncertainty in these estimates, and what is the likely magnitude of the differences between the *ex ante* estimates and their *ex post* realizations?," and "What is the likely effect on income from these differences in estimates and realizations?" Asking and answering such questions can serve as a major organizing force in the evaluation of existing or proposed rules.

Asking such questions also sheds new light on some existing controversies. An instructive example of the power of this approach is the consideration of fair value accounting. Although there are several existing flavors of fair value accounting, for simplicity and clarity, let us consider the example of a stock investment under a pure version of fair value accounting, where the book value of the stock is updated to fair value at the end of each period and the fair value changes are run through the income statement as components of regular income. Proponents of fair value accounting point out that the advantage of this method is that the stock's book value is continuously updated to fair value, which is essentially an unbiased estimate of what the stock can be eventually sold for. In terms of the effects on the income statement, the benefit of fair value accounting is that the eventual gain/loss on the sale of the investment security is continuously updated and anticipated before the actual realization. In the language of this paper, fair value accounting provides a more timely signal of stock investment performance, a timing benefit. On some level, these arguments make a lot of sense, and indeed, the push for more fair value accounting has become one of the defining features of modern standard setting.

When seen through the framework advanced in this paper, however, these arguments have a major problem. The benefit of the timely anticipation of the eventual realized gain/loss is achieved at the cost of a continuous stream of fair value changes, which are timing errors resulting from the differences between the estimates of realizable value at the beginning of a period versus the estimates at the end. Notice that, even with moderate holding periods of say 20 fiscal quarters and average stock volatility, the sum of the absolute value of timing errors can vastly exceed the benefit of timely anticipation of the eventual realized gain/loss on the stock investment. Thus, the timing benefit of fair value accounting is achieved at the cost of introducing a tremendous amount of timing noise. Notice that this interpretation of the benefits and costs of fair value accounting accords pretty well with companies' main complaint about it, which is that it "introduces too much volatility in income."

In summary, the point of all these examples is that the fundamental tradeoff between timing benefits and timing costs can serve as a major organizing force in thinking about the practical problems of accrual accounting, including for standard setting. What already exists as scattered intuitions and rules of thumb can now be reorganized and seen as branches from the same cohesive whole.

Implications for Research

Some research implications have already been discussed above, and this section presents some further opportunities. To start with, even some of the basic premises of this paper are not well understood or at least have not

been operationalized and empirically estimated. For example, one of the early building blocks of the paper is that all differences between cash flow and accrual accounting are temporary, and therefore, the results from these two systems of accounting converge over time. But how long does this convergence actually take for a typical firm? Is it, say, 50 percent or 70 percent complete within five years? Would it make sense to have an "annual rate of convergence" metric, and what can it be used for? Can it be used as a quality of earnings metric, in the sense that accrual results that converge faster to cash flow results are more reliable (akin to the intuition in Bloomfield, Gerakos, and Kovrijnykh 2019)? What is the effect of firm growth on such convergence? Questions like these remain largely unanswered.

Moving to the main results of the paper, there are simply no comprehensive empirical estimates of the magnitude of the timing/estimation errors in earnings, either on average or for meaningful subsamples along natural conditioning variables, such as investment and accrual horizon and steady versus volatile operating environments. The theory and evidence in Dechow and Dichev (2002), hereafter DD, are a useful starting point to what needs to be done and to the possible magnitudes of the associated timing errors. The story in DD is that operating accruals that anticipate future cash flow realizations, e.g., accounts receivable or wages payable, are subject to estimation errors, and these estimation errors and their correction introduce noise in income. DD uses the residuals from regressions of working capital accruals on one-year past, current, and one-year future cash flow from operations as a proxy for these estimation errors and finds that the magnitude and effects of such noise are considerable.

The timing costs arguments in this paper are essentially a generalization of the DD story. Estimation errors arise for all kinds of accrual estimates (not only for operating accruals anticipating future cash flows), including for accruals where the cash realization precedes the accruals (e.g., the difference between estimates and realizations of depreciable lives). In fact, such considerations apply to pretty much any accrual estimate, including all operating, investing, and financing accruals, and short-term and long-term accruals. The implication is that the possible magnitudes of such estimation noise—timing errors in the language of this paper—are likely to be much larger, perhaps an order of magnitude larger, than the likely effects of the DD setting. Intuitively, the estimation errors of long-term accruals, such as pensions, are likely to be much, much larger than those for operating accruals, with a typical estimation horizon of less than a year.

The difficulty in applying this intuition is that, as discussed above, the existing financial reporting output is ill-suited to estimating such timing errors. Essentially, you need data on accrual estimates, changes in these estimates, and their ultimate realizations. Some information like this already exists, for example, many companies provide tables with reconciliations of their allowance and reserve accounts in their notes (e.g., disclosures about warranty provisions, bad debt provisions, tax provisions, and provisions for sales returns), where the effect of changes in estimates is sometimes directly disclosed as a line item in the reconciliation of the associated liabilities. As mentioned before, the information in the pensions notes includes disclosure about the effect of changes in actuarial estimates.

It is also possible to start with a more limited but cleaner analysis in a specific setting or industry. For example, property and casualty insurance firms are required to disclose their estimates of insured losses by cohort and line of business, the changes in these estimates over insured life, and their actual realizations (Ding, Lev, Peng, Sun, and Vasarhelyi 2020). Such information can be used to derive precise estimates of the magnitude of estimation/timing errors as a percentage of total income. Finally, Dichev and Owens (2024) provide an approach that can be adapted to derive large-sample proxies of timing/estimation errors.

Since the timing benefits/costs framework in this paper is quite broad, there are many other intriguing directions for possible research. For example, the discussion above reveals that the magnitudes of timing benefits and costs of accruals are inextricably linked by the nature of the accrual process: basically, it is difficult to get large timing benefits without corresponding large timing costs. Following this line of thought leads to an interesting question: is there a difference in the *relative* rates of increase and decay in the timing benefits versus timing costs of accrual accounting over common reporting horizons?

Perhaps it is not accidental that accrual accounting in practice is primarily centered on the annual and quarterly reporting windows, with few efforts in the direction of either shorter or longer reporting windows. Perhaps the annual and quarterly reporting window are the sweet spot for financial reporting, where the timing benefits clearly dominate the timing costs. As reporting periods get longer and longer, the timing benefits and costs of accrual accounting recede away and accrual accounting converges to cash flow accounting—there is little benefit to doing accrual accounting over longer reporting periods. On the shorter horizon end, (apart from the operating costs explained above) it is possible that timing costs rise much faster than the timing benefits of accrual accounting at the weekly or daily interval. For example, daily revenue recognition under the percentage-of-completion method for a complex contract would be quite noisy without much gain on the benefit side.

IV. CONCLUSION

This paper argues that at the heart of accrual accounting lies a fundamental tradeoff between timing benefits and timing costs. Timing benefits arise because accrual accounting recognizes income in periods that better reflect the firm's core performance of selling goods and services to willing customers as compared with cash flow accounting. Timing costs arise because recording income in periods away from the corresponding cash flows relies on using estimates, and the difference between estimates and their realizations manifests as noise in reported income. The main point is that it is impossible to have the timing benefits of accrual income without the timing costs, and so managing the practical tensions of this tradeoff produces much of the richness and challenges in accrual accounting.

The good news is that improved awareness of this tradeoff can bring an organizing focus into tackling these challenges. After laying out the main argument, the paper discusses possible applications along two dimensions. First, the paper argues that existing accounting rules already embody the tradeoff of timing benefits and costs. It also argues that a fuller and more systematic consideration of this tradeoff can bring much clarity, and better solutions, to accounting rule-making. Second, the paper sketches out several possible research directions, where perhaps the most important and urgent task is to derive empirical measures of the timing costs of accrual accounting.

REFERENCES

Bloomfield, M., J. Gerakos, and A. Kovrijnykh. 2019. Accrual reversals and cash conversion. (Working paper). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2495610

Dechow, P. M. 1994. Accounting earnings and cash flows as measures of firm performance: The role of accounting accruals. *Journal of Accounting and Economics* 18 (1): 3–42. https://doi.org/10.1016/0165-4101(94)90016-7

Dechow, P. M., and I. Dichev (DD). 2002. The quality of accruals and earnings: The role of accrual estimation errors. *The Accounting Review* 77 (S-1): 35–59. https://doi.org/10.2308/accr.2002.77.s-1.35

Dechow, P. M., A. P. Hutton, J. H. Kim, and R. G. Sloan. 2012. Detecting earnings management: A new approach. *Journal of Accounting Research* 50 (2): 275–334. https://doi.org/10.1111/j.1475-679X.2012.00449.x

Dichev, I., and E. Owens. 2024. Accrual duration. *Review of Accounting Studies* (forthcoming). https://doi.org/10.1007/s11142-024-09826-8

Dichev, I. D., and V. W. Tang. 2008. Matching and the changing properties of accounting earnings over the last 40 years. *The Accounting Review* 83 (6): 1425–1460. https://doi.org/10.2308/accr.2008.83.6.1425

Ding, K., B. Lev, X. Peng, T. Sun, and M. A. Vasarhelyi. 2020. Machine learning improves accounting estimates: Evidence from insurance payments. *Review of Accounting Studies* 25 (3): 1098–1134. https://doi.org/10.1007/s11142-020-09546-9

Graham, J. R., C. R. Harvey, and S. Rajgopal. 2005. The economic implications of corporate financial reporting. *Journal of Accounting and Economics* 40 (1–3): 3–73. https://doi.org/10.1016/j.jacceco.2005.01.002

Kothari, S. P., T. E. Laguerre, and A. J. Leone. 2002. Capitalization versus expensing: Evidence on the uncertainty of future earnings from capital expenditures versus R&D outlays. *Review of Accounting Studies* 7 (4): 355–382. https://doi.org/10.1023/A:1020764227390

Richardson, S. A., R. G. Sloan, M. T. Soliman, and İ. Tuna. 2005. Accrual reliability, earnings persistence and stock prices. *Journal of Accounting and Economics* 39 (3): 437–485. https://doi.org/10.1016/j.jacceco.2005.04.005

Quantifying the benefits and costs of accrual accounting: Evidence from insurance industry data

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Quantifying the benefits and costs of accrual accounting: Evidence from insurance industry data

1. Introduction

There is widespread interest in the properties and functions of accrual accounting since it is the dominant form of accounting as practiced today. Foundational studies such as Dechow (1994) suggest that the use of accruals leads to superior performance measures as compared to the chief alternative of cash accounting. Dozens of studies develop this core message, with the most prominent strand generally finding higher correlations between accrual measures and stock prices and returns as compared to cash accounting alternatives. Assuming that stock prices are efficient aggregators of information, such evidence points to the broad superiority of accrual accounting.

Other directions in this literature investigate the origins and functions of this superiority, looking into the properties of the accrual process and the resulting accruals and accrual-based measures like GAAP earnings. The main message is that the use of accruals brings benefits in resolving timing and mismatching problems in the underlying cash flows. For example, the capitalization and depreciation of PPE correctly reflects the economic logic of long-term investment, where the cost of the initial investment benefits many future periods, and is accordingly deferred and allocated to them. It is also widely recognized, however, that the benefits of accrual accounting come at some costs. A major cost of recording accruals is the necessity of using estimates, where the deviation of estimates from realizations produces noise in performance measures. For example, booking a receivable for credit sales requires an estimation of the collectability of future cash flows, and inaccuracy in this estimation could produce inflated

or understated revenue and profit at inception, with corresponding corrections later on (Dechow and Dichev 2002).

While these broad intuitions are well-known, quantitative estimates of such benefits and costs are mostly lacking. There is simply no good answer to questions like “What is the magnitude of accruals-induced noise in existing performance measures?” Is it on the magnitude of 1% or 5% or 10% or 20%? One would hope that it does not go as high as say 50% - but it is just hard to be sure. Other questions like this are “How would you quantify the benefits of the accrual process?” and “Do the benefits of the accrual process correlate with its costs across business environments and types of transactions, and to what extent?” Such questions seems rather fundamental, and there is no good way to answer them without at least reasonable quantitative estimates. At the same time, decisions which reflect such considerations are taken every day, including at the highest level. For example, standard setters advocating for an expanded use of some accruals (like more use of fair value or expanded capitalization of R&D) assumes that the benefits of such an intervention exceed the costs. But how do we really know?

To put it plainly, despite the progress already made most existing evidence on the benefits and costs of accrual accounting is broad-brush and is not well-anchored on the nuts and bolts of the accrual process. The major reason for this lack of precision is that the current rules of financial reporting are not oriented towards the clean articulation of the critical relation between associated cash flows, accruals, and the resulting accrual measures. Exceptions exist but they are mostly just that, exceptions, and serve mostly to illustrate what is missing. For example, sometimes the notes of the financial statements have a reconciliation of certain estimates, e.g., a company might disclose beginning and ending balances of warranty liabilities, additions to these labilities, and cash payments for warranty service. Tracking this information over time allows

one to discern the critical relation between the warranty provision (current accrual expense), changes in the warranty liability (the net warranty accrual), and warranty cash flows. Ideally, such information would be available for most major accruals of the company. But that is simply not the case under current rules, and this situation is unlikely to change in the foreseeable future.

Fortunately, there are some settings where there are detailed and specific data about the relation between associated cash flows and accruals. Perhaps the most prominent such setting is the property and casualty insurance industry, where firms provide reports both under GAAP financial accounting and - because they are subject to regulation – under Statutory Accounting Principles (SAP).[1] Specifically, under SAP insurance firms provide extensive information about their biggest accrual and its cash flow realizations, the provision for losses. For example, an insurance firm estimates a loss due to a car accident, and tracks the subsequent cash payments for car repairs and medical care, with possible revisions to the original estimate as applicable. Such information is produced at the annual level, and is typically organized by line of business (homeowner insurance, personal auto, commercial auto, workers compensation, etc.)

[1] Insurance firms are primarily regulated at the state level. State regulators coordinate their activities through the National Association of Insurance Commissioners (NAIC), which develops and codifies SAP through its *Accounting Practices and Procedures Manual*, which serves as the primary source of statutory accounting guidance. While the NAIC itself has no direct regulatory authority, its standards are almost universally adopted by state regulators.

2. Theory: the effect of accrual estimation errors on accrual income, and the costs and benefits of accrual accounting

The measurement of accrual estimation errors is non-controversial, typically defined as the difference between the accrual estimates and their actual realizations (Ding et al. 2020). The magnitude of accrual estimation errors is not the same, however, as the effect of the accrual estimation errors on accrual earnings. The main intuition here is that the effect of accrual estimation errors on accrual earnings is *at least twice* the magnitude of the accrual estimation errors because accrual estimation errors affect accrual earnings at their inception but also at their reversal. In addition, repeated accrual revisions and reversals could further inflate the effect of accrual estimation errors on accrual earnings.

We start with a simple example that illustrates this main intuition for our insurance industry setting. Specifically, consider the insurance provision for an auto liability incident occurring in year 1 with the following provisions and cash flows over three years:

Year	**1**	**2**	**3**
Provision (expense) for incurred losses	11	-2	1
Cash payments during the current year	5	3	2
Balance in insurance liability account at year end	6	1	0
GAAP Accruals	6	-5	-1
Accrual estimation errors and revisions	1	-2	1
Perfect foresight expense	10	0	0
Perfect foresight accruals	5	-3	-2

In this example, the company makes a provision for $11 in incurred losses in year 1, where actual realized payments are at 5/3/2 over three years, and the provision is revised down by -2 in year 2, and revised back up by 1 in year 3. (Note that for ease of exposition, the expense here is coded as a positive number, while of course an expense denotes a negative effect on income.) From the pattern of provisions and cash flows, it is clear that the insurance liability is overstated at the beginning, it is revised down in year 2 but now it overshoots in the other direction, and it is revised up to the correct final amount in year

3. The annual accruals are given by the combination of the initial provision, the revisions, and the reversal of accruals at the payment of the losses. So, for the first year, it is equal to the provision of $11 minus the cash settlements of $5, so net accrual of $6. For the second year, it is equal to the revision for the year (-$2) plus the reduction in the insurance liability (-$3) due to cash payments, so total of -$5. For the third year, it is equal to the revision of $1 plus the reduction in the liability due to payments (-$2), so net of -$1. These same accruals can be also derived as the changes in the corresponding liability account, consistent with the definition of accruals in Richardson, Sloan, Soliman, and Tuna (2005). Note that the algebraic sum of accruals over the three-year life of this transaction is 0, as expected because of their reversals. In addition, note that the estimated expense for incurred losses eventually trues up to the actual losses of $10, i.e., the algebraic sum of provisions over time equals the algebraic sum of cash payments over time.

The accrual estimation error is the difference between the initial estimate of $11 and the total cash payments of $10, so it is $1. But the total effect of the accrual estimation errors on accrual income is not $1, and it is not double that either. In this case its absolute value is spread out over the three years as $1/$2/$1, for a total effect of $4. In addition, the algebraic sum of the initial accrual estimation error and the revisions is zero. In other words, this is a reminder that accrual estimation errors are estimation errors of a special type, where by construction they are zeroed out by the accrual process over the life of the transaction.[2]

Stretching this example further, define a hypothetical variable called “perfect foresight expense” as $10 in year 1, with zero further expenses in years 2 and 3. “Perfect foresight expense” is what the expense would be if the accrual estimate was a perfect foresight of the eventual cash payments. Essentially, “perfect foresight expense” is expense of the highest possible quality, which has all the benefits of accrual income, while avoiding the costs of accrual accounting as reflected in actual reported earnings (see a theoretical development of the perfect foresight earnings concept in Richardson et al. 2005). It is also clear that actual reported expense is equal to perfect foresight expense plus the accrual

[2] In most other cases in practice, estimation errors do not have this property. For example, weather forecasts and forecasts of GDP have estimation errors – but such estimation errors are never reversed or zeroed out.

estimation errors and their reversals. Since $5 are already paid by the end of the first period, a perfect foresight expense of $10 implies a perfect foresight accrual for period 1 of $5, and perfect foresight accruals of -3 and -2 at the cash payments for the same amount in periods 2 and 3 (since with perfect foresight there would be no revisions).

The difference between perfect foresight accruals and actual GAAP accruals is the accrual estimation errors and their gradual correction through the revisions, so that:

GAAP Accruals = Perfect Foresight (PF) Accruals + Accrual Estimation Errors/Revisions (1)

which is the key expression that succinctly conveys the intuition for our study. Essentially, expression (1) suggests that reported GAAP accruals reflect the combined effect of the benefits and costs of accrual accounting, where the first term on the right-hand side reflects the benefits, and the second term reflects the costs. Perfect Foresight Accruals embodies the benefits of accrual accounting, which are aimed at shifting the recognition of some cash flows into income in a period different from when they occur. In this case, the Perfect Foresight Accruals shift the recognition of cash payments on the accident claims from periods 2 and 3 to period 1. This is a better accounting for the economics of insurance than cash accounting because the accident losses incurred over years 1-3 are really due to the cost of providing insurance coverage in period 1. Thus, the accrual accounting for insurance losses provides a better measure of firm performance than the corresponding measures from cash accounting.

The benefits of accrual accounting, however, come at the cost of incurring accrual estimation errors/revisions, and their effect on earnings. Essentially, accrual estimation errors act as noise, as nuisance pieces of income that distort the function of earnings as a measure of firm performance (Dichev 2025). Instead of the “correct” measure of expense of $10 in year 1, the firm reports $11, which overstates expense and understates income, with continuing ripple effects of nuisance pieces of income of $2 in year 2 and $1 in year 3.

Summarizing, the gist of this example is that accrual accounting provides a benefit of moving the recognition of cash payments $3/$2 in periods 2/3 to period 1 but at the cost of including nuisance pieces of income of $1/$2/$1 over period 1-3. Thus, this framework provides an effective quantification of the benefits and costs of accrual accounting, and allows for further analysis of the fundamental trade-offs between such benefits and costs. At a minimum, it allows to address questions such as whether the benefits exceed the costs of current or potential accounting treatments, the calculation of benefit/cost ratios, and a relative ranking of accounting rules on their relative benefit/cost ratios.

Data and Sample Construction

We downloaded the NAIC annual reports of US-based property and casualty insurance companies from the S&P Global Market Intelligence platform. Even though property and casualty insurance companies offer a wide range of products across difference business lines, we mainly focus on the private passenger auto liability insurance following prior literature (Narayanamoorthy, Page, and Song [2023]). Our sample covers the reports filed between 1996 to 2024. We dropped observations with (1) missing or negative incurred loss in Schedule P, Part 2; (2) missing or negative cumulative paid net losses in Schedule P, Part 3; (3) non-positive total assets or net premium written; (4) non-positive initial estimated loss, premium for the line, and initial payment; (5) unsigned accrual estimation errors larger than 50% of the perfect foresight expense, (6) non-positive PF accrual, and (7) non-positive cash flow duration. Our final sample contains 18,105 observations.

Variables

Following SAP, managers of property and casualty companies are required to provide the initial estimation for all losses incurred in the current year and re-estimations for the losses incurred in each of the previous nine years. These estimations are reported as “incurred losses” in Schedule P, Part 2 of the statutory filing. Managers also need to document cumulative payments for the losses incurred in the current year and each of the previous nine accident years in Schedule P, Part 3. Since Schedule P provides both annual loss estimates and cumulative payments over a ten-year window, the data allow us to observe accrual expenses, “perfect foresight” expenses, estimation errors and revisions, and realized cash flows.

Table 1 illustrates this structure using the private passenger auto liability line from Island Insurance Company, Ltd.’s 2020 annual statement. Panel A (Part 2) shows the development of loss reserve estimates for accident years 2011–2020, plus a “prior” line. Panel B (Part 3) reports cumulative paid losses for the same accident years. Each panel is organized as a triangle, with accident years shown in rows and calendar years shown in columns. For example, in Panel A, the estimate for accident year 2015 is $7,415 in calendar year 2015 and $6,764 in calendar year 2016, implying a downward revision of

$651 ($7,415 − $6,764). In Panel B, cumulative paid losses for accident year 2015 are $2,628 in calendar year 2015 and $4,295 in calendar year 2016, meaning the firm paid $1,667 ($4,295 − $2,628) during calendar year 2016 for losses from accident year 2015.

We compute all variables for firm *i* and accident year t using the year *t* + 5 annual report (Narayanamoorthy, Page, and Song [2023]). We proxy the perfect foresight expense for accident year *t* () with incurred losses measured at the end of calendar year *t* + 5, e.g., $7,456 in Panel A of Table 1. If that value is unavailable in the *t* + 5 report, we use the most recent number in the *t* + 4 report instead. The initial estimation for accident year *t* () is the incurred losses reported at the end of calendar year *t*, e.g., $7,415 in Panel A, Table 1. The initial payment for accident year *t* () is the cumulative paid loss at the end of calendar year *t*, e.g., $2,689 in Panel B, Table 1.

Accrual accounting measures

We measure the benefit of accrual accounting for year *t* using the perfect foresight accrual (), defined as the difference between the perfect foresight expense and the initial payment for accident year *t*, e.g., $4,767 ($7,456 − $2,689).

We measure the cost of accrual accounting for year *t* under the "as-reported" (calendar-year) view with , which equals (i) the accrual estimation error for accident year *t* () plus (ii) the calendar-year revision to prior accident years' loss estimates (). Specifically, is the difference between and , e.g., –$41 ($7,415 – $7,456). is the sum of the change of loss estimation from calendar year *t*-1 to calendar year *t* for the "prior" row and for accident years *t* − 4 through *t* − 1. For example, Island Insurance Company's in 2015 is: $53 ($5,952 – $5,899) + $114 ($7,649 – $7,535) – $148 ($6,384 – $6,532) + $323 ($6,996 – $6,673) – $595 ($6,317 – $6,912).

In the accident year view, we capture the cost of accrual accounting for accident year *t* by the effect of accrual estimation errors and revisions across periods (). This equals the absolute value of the initial accrual estimation error for accident year *t* () plus the absolute value of all subsequent revisions to the loss estimate from calendar years *t* + 1 through *t* + 5 (). Let denote the loss estimate for accident year

t in calendar year *t* + k, then is . Using Panel A of Table 1, for year 2015 is $1,394 (|$7,415 – $7,456| + |$6,764 – $7,415| + |$7,185 – $6,764| + |$7,249 – $7,185| + |$7,461 – $7,249| + |$7,456 – $7,461|).

Cash flow accounting measures

Under the "as-reported" view for calendar year *t*, calendar-year cash flow () equals the initial payment for accident year *t* plus payments for prior accident years, where each prior-year payment is the change in cumulative paid losses from calendar year *t* − 1 to *t*. For example, the 2015 cash flow in Panel B of Table 1 is $2,689 + $1,093 ($5,176 – $4,083) + $449 ($7,215 – $6,766) + $394 ($5,875 – $5,481) + $1,009 ($5,253 – $4,244) + $1,667 ($4,295 – $2,628). For the accident year view, cash flow is simply the initial payment as defined above.

Finally, to study the trade-off between accrual accounting and cash accounting, we construct a cash flow duration measure. Assuming cash is paid mid-period, duration for accident year *t* is the time-weighted average of relative cash flows:

where is the cashflow for accident year *t* during the calendar year *t* + k.

References:

Dechow, P. 1994. Accounting earnings and cash flows as measures of firm performance: The role of accounting accruals. *Journal of Accounting and Economics* 18: 3-42.

Dechow, P., and I. Dichev. 2002. The quality of accruals and earnings: The role of accrual estimation errors. *The Accounting Review* 77 (S-1): 35-59.

Dichev, I., and E. Owens, 2024, Accrual duration, *Review of Accounting Studies* 30: 611-649.

Narayanamoorthy, G., J. PAGE, and B. SONG, 2023, Insurance Rate Regulation, Management of the Loss Reserve and Pricing." *The Accounting Review* 98 (2023): 407–34. https://doi.org/10.2308/TAR-2020-0637.

Richardson, S., R. Sloan, M. Soliman, and I. Tuna. 2005. Accrual reliability, earnings persistence, and stock prices. *Journal of Accounting and Economics* 39 (3): 437-485.

Appendix X Variable definitions

Variables	Definition
	The perfect foresight expense, defined as the incurred losses for the accident year *t* at the end of the calendar year *t*+5. If the number is not available in the *t*+5 report, then we obtained the most recent estimate from the *t*+4 report. The initial estimation for losses incurred in year *t*, defined as the incurred losses reported as of calendar year *t*. The initial payment for accidents incurred in year *t*, defined as cumulative paid loss for accident year *t* at the end of calendar year *t*. The perfect foresight accruals for accident year t, defined as . The accrual estimation error for accident year *t*, defined as . The absolute value of . The revision of loss estimations for each accident year prior to year *t*, defined as sum of the changes of loss estimation from calendar year *t*-1 to calendar year *t* for the "prior" row and for accident years $t-4$ through $t-1$. The absolute value of . Total revisions of loss estimates for accident year *t*, defined as , where is the loss estimate for accident year *t* in calendar year $t+k$. The accrual estimation error and revisions under the "as reported" view for year *t*, defined as . The absolute value of . The accrual estimation error and revisions for the accidents incurred in year *t* across periods, defined as . Total cash flow for calendar year *t*, defined as the sum of payments made in calendar year *t* for accident years $t-4$ through *t*, plus payments associated with the "prior" row. Cash payment for accident year *t* is the initial payment defined above, while cash payments for other accident years are the changes of cumulative payment from calendar year *t*-1 to calendar year *t*. The cash flow duration, defined as the sum of time weighted relative cash flow value. Calculated as , where is the cashflow for accident year *t* during the calendar year $t+k$.

Table 1 Examples of Schedule P

Panel A: Schedule P, Part 2 from the 2020 annual statement

Years in Which Losses Were Incurred	Incurred Net Losses and Defense and Cost Containment Expenses Reported at Year End ($000 omitted)									
	1	2	3	4	5	6	7	8	9	10
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1. Prior	7,017	5,836	5,677	5,899	5,952	5,682	5,679	5,676	5,674	5,659
2. 2011	7,913	7,812	7,437	7,535	7,649	7,676	7,583	7,546	7,506	7,532
3. 2012	XXX	7,352	7,267	6,532	6,384	6,370	6,522	6,558	6,546	6,609
4. 2013	XXX	XXX	7,620	6,673	6,996	7,040	7,246	7,089	7,227	7,203
5. 2014	XXX	XXX	XXX	6,912	6,317	6,080	6,263	6,128	6,238	6,315
6. 2015	XXX	XXX	XXX	XXX	7,415	6,764	7,185	7,249	7,461	7,456
7. 2016	XXX	XXX	XXX	XXX	XXX	8,423	8,715	8,265	8,183	8,030
8. 2017	XXX	XXX	XXX	XXX	XXX	XXX	9,561	8,768	8,593	8,266
9. 2018	XXX	XXX	XXX	XXX	XXX	XXX	XXX	10,101	9,793	8,873
10. 2019	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	9,717	9,773
11. 2020	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	6,850

Panel B: Schedule P, Part 3 from the 2020 annual statement

Years in Which Losses Were Incurred	Cumulative Paid Net Losses and Defense and Cost Containment Expenses Reported at Year End ($000 omitted)									
	1	2	3	4	5	6	7	8	9	10
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1. Prior	000	2,286	3,483	4,083	5,176	5,478	5,593	5,667	5,655	5,640
2. 2011	3,229	5,027	6,177	6,766	7,215	7,458	7,497	7,497	7,483	7,532
3. 2012	XXX	2,962	5,021	5,481	5,875	6,074	6,425	6,425	6,424	6,607
4. 2013	XXX	XXX	2,921	4,244	5,253	6,320	6,947	6,948	7,118	7,154
5. 2014	XXX	XXX	XXX	2,628	4,295	5,196	5,396	5,792	5,970	6,218
6. 2015	XXX	XXX	XXX	XXX	2,689	5,466	5,924	6,318	6,725	6,852
7. 2016	XXX	XXX	XXX	XXX	XXX	3,575	6,575	7,116	7,383	7,688
8. 2017	XXX	XXX	XXX	XXX	XXX	XXX	3,615	5,965	6,966	7,283
9. 2018	XXX	XXX	XXX	XXX	XXX	XXX	XXX	3,848	6,587	7,506
10. 2019	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	3,695	7,096
11. 2020	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	2,476

This table provides an example from the 2020 annual statement of Island Insurance Company, Ltd. for the private passenger auto liability business line. Panel A presents Part 2 of Schedule P, and Panel B presents Part 3.