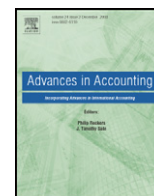




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Are inter-segment revenues informative about future performance?



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ABSTRACT

This study investigates the degree to which a specific component of segmental disclosure, intersegment transactions, informs future segment-level and firm-level profitability. By using segment data reported under the FAS No. 131 regime, we find a positive association between intersegment revenues and one-year-ahead segment operating profits; this association is weakened by agency costs but not proprietary costs. We also find that the aggregate intersegment revenue reported by a firm is positively associated with future firm-level earnings. However, analysts seem to underreact to information in aggregate intersegment revenue.

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1. Introduction

This study investigates the degree to which a specific component of segmental disclosure, intersegment transactions, informs future segment-level and firm-level profitability. Segmental disclosure is considered by regulators and investors to be one of the central issues in financial reporting (Association for Investment and Management Research, 1993; Chasan, 2013; PricewaterhouseCoopers, 2007). Adequate segmental information enables users of financial statements to comprehend the different types of economic environments and business activities in which a firm engages and to evaluate the firm's overall performance. This study examines whether the intersegment revenue reported by a segment predicts the reporting segment's future earnings and whether *aggregate* firm-level intersegment revenue predicts the future earnings of the firm. We conduct our study in the context of the current segment reporting standard SFAS No. 131, Disclosures about Segments on Enterprise and Related Information (hereafter referred to as FAS 131).

We argue that intersegment revenues are related to future segment-level earnings because intersegment transactions usually involve transfers of inventory, which are recurring events. Although intersegment

profit/loss, a component of segment earnings, is not disclosed, each segment is required to disclose the revenues from intersegment transactions.³ Based on the assumptions that the profit margin on intersegment transactions is positive and remains relatively stable, we expect that intersegment revenues are positively associated with future segment-level earnings.

The informativeness of intersegment revenues may vary with the disclosure costs faced by management. Harris (1998), Piotroski (2003), and Botosan and Stanford (2005) provide consistent evidence that the quality of segment reporting is constrained by proprietary costs. Meanwhile, Bennis and Monahan (2004) and Berger and Hann (2007) suggest that managers face potential costs from segment reporting that reveal underperformance associated with the agency problem. Proprietary costs and agency costs may influence the informativeness of disclosed intersegment revenues because top managers may manipulate transfer pricing to achieve cross-subsidization (Chang & Hong, 2000). Therefore, we expect the degree to which intersegment revenues inform future earnings to decrease in proprietary costs and agency costs.

At the firm level, we expect aggregate intersegment revenue to be positively related to future firm-level earnings. Intersegment transactions involve products transferred (or services performed) from (by) an upstream segment to a downstream segment to fulfill internal demand. From top management's point of view, such transactions are a milestone toward the completion of the value creation process. From an accounting perspective, the earnings component of intersegment revenues will not be recognized in consolidated earnings until the

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³ Under FAS 13, each segment has to disclose revenue, but not profit/loss, from intersegment transactions.

value creation process is complete (i.e., the final products are sold to third parties). Therefore, if value creation in the downstream segment takes place in a year after the intersegment transaction, there will be a positive correlation between the amount of intersegment revenue recorded by the upstream segment in one year and the earnings recorded by the downstream segment in the subsequent year. Overall, we predict that total firm-level intersegment revenue positively predicts future firm-level earnings.

We test our predictions by using segment data obtained from the Compustat Segment File from 1999 to 2012.⁴ We find a positive association between intersegment revenues and one-year-ahead segment operating profits. When examining how proprietary costs and agency costs affect the degree to which intersegment revenues inform future segment-level earnings, we assume that segments with high abnormal profit relative to industry peers have high proprietary costs (e.g., [Bens, Berger, & Monahan, 2011](#)) and segments with low abnormal profit relative to industry peers have high agency costs ([Berger & Hann, 2007](#)). We find that the informativeness of intersegment revenues decreases in agency costs. However, we find no evidence about proprietary costs affecting the informativeness of intersegment revenues.

We also find that the aggregate intersegment revenue reported by a firm is positively associated with future firm-level earnings, suggesting that intensive intersegment transactions are indicative of future value creation. Overall, our results provide support for FAS 131 in that the mandated disclosure of intersegment transactions may benefit financial statement users when assessing the financial prospects of a segment or a firm.

Our final investigation examines whether financial analysts' earnings forecasts incorporate information on current aggregate intersegment revenue. Specifically, we investigate whether analyst forecast error is systematically correlated with aggregate intersegment revenue. We find an inverse relationship between the two, suggesting that analysts generally underreact to information in aggregate intersegment revenue.

Our study contributes to the literature in several ways. First, this is the first study to document the degree to which intersegment revenue informs future segment earnings. We also show that the informativeness of intersegment revenue might be influenced by disclosure costs. A number of studies of segmental disclosure document that managers' discretionary reporting behavior is influenced by agency costs and proprietary costs ([Alfonso, Hollie, & Yu, 2010](#); [Bens et al., 2011](#); [Berger & Hann, 2007](#); [Botosan & Stanford, 2005](#); [Ettredge, Kwon, Smith, & Stone, 2006](#); [Wang & Ettredge, 2014](#)). However, no evidence has directly linked agency costs and proprietary costs to the informativeness of segment information. We provide evidence that agency costs reduce the degree to which intersegment revenues inform future segment earnings, but show that proprietary costs do not.

Second, we also document that aggregate intersegment revenue informs future firm-level earnings. Most research on the current segment disclosure practice focuses on comparisons between the information environments under FAS 14 and FAS 131 (e.g., [Berger & Hann, 2003, 2007](#); [Botosan, McMahon, & Stanford, 2011](#); [Botosan & Stanford, 2005](#)). To our knowledge, the only studies that focus on the degree to which segment disclosure informs future earnings under the FAS 131 reporting regime are [Hollie and Yu \(2012\)](#) and [Wang and Ettredge \(2014\)](#). They find that the "gap" between aggregate segment-level earnings and firm-level earnings is positively associated with future earnings.⁵ However, the gap between these two earnings contains various components. These studies fail to specify which component of

the gap informs future earnings, mainly because separating out these components is difficult.⁶ Our study thus adds to this body of research by focusing on one component of the gap that has clear disclosure requirements, namely, intersegment revenues. The positive relationship we find between aggregate intersegment revenues and future firm-level earnings may partially explain the findings presented in [Hollie and Yu \(2012\)](#) and [Wang and Ettredge \(2014\)](#).

Finally, our research has implications for the literature on financial analysts' earnings forecasts. Financial analysts' forecasts typically adopt a "sum-of-the-parts" approach (i.e., estimating the earnings of individual segments and aggregating these estimates across segments). Our finding on analysts' underreactions to information on intersegment revenues suggests that they might be able to improve their forecast performance by incorporating intersegment revenues.

The rest of the paper is organized as follows. [Section 2](#) reviews the background of FAS 131. [Section 3](#) discusses the related literature and develops testable hypotheses. [Section 4](#) describes the research design and outlines the sample selection procedure. [Sections 5 and 6](#) present the empirical findings. [Section 7](#) concludes.

2. Background

FAS 131, which became effective from the fiscal year beginning December 15, 1997, superseded FAS 14, which had come under severe criticism from various user groups. Perhaps most importantly, the CFA Institute (formerly the Association for Investment Management and Research or AIMR) issued a position paper in 1993 requesting that financial statement information be disaggregated to a much greater degree and more information be provided at the segment level ([AIMR, 1993](#)). Similarly, the [American Institute of Certified Public Accountants \(1994\)](#) listed improved segment information as its number one recommendation.

Under FAS 14, firms were required to disclose segment information by both line-of-business and geographic area with no specific link to the internal organization of the company. FAS 131 fundamentally changed the manner in which firms provide segment information. The standard requires companies to report disaggregated information about reportable operating segments based on management's organization of the enterprise (the "management approach").⁷ Under FAS 131, operating segments may be based on products and services, geographic location, legal entity, customer type, or other basis.

FAS 131 requires that, for each operating segment, firms provide information about segment profit or loss, certain revenue and expense items, and assets. Among all the information required to be presented, "revenues from external customers" and "revenues from transactions with other operating segments of the same enterprise" should be separately disclosed.⁸ Together with segment information, an enterprise must also provide reconciliations of a) the total of the reportable

⁶ [Wang and Ettredge \(2014\)](#) provide the following explanation for not decomposing the gap: "Under FAS 131, companies provide reconciliation schedules that indicate the items included in corporate income that have not been allocated to its segments. ... We choose not to derive our proxies for income items that are difficult to allocate from these schedules. One reason for this decision is that reading and interpreting thousands of such schedules requires too much effort relative to the benefit. The benefit is low because the schedules are not very comparable across companies due, for example, to differences in terminology. In addition, the result of such an exercise would be descriptive in nature. We prefer to investigate the explanatory power of variables chosen on an ex ante basis."

⁷ An operating segment is defined as a component of an enterprise (1) that engages in business activities from which it may earn revenues and incur expenses, (2) whose operating results are regularly reviewed by the enterprise's chief operating decision maker, and (3) for which discrete financial information is available (FAS 131, paragraph 10).

⁸ If the specific amounts about the following items are included in the segment profit/loss reviewed by the chief operating decision maker, they should also be disclosed: interest revenue, interest expense, depreciation, depletion, and amortization expense, unusual items as described in paragraph 26 of APB Opinion No. 30, equity in the net income of investees accounted for by the equity method, income tax expense or benefit, and extraordinary items and significant noncash items other than depreciation, depletion, and amortization expense.

⁴ The sample period begins from 1999 because FAS 131 became effective in 1997 and our research design requires three consecutive years of segment data.

⁵ Segment reconciliation occurs because FAS 131 requires that firms report segment financial information consistent with how the business is managed internally (a.k.a. the management approach). As the management approach may lead to reported segment-level earnings measures that differ from GAAP earnings measures, segment-level data in financial reports may not necessarily equate with the consolidated financial information provided at the firm level.

segments' revenues to the enterprise's consolidated revenues, b) the total of the reportable segments' measures of profit or loss to the enterprise's consolidated income before income taxes, extraordinary items, discontinued operations, and the cumulative effect of changes in accounting principles, c) the total of the reportable segments' assets to the enterprise's consolidated assets, and d) the total of the reportable segments' amounts for every other significant item of information disclosed to the corresponding consolidated amount. [Appendix 1](#) displays the suggested format for presenting segment information and segment–firm reconciliations. Regarding the measurement of intersegment revenues, the guideline requires that diversified companies must account for “intersegment sales and transfers as if the sales or transfers were to third parties, that is, at current market prices.”

3. Related literature and hypothesis development

3.1. Informativeness of segment disclosure under FAS 131

Among the numerous studies that examine the quality of firms' segment reporting under the FAS 131 regime, the majority compare the information environments before and after the introduction of FAS 131. For example, [Street, Nichols, and Gray \(2000\)](#) and [Berger and Hann \(2003\)](#) document that a significant portion of firms in their sample that claimed single-segment status under FAS 14 initiated segment disclosure under FAS 131. [Herrmann and Thomas \(2000\)](#) examine segment disclosure by the largest of the Fortune 500 firms following the advent of FAS 131 and find increased consistency between segment disclosure and the rest of the annual report. [Ettredge et al. \(2006\)](#) find that compared with a control sample from the FAS 14 regime, the sample from the FAS 131 regime exhibits the greater cross-segment variability of segment profits and a stronger association between reported variability and capital market incentives to disclose. Finally, [Venkataraman \(2001\)](#) uses a model to estimate the precision of public and private information and finds that the precision of public information and overall precision of information increased for firms that changed the number of segments they disclosed post-FAS 131. All the above studies draw their inferences based on segment disclosure by firms during their periods of transition from FAS 14 to FAS 131. Although it is not our goal to compare the information environment under these two segment reporting regimes, the conclusions drawn by prior works on improved segment reporting provide a certain level of assurance about the credibility of segment information reported under the FAS 131 regime.

Existing studies investigating the degree to which segment reporting informs profitability under the FAS 131 regime include [Hollie and Yu \(2012\)](#) and [Wang and Ettredge \(2014\)](#). The former authors investigate whether segment reconciliation differences inform firms' future performance and whether abnormal returns can be earned based on the gap between firm-level earnings and aggregate segment earnings. A negative (positive) gap exists when corporate earnings are smaller (larger) than aggregated segment earnings. In particular, they find that firms that report a negative gap have greater sales and profitability, greater return on equity, as well as more operating cash flow and firm growth. In addition, they find evidence of mispricing in positive gap firms but not in negative gap firms.

[Wang and Ettredge \(2014\)](#) examine why gaps exist and investigate their effects on the usefulness of segment earnings for investors. They find evidence that companies facing powerful same-industry competitors and those expanding operations inefficiently are likely to exhibit higher gaps. Thus, the existence and signs of gaps seem to reflect both sensible internal reporting decisions and efforts to obscure differences in profitability across segments, consistent with agency cost theory and proprietary cost theory. They also find that such a gap provides useful information to investors, contingent on its signs, and that summed segment earnings are more persistent and informative than corporate earnings when there are negative

gaps, while corporate earnings are more persistent and informative when there are positive gaps.

In summary, these studies suggest that segment disclosure under the FAS 131 regime may improve the ability of financial statement users to assess a firm's performance. Most of these studies, however, focus on segment earnings or the gap between segment earnings and firm earnings. None examines the informativeness of specific earnings components.

3.2. How intersegment transactions inform future segment profitability

One specific requirement in FAS 131 is that firms need to report the intersegment revenue for each reportable segment separately from external revenue. From the point of view of financial statement users, as intersegment revenue is a component of the total revenue reported by a segment, this should be important for assessing a segment's future performance. We predict that intersegment revenue is positively related to future segment-level earnings because intersegment transactions are inventory transfers, which tend to be persistent over time. Our prediction is also based on the assumption that the transfer price allows the selling segment to earn a positive profit margin. Conversely, if intersegment revenues are mostly transitory or if the profit margin on intersegment transactions is negative to cross-subsidize the buying segment, the predicted relationship will not hold. Therefore, we hypothesize that (in the alternative form):

H1. *The level of intersegment revenue is positively correlated with future segment-level earnings.*

3.3. Disclosure costs that may affect the credibility of segment information

According to the literature, managers may withhold or obscure segment disclosure in order to avoid the costs associated with disclosure. One such type is proprietary costs. [Hayes and Lundholm \(1996\)](#) and [Nagarajan and Sridhar \(1996\)](#) analytically demonstrate that although the accurate and clear disclosure of segmental information helps investors better value the company, it also helps competitors gain insight into profitable opportunities being exploited by the company. Consequently, the company may choose accounting methods that mask segmental information. [Ettredge, Kwon, and Smith \(2002\)](#) report that 86% of the firms that commented on the Exposure Draft for FAS 131 opposed the standard on the grounds that “it would reveal proprietary information and ... put them at competitive disadvantage.” Similarly, [Harris \(1998\)](#), [Piotroski \(2003\)](#), and [Botosan and Stanford \(2005\)](#) all provide consistent evidence that the quality of segment reporting is constrained by proprietary costs. Specifically, their results indicate that the managers of firms forced to initiate segment disclosure under FAS 131 withheld segment information under FAS 14 to protect profits in less competitive industries.

Another type of costs associated with segment disclosure is agency costs. Prior studies provide evidence that multi-segment firms trade at a discount relative to standalone firms (see, for example, [Lang & Stulz, 1994](#); [Berger & Ofek, 1995](#)) and that such a diversification discount is associated with measures of the agency problem ([Denis, Denis, & Sarin, 1997](#)). Related to segment disclosure, [Berger and Hann \(2003\)](#) document that firms that later restate from single-segment under FAS 14 to multi-segment status under FAS 131 had small diversification discounts before the introduction of FAS 131. In the post-FAS 131 adoption period, the discount for those firms increased to exceed slightly the average discount of the firms that reported multi-segment status under FAS 14.

[Berger and Hann \(2007\)](#) hypothesize that managers face agency costs of segment disclosure if the revelation of a segment that earns low abnormal profits reveals unresolved agency problems, which ultimately leads to heightened external monitoring. Consistent with their

hypothesis, they find that managers tend to withhold segments with relatively low abnormal segment profits when the agency cost motive prevails. In addition, Bens et al. (2011) examine discretionary segment disclosure by comparing confidential internal firm data with externally reported segment data. Their results show that a segment is more likely to be aggregated when both the agency and the proprietary costs of separately reporting the segment are higher. Moreover, for firms reporting multiple external segments, the aggregation of segments is driven by both agency and proprietary costs. However, for firms reporting a single external segment, proprietary costs related to private competition seem to be the key motive for nondisclosure.

Taken together, prior studies suggest that managers are motivated by proprietary costs and agency costs to strategically disclose segment information. As the implementation of the management approach under FAS 131 may provide management with significant latitude to measure intersegment revenues (Albrecht & Chipalkatti, 1998), we expect the degree to which intersegment revenues inform future segment-level earnings to decrease disclosure costs. Specifically, we hypothesize that (in the alternative form):

H2a. *The degree to which intersegment revenues inform future segment-level profitability decreases with proprietary costs.*

H2b. *The degree to which intersegment revenues inform future segment-level profitability decreases with agency costs.*

3.4. How aggregate intersegment revenue informs future firm profitability

As mentioned earlier, Hollie and Yu (2012) and Wang and Ettredge (2014) provide evidence that the gap between firm-level earnings and aggregate segment earnings informs future earnings. However, the gap between these two earnings contains various components including profits and losses from intersegment transactions and unreported segments, but excludes nonrecurring gains and losses from segment earnings. Consequently, it remains unclear which component of the gap informs future earnings. We attempt to add some evidence to that presented by Hollie and Yu (2012) and Wang and Ettredge (2014) by examining whether intersegment transactions are associated with a firm's future profitability. As mentioned in the previous section, FAS 131 was developed primarily to enable external users to view companies "through the eyes of management" by requiring firms to report segment-level financial information consistent with how the business is managed internally. Therefore, the management approach may lead to differences between reported segment-level earnings and GAAP earnings measures. One difference is that while the profits/losses from intersegment transactions are included in reported segment-level earnings, they are excluded from GAAP. Consequently, our study may shed light on the informativeness of the previously reported gap.

At the firm level, as noted in the Introduction, we also expect aggregate intersegment revenue to be positively related to future firm-level earnings. To elaborate on our conjecture, we consider a manufacturing firm with two segments: Segment A and Segment B. Segment A is the upstream segment and Segment B is the downstream segment. In year 1, Segment A sells n units to Segment B. The cost of the product is $\$x$ per unit and the selling price is $\$y$ per unit. In year 2, Segment B sells n units of inventory to a third party at $\$z$ per unit and records total external sales of $\$(z*n)$. On its consolidated financial statements, in year 1, the firm records an elimination item of intersegment revenues of $\$(y*n)$ and total revenue of $\$0$; in year $t + 1$, the firm records total revenue of $\$(z*n)$ and total gross profit of $\$(z*n - x*n)$. Based on this example, we can see that as long as z is greater than x , total firm-level gross profit in year 2 increases intersegment revenues in year 1. We thus make the following hypothesis:

H3. *Aggregate intersegment revenue is positively correlated with future firm-level earnings.*

4. Research design and sample selection

4.1. Research design

4.1.1. Testing of H1

We test H1 by examining whether intersegment revenues are associated with future segment earnings. We estimate an OLS regression model containing intersegment revenues along with a set of segment-level and firm-level variables designed to control for other factors that may be associated with segment earnings. The regression model is specified as follows⁹:

$$\begin{aligned} EARN_{Segment, t+1} &= \beta_0 + \beta_1 \times INTREV_{Segment, t} + \beta_2 \times EXTREV_{Segment, t} \\ &+ \beta_3 \times EXP_{Segment, t} + \beta_4 \times CHGSAL_{Segment, t} + \beta_5 \\ &\times SIZE_{Segment, t} + \beta_6 \times BTM_t + \beta_7 \times CHGSAL_t + \beta_8 \times LEV_t \\ &+ \beta_9 \times MA\&REST_t + \beta_{10} \times SIZE_t \end{aligned} \quad (1)$$

where:

$EARN_{Segment, t+1}$ Segment-level earnings, defined as operating profit in year $t + 1$ (Compustat segment item: **OPS**) divided by segment assets at the end of year t (Compustat segment item: **IAS**).

$INTREV_{Segment, t}$ Intersegment revenue, defined as intersegment revenue in year t (Compustat segment item: **INTSEG**) divided by segment assets at the end of year $t - 1$ (Compustat segment item: **IAS**).

$EXTREV_{Segment, t}$ External segment-level revenue in year t , defined as external revenue (Compustat segment item: **SALES**) divided by segment assets at the end of year $t - 1$ (Compustat segment item: **IAS**).

$EXP_{Segment, t}$ Segment total expense, calculated as segment total revenue in year t minus segment earnings (Compustat segment item: **SALES + INTSEG - OPS**), scaled by segment assets at the end of year $t - 1$ (Compustat segment item: **IAS**).

$CHGSAL_{Segment, t}$ Change in external segment-level revenue, calculated as the natural logarithm of the ratio of current to prior year external segment-level revenue (Compustat segment item: **SALES**).

$SIZE_{Segment, t}$ Segment-level assets, defined as the natural logarithm of segment assets (Compustat segment item: **IAS**).

BTM_t Book-to-market ratio, defined as the book value of equity over the market value of common equity (Compustat annual item: **(PRCC_F * CSHO) / CEQ**)

$CHGSAL_t$ Change in external revenue, calculated as the natural logarithm of the ratio of current to prior year corporate level external revenue (Compustat annual item: **SALE**).

LEV_t Financial leverage, defined as the long-term debt over the book value of equity (Compustat annual item: **DLTT / CEQ**).

$MA\&REST_t$ Merger & acquisition and corporate restructure indicator, defined as an indicator that equals 1 if the absolute value of merger and acquisition costs (Compustat annual item: **AQP**) or restructuring charges (Compustat annual item: **RCP**) is greater than one million dollars, and 0 otherwise.

$SIZE_t$ Corporation-level assets, defined as the natural logarithm of firm assets (Compustat annual item: **AT**).

$EARN_{segment, t+1}$ is segment-level earnings in year $t + 1$ and $INTREV_{segment, t}$ is intersegment revenues in year t . Prior research suggests that firm revenues are the most important predictor of future earnings. As we would expect intersegment revenues to have a similar effect as external revenues under the assumption that intersegment

⁹ A complete list of the variable definitions also appears in Appendix 2.

revenues are accounted for at the current market price, we expect the coefficient of $INTREV_{segment, t}$ to be positive (i.e., $\beta_1 > 0$).

We include a set of control variables based on prior studies that examine the informativeness of segment disclosure. We control for external segment-level revenues ($EXTREV_{segment, t}$) as an independent variable and expect it to be positively associated with future segment-level earnings. Segment-level expense ($EXP_{segment, t}$) represents the total resources sacrificed in order to generate revenues and, consequently, this is expected to be negatively associated with future segment-level earnings. We control for the change in segment-level and firm-level sales revenues ($CHGSAL_{segment, t}$ and $CHGSAL_t$). As the past growth trend may continue or reverse, we make no prediction on the signs of $CHGSAL_{segment, t}$ or $CHGSAL_t$. We also control for merger, acquisition, and restructuring events ($MA&REST_t$) as possible organizational reconfigurations that may affect future earnings (e.g., Brickley & Drunen, 1990; John, Lang, & Netter, 1992). Since prior studies show mixed evidence on the effect of organizational reconfigurations on future earnings, we refrain from making a prediction on the sign of $MA&REST_t$. $SIZE_t$ and LEV_t represent the possible financial resources available to a segment and financial constraints faced by a segment, respectively. Economic theory suggests that greater financial resources and constraints play key roles in achieving economies of scale and, in turn, profits. Thus, we expect the coefficient of $SIZE_t$ to be positive and that of LEV_t to be negative. Finally, we include BTM_t as a control variable based on prior inconclusive evidence (Penman, 1996) that the book-to-market ratio is associated with growth opportunity and expect the coefficient to be negative.

4.1.2. Testing of H2

Prior research suggests that management faces proprietary costs when disclosing profitable segment performance, as this may attract competition (Berger & Ofek, 1995; Lang & Stulz, 1994). Management also faces agency costs when revealing poor segment performance, as this may heighten stakeholder scrutiny (Berger & Hann, 2003). Consistent with both streams of literature, we measure proprietary costs and agency costs based on a segment's performance relative to its industry peers. Specifically, we construct a dummy variable ($REP_{High, t}$) to capture high proprietary costs. $REP_{High} = 1$ if a segment's return on assets (ROA) is in the top quintile of the ROA distribution among the segment's industry peers. Similarly, we use a dummy variable ($REP_{Low, t}$) to capture high agency costs. $REP_{Low} = 1$ if a segment's ROA is in the bottom quintile of the ROA distribution among the segment's industry peers. We then test the effects of proprietary costs and agency costs on the degree to which intersegment revenues inform future segment-level earnings by examining how $REP_{High, t}$ and $REP_{Low, t}$ interact with intersegment revenues to predict future segment-level earnings. The regression model is specified as follows:

$$EARN_{Segment, t+1} = \beta_0 + \beta_{1a} \times INTREV_{Segment, t} + \beta_{1b} \times REP_{High, t} + \beta_{1c} \times REP_{Low, t} + \beta_{1d} \times REP_{High, t} \times INTREV_{Segment, t} + \beta_{1e} \times REP_{Low, t} \times INTREV_{Segment, t} + \beta_2 \times EXTREV_{Segment, t} + \beta_3 \times EXP_{Segment, t} + \beta_4 \times CHGSAL_{Segment, t} + \beta_5 \times SIZE_{Segment, t} + \beta_6 \times BTM_t + \beta_7 \times CHGSAL_t + \beta_8 \times LEV_t + \beta_9 \times MA&REST_t + \beta_{10} \times SIZE_t \tag{2}$$

where:

$REP_{High, t}$ High segment operation performance relative to its industry peers, defined as an indicator that equals 1 if segment-level ROA is greater than the upper quintile of the ROA distribution within the same industry, and 0 otherwise. Segment-level ROA is defined as operating profit in year t (Compustat segment item: **OPS**) divided by segment assets at the end of year $t - 1$ (Compustat segment item: **IAS**). The ROA of

industry peers is calculated as income before extraordinary items in year t (Compustat item: **IB**) divided by total assets at the end of year $t - 1$ (Compustat item: **AT**).

$REP_{Low, t}$ Low segment operation performance relative to its industry peers, defined as an indicator that equals 1 if segment-level ROA is lower than the lower quintile of the ROA distribution within the same industry, and 0 otherwise. Segment-level ROA is defined as operating profit in year t (Compustat segment item: **OPS**) divided by segment assets at the end of year $t - 1$ (Compustat segment item: **IAS**). The ROA of industry peers is calculated as income before extraordinary items in year t (Compustat item: **IB**) divided by total assets at the end of year $t - 1$ (Compustat item: **AT**).

Our main prediction is that high proprietary costs and high agency costs decrease the degree to which intersegment revenues inform future segment-level earnings. Therefore, we expect negative coefficients for $REP_{High, t} \times INTREV_{Segment, t}$ and $REP_{Low, t} \times INTREV_{Segment, t}$.

4.1.3. Testing of H3

To investigate the degree to which aggregate intersegment revenue informs future firm-level earnings, we aggregate intersegment revenues across all segments reported by a firm and scale this by firm-level total assets. We estimate an OLS regression model containing aggregate intersegment revenue along with a set of firm-level variables designed to control for other factors that may be associated with firm-level earnings. The regression model is specified as follows:

$$EARN_{t+1} = \beta_0 + \beta_1 \times INTREV_t + \beta_2 \times EXTREV_t + \beta_3 \times EXP_t + \beta_4 \times CHGSAL_t + \beta_5 \times SIZE_t + \beta_6 \times BTM_t + \beta_7 \times LEV_t + \beta_8 \times MA&REST_t \tag{3}$$

where:

$EARN_{t+1}$ Corporate earnings, defined as pre-tax income in year $t + 1$ (Compustat annual item: **PI**) divided by total assets at the end of year t (Compustat annual item: **AT**).

$INTREV_t$ Aggregate intersegment revenue, defined as the sum of intersegment revenue in year t (Compustat segment item: **INTSEG**) divided by the sum of segment assets at the end of year $t - 1$ (Compustat segment item: **IAS**).

$EXTREV_t$ Aggregate external segment-level revenue, defined as the sum of external revenue in year t (Compustat segment item: **SALES**) divided by the sum of segment assets at the end of year $t - 1$.

EXP_t Aggregate segment total expense, calculated as the sum of segments' revenues in year t minus segment earnings (Compustat segment item: **SALES + INTSEG - OPS**), scaled by the sum of the segments' assets at the end of year $t - 1$ (Compustat segment item: **IAS**).

$EARN_{t+1}$ is firm-level earnings in year $t + 1$ and $INTREV_t$ aggregate intersegment revenue in year t . As stated earlier, intersegment revenues contribute to future firm-level earnings because of the delayed recognition of the earnings from upstream segments. Thus, we predict that the coefficient of $INTREV_t$ is positive (i.e., $\beta_1 > 0$).

In Eq. (3) we include external revenues ($EXTREV_t$) because sales revenue is the most persistent predictor of future earnings; we expect the coefficient of $EXTREV_t$ to be positive. EXP_t represents firm-level expense and this is expected to be negatively associated with future firm-level earnings. As in Eq. (1), we control for the change in firm-level external sales revenues ($CHGSAL_t$) and merger, acquisition, and restructuring events ($MA&REST_t$) as organizational reconfigurations may inform future earnings. We make no prediction on the sign of $CHGSAL_t$ and $MA&REST_t$. $SIZE_t$ represents the financial resources

available and this is expected to be positively correlated with future earnings. LEV_t represents the constraint on the use of financial resources and this is expected to be negatively associated with future firm-level earnings. Finally, we include BTM_t to control for growth opportunity and expect the coefficient to be negative.

4.2. Sample selection

The sample selection process, summarized in Panel A of Table 1, begins with all operating segment observations in the Compustat Segment File over the period from 1998 to 2011. The sample period starts from fiscal year 1998 because FAS 131 became effective in 1997 and our research design requires two consecutive years of segment information to calculate sales growth. We eliminate segment-year observations that do not have clear business functions (i.e., “corporate”, “adjustment(s)”, “elimination(s)”, and “other(s)”). We also eliminate segment-year observations with non-positive intersegment revenue, with missing one-year-ahead operating profit, or with lagged segment assets lower than one million dollars. We then eliminate segment-year observations if the corresponding firm does not have I/B/E/S analysts’ forecasts for the next fiscal year’s earnings. Finally, we eliminate observations lacking sufficient data for the computation of the variables used in our regressions. The final sample consists of 6103 segment-year observations, namely 2801 firm-year observations for 601 firms. We winsorize each of the continuous variables at the 1st and 99th percentiles to minimize the effects of outliers. Panel B in Table 1 reports the sample distribution by year.

5. Empirical findings

Table 2 summarizes the descriptive statistics for the segment-level and firm-level variables. At the segment level, the average (median) level of segment earnings, scaled on segment assets, is 0.146 (0.100). The average (median) level of scaled intersegment revenue is 0.343 (0.098), while the average (median) level of scaled external revenue is 1.534 (0.990). On average, the magnitude of the intersegment revenue reported by a segment is about one-fifth of that of external revenue. The average (median) level of segment expense is 1.695 (1.048). Segment revenue grows at an average rate of 0.101. The average segment size (in total assets) is 6.81 million.

According to Panel B in Table 2, the firms included in the sample are overall profitable, with an average (median) firm-level pre-tax income (scaled on firm-level assets) of 0.077 (0.068). Average firm-level aggregate intersegment revenue (scaled) is about 0.249 and average firm-level external revenue (scaled) is about 1.332. The magnitude of aggregate intersegment revenue is still substantial compared with that of firm-level external revenue. Sample firms have an average growth rate of 0.087 and average firm-level total assets of 7.895 million. The average book-to-market ratio is 0.625 and average leverage is 0.781; about 28% of sample firms have merger, acquisition, or restructuring events during the year. The average analyst forecast error is -0.021 , suggesting that analysts are generally pessimistic.

Panels A and B in Table 3 report the Pearson correlations between the segment-level and firm-level variables. At the segment level, $INTREV_{segment}$ and $EXTREV_{segment}$ are highly positively correlated and

Table 1
Sample selection and sample distribution.

Panel A. Sample selection			
Sample selection procedure	Segment-year observations	Firm-year observations	Distinct firm observations
Initial sample: All operational segment observations with non-positive intersegment revenues covered in the Compustat Segment file over the period 1998 to 2011.	27,578	9398	1686
Exclude: Segment-year observations that don't have clear business functions (i.e., “corporate”, “adjustment(s)”, “elimination(s)”, and “other(s)”).	(586)	(250)	(60)
Exclude: Segment-year observations with missing next fiscal year operating profit, or lagged identifiable assets lower than one million dollars.	(10,322)	(2936)	(453)
Exclude: Segment-year observations of the firms without I/B/E/S analysts' forecasts of next fiscal year earnings.	(8246)	(2405)	(411)
Exclude: Segment-year observations lacking sufficient data for the computation of the variables used in our regressions.	(2321)	(1006)	(161)
Final sample	6103	2801	601
Panel B. Sample distribution by year			
Year	Segment-year observations	Firm-year observations	
1998	308	165	
1999	426	213	
2000	494	222	
2001	525	238	
2002	528	230	
2003	477	220	
2004	482	216	
2005	537	227	
2006	500	228	
2007	451	218	
2008	471	220	
2009	431	199	
2010	459	201	
2011	14	4	
All Years	6103	2801	

Note to Table 1: Table 1 Panel A summarizes the sample selection process, which begins with all operational segment observations in the Compustat Segment file over the period from 1998 to 2011. The choice of sample period is due to FAS 131 which became effective in 1997 and our research design requires two consecutive years of segment data and one-year ahead financial analysts' earnings forecasts. We eliminate segment-year observations that don't have clear business functions (i.e., “corporate”, “adjustment (s)”, “elimination(s)”, and “other(s)”). We eliminate segment-year observations with non-positive inter-segment revenue, missing next year operating profit, or lagged segment assets lower than one million dollars. We then eliminate segment-year observations of the firms without I/B/E/S analysts' forecasts of next fiscal year earnings. Finally, we eliminate observations lacking sufficient data for the computation of the variables used in our regressions. The final sample consists of 6103 segment-year observations, 2801 firm-year observations for 601 firms. Panel B reports the sample distribution by year.

Table 2
Summary statistics.

Variables	Mean	p25	p50	p75	Std. dev.
<i>Panel A. Segment level variables</i>					
$EARN_{Segment, t+1}$	0.1460	0.0305	0.1002	0.1984	0.2508
$INTREV_{Segment, t}$	0.3437	0.0340	0.0981	0.2991	0.7978
$EXTREV_{Segment, t}$	1.5346	0.4971	0.9901	1.7078	2.0734
$EXP_{Segment, t}$	1.6954	0.5318	1.0489	1.8412	2.4709
$CHGSAL_{Segment, t}$	0.1010	-0.0395	0.0713	0.2013	0.5756
$SIZE_{Segment, t}$	6.8108	5.3729	6.8373	8.3264	2.0806
<i>Panel B. Firm level variables</i>					
$EARN_{t+1}$	0.0765	0.0266	0.0685	0.1295	0.1004
$INTREV_t$	0.2497	0.0414	0.1077	0.2654	0.3916
$EXTREV_t$	1.3320	0.5515	0.9780	1.5814	1.3735
EXP_t	1.4079	0.5547	0.9918	1.7063	1.5206
$CHGSAL_t$	0.0871	-0.0165	0.0757	0.1834	0.2153
$SIZE_t$	7.8596	6.5099	7.7229	9.2147	1.9912
FE_{t+1}	-0.0205	-0.0515	-0.0225	0.0021	0.0692
BTM_t	0.6252	0.3251	0.5127	0.7653	0.5176
LEV_t	0.7816	0.2316	0.5431	1.0246	1.3466
$MA&REST_t$	0.2812	0.0000	0.0000	1.0000	0.4497

Note to Table 2: Table 2 Panel A (Panel B) presents summary statistics for the segment level variables (Corporate level variables) used in the later regression analyses. Variables are defined as follows: $EARN_{Segment, t+1}$ = Segment level earnings. $INTREV_{Segment, t}$ = Intersegment revenue. $EXTREV_{Segment, t}$ = Segment external revenue. $EXP_{Segment, t}$ = Segment total expense. $CHGSAL_{Segment, t}$ = Change in segment external revenue. $SIZE_{Segment, t}$ = Segment level assets. $EARN_{t+1}$ = Corporate level earnings. $INTREV_t$ = Aggregate intersegment revenue. $EXTREV_t$ = Aggregate segment external revenue. EXP_t = Aggregate segment total expense. $CHGSAL_t$ = Change in external revenue. $SIZE_t$ = Corporate level assets. FE_{t+1} = Analyst forecast error. BTM_t = Book-to-market ratio. LEV_t = Financial leverage. $MA&REST_t$ = Merger & acquisition and corporate restructure indicator. See Appendix for detailed variable definitions. All continuous variables are winsorized at the 1st and 99th percentiles.

both are positively correlated with one-year-ahead segment earnings ($EARN_{Segment, t+1}$). Segment expense ($EXP_{segment}$) is also positively correlated with one-year-ahead segment earnings ($EARN_{Segment, t+1}$). However, without controlling for other factors, we cannot draw any conclusions from the observed correlations. In addition, we find that consistent with our predictions, book-to-market firms and leverage are associated with lower segment earnings.

The correlations in Panel B largely mirror the results in Panel A. At the firm level, $INTREV$ and $EXTREV$ are highly positively correlated with each other. Further, both are positively correlated with one-year-ahead firm earnings ($EARN_{t+1}$). In addition, book-to-market ratio and leverage are negatively correlated with $EARN_{t+1}$. Merger, acquisition, and restructuring events negatively predict $EARN_{t+1}$. We also find that analyst forecast errors are negatively correlated with both firm-level external revenue ($EXTREV_t$) and firm-level intersegment revenue ($INTREV_t$).

Table 4 reports the regression results for Eq. (1), the segment-level test. The dependent variable is $EARN_{Segment, t+1}$, namely one-year-ahead segment earnings. As expected, we find that the coefficient of $INTREV_{Segment}$ is positive and significant, as is the coefficient of $EXTREV_{Segment}$. Moreover, based on visual inspection, there is no significant difference between the two coefficients, which suggests that intersegment revenues are as informative as external revenues about future segment-level earnings. The coefficient of segment expense ($EXP_{Segment}$) is negative, suggesting that segment expense tends to be persistent. We also find that segment-level sales growth is negatively correlated with one-year-ahead segment earnings, possibly suggesting that segment-level sales growth tends to reverse. Segment total assets ($SIZE_{Segment}$) are also negatively correlated with $EARN_{Segment, t+1}$.

Table 3
Pearson correlation coefficient.

Panel A. Pearson correlation coefficient among segment level variables and firm level control variables										
	$EARN_{Segment, t+1}$	$INTREV_{Segment, t}$	$EXTREV_{Segment, t}$	$EXP_{Segment, t}$	$CHGSAL_{Segment, t}$	$SIZE_{Segment, t}$	BTM_t	$CHGSAL_t$	LEV_t	$MA&REST_t$
$EARN_{Segment, t+1}$	1.00									
$INTREV_{Segment, t}$	0.19***	1.00								
$EXTREV_{Segment, t}$	0.30***	0.45***	1.00							
$EXP_{Segment, t}$	0.21***	0.67***	0.91***	1.00						
$CHGSAL_{Segment, t}$	0.00	0.25***	0.26***	0.26***	1.00					
$SIZE_{Segment, t}$	-0.16***	-0.13***	-0.16***	-0.17***	0.05***	1.00				
BTM_t	-0.17***	-0.01	-0.04***	-0.02	-0.04***	0.00	1.00			
$CHGSAL_t$	0.01	0.04***	-0.00	0.01	0.04***	-0.04***	-0.11***	1.00		
LEV_t	-0.07***	0.00	-0.05***	-0.03**	-0.03**	0.04***	0.03**	-0.05***	1.00	
$MA&REST_t$	0.02	-0.02*	-0.03**	-0.02*	-0.03**	0.17***	-0.01	-0.14***	0.02*	1.00
$SIZE_t$	0.04***	0.01	-0.01	-0.02	0.02	0.76***	-0.31***	0.02	-0.07***	0.14***
Panel B. Pearson correlation coefficient among corporate level variables										
	$EARN_{t+1}$	$INTREV_t$	$EXTREV_t$	EXP_t	$CHGSAL_t$	$SIZE_t$	FE_{t+1}	BTM_t	LEV_t	
$EARN_{t+1}$	1.00									
$INTREV_t$	0.04**	1.00								
$EXTREV_t$	0.11***	0.42***	1.00							
EXP_t	0.05***	0.61***	0.92***	1.00						
$CHGSAL_t$	0.14***	0.06***	-0.01	-0.00	1.00					
$SIZE_t$	0.25***	-0.04**	-0.12***	-0.12***	0.03*	1.00				
FE_{t+1}	-0.88***	-0.04**	-0.06***	-0.02	-0.06***	-0.22***	1.00			
BTM_t	-0.40***	0.01	-0.04**	-0.00	-0.11***	-0.33***	0.28***	1.00		
LEV_t	-0.16***	0.01	-0.07***	-0.05***	-0.03**	-0.02	0.09***	0.07***	1.00	
$MA&REST_t$	-0.10***	-0.04**	-0.01	-0.01	-0.14***	0.13***	0.06***	-0.01	0.03	

Note to Table 3: Table 3 Panel A (Panel B) presents the Pearson correlation coefficient among the segment level variables (Corporate level variables) used in the later regression analyses. Variables are defined as follows: $EARN_{Segment, t+1}$ = Segment level earnings. $INTREV_{Segment, t}$ = Intersegment revenue. $EXTREV_{Segment, t}$ = Segment external revenue. $EXP_{Segment, t}$ = Segment total expense. $CHGSAL_{Segment, t}$ = Change in segment external revenue. $SIZE_{Segment, t}$ = Segment level assets. $EARN_{t+1}$ = Corporate level earnings. $INTREV_t$ = Aggregate intersegment revenue. $EXTREV_t$ = Aggregate segment external revenue. EXP_t = Aggregate segment total expense. $CHGSAL_t$ = Change in external revenue. $SIZE_t$ = Corporate level assets. FE_{t+1} = Analyst forecast error. BTM_t = Book-to-market ratio. LEV_t = Financial leverage. $MA&REST_t$ = Merger & acquisition and corporate restructure indicator. See Appendix for detailed variable definitions. All continuous variables are winsorized at the 1st and 99th percentiles.

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table 4
Informativeness of intersegment revenues to future segment-level earnings.

Explanatory variable	Dependent variable = $EARN_{Segment, t+1}$
<i>Main variable:</i>	
$INTREV_{Segment, t}$	0.1125***
<i>Control variables—segment level:</i>	
$EXTREV_{Segment, t}$	0.1124***
$EXP_{Segment, t}$	-0.0906***
$CHGSAL_{Segment, t}$	-0.0340***
$SIZE_{Segment, t}$	-0.0343***
<i>Control variables—firm level:</i>	
BTM_t	-0.0399***
$CHGSAL_t$	-0.0045
LEV_t	-0.0043
$MA&REST_t$	0.0136
$SIZE_t$	0.0266***
Intercept	Yes
Year fixed effect	Yes
N	6103
R ²	0.236
Adj. R ²	0.233

Note to Table 4: Table 4 presents the coefficient estimates for the following regression models:

$$\begin{aligned}
 EARN_{Segment, t+1} &= \beta_0 + \beta_1 \times INTREV_{Segment, t} \\
 &+ \beta_2 \times EXTREV_{Segment, t} + \beta_3 \\
 &\times EXP_{Segment, t} + \beta_4 \times CHGSAL_{Segment, t} \\
 &+ \beta_5 \times SIZE_{Segment, t} + \beta_6 \\
 &\times BTM_t + \beta_7 \times CHGSAL_t + \beta_8 \times LEV_t \\
 &+ \beta_9 \times MA&REST_t + \beta_{10} \times SIZE_t
 \end{aligned}$$

We estimate the coefficient in each specification with ordinary least squares. Standard errors in the regression results are corrected for firm-segment clustering effect (firm clustering effect). Variable definitions are as follows: $EARN_{Segment, t+1}$ = Segment level earnings. $INTREV_{Segment, t}$ = Intersegment revenue. $EXTREV_{Segment, t}$ = Segment external revenue. $EXP_{Segment, t}$ = Segment total expense. $CHGSAL_{Segment, t}$ = Change in segment external revenue. $SIZE_{Segment, t}$ = Segment level assets. BTM_t = Book-to-market ratio. $CHGSAL_t$ = Change in external revenue. LEV_t = Financial leverage. $MA&REST_t$ = Merger & acquisition and corporate restructure indicator. $SIZE_t$ = Corporate level assets. See Appendix for detailed variable definitions. All continuous variables are winsorized at the 1st and 99th percentiles.

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

However, this correlation could be mechanical, as $EARN_{Segment, t+1}$ is computed as segment earnings scaled on segment total assets. The firm-level variables that have significant impacts on $EARN_{Segment, t+1}$ are the book-to-market ratio (BTM_t) and firm size ($SIZE_t$). As expected, a high book-to-market ratio is associated with lower segment earnings, while a larger firm size is associated with higher segment earnings.

Table 5 reports the regression results for Eq. (2). The coefficient of $REP_{High, t} \times INTREV_{Segment, t}$ indicates the effect of proprietary costs on the degree to which intersegment revenues inform future segment earnings, while the coefficient of $REP_{Low, t} \times INTREV_{Segment, t}$ indicates the effect of agency costs. We find that the coefficient of $REP_{Low, t} \times INTREV_{Segment, t}$ is negative and significant, consistent with the prediction that agency costs reduce the informativeness of intersegment revenues. However, we fail to find any significant result regarding proprietary costs affecting the informativeness of intersegment revenues. The signs of the other coefficients remain the same as in Eq. (1).

Table 5
Effects of disclosure costs on informativeness of intersegment revenues to future segment-level earnings.

Explanatory variable	Dependent variable = $EARN_{Segment, t+1}$
<i>Main variables:</i>	
$INTREV_{Segment, t}$	0.0953***
$REP_{High, t}$	0.1619***
$REP_{Low, t}$	-0.0937***
$REP_{High, t} \times INTREV_{Segment, t}$	0.0029
$REP_{Low, t} \times INTREV_{Segment, t}$	-0.0408**
<i>Control variables—segment level:</i>	
$EXTREV_{Segment, t}$	0.0827***
$EXP_{Segment, t}$	-0.0676***
$CHGSAL_{Segment, t}$	-0.0402***
$SIZE_{Segment, t}$	-0.0344***
<i>Control variables—firm level:</i>	
BTM_t	-0.0195**
$CHGSAL_t$	-0.0056
LEV_t	-0.0032
$MA&REST_t$	0.0124
$SIZE_t$	0.0266***
Intercept	Yes
Year fixed effect	Yes
N	6103
R ²	0.342
Adj. R ²	0.339

Note to Table 5: Table 5 presents the coefficient estimates for the following regression models:

$$\begin{aligned}
 EARN_{Segment, t+1} &= \beta_0 + \beta_{1a} \times INTREV_{Segment, t} \\
 &+ \beta_{1b} \times REP_{High, t} + \beta_{1c} \times REP_{Low, t} \\
 &+ \beta_{1d} \times REP_{High, t} \times INTREV_{Segment, t} \\
 &+ \beta_{1e} \times REP_{Low, t} \\
 &\times INTREV_{Segment, t} + \beta_2 \times EXTREV_{Segment, t} \\
 &+ \beta_3 \times EXP_{Segment, t} + \beta_4 \\
 &\times CHGSAL_{Segment, t} + \beta_5 \times SIZE_{Segment, t} \\
 &+ \beta_6 \times BTM_t + \beta_7 \times CHGSAL_t \\
 &+ \beta_8 \times LEV_t + \beta_9 \times MA&REST_t + \beta_{10} \times SIZE_t
 \end{aligned}$$

We estimate the coefficient in each specification with ordinary least squares. Standard errors in the regression results are corrected for firm-segment clustering effect (firm clustering effect). Variable definitions are as follows: $EARN_{Segment, t+1}$ = Segment level earnings. $INTREV_{Segment, t}$ = Intersegment revenue. $REP_{High, t}$ = Dummy variable that indicates segment profitability greater than upper quintile of same industry return on assets distribution. $REP_{Low, t}$ = Dummy variable that indicates segment profitability lower than lower quintile of same industry return on assets distribution. $EXTREV_{Segment, t}$ = Segment external revenue. $EXP_{Segment, t}$ = Segment total expense. $CHGSAL_{Segment, t}$ = Change in segment external revenue. $SIZE_{Segment, t}$ = Segment level assets. BTM_t = Book-to-market ratio. $CHGSAL_t$ = Change in external sales. LEV_t = Financial leverage. $MA&REST_t$ = Merger & acquisition and corporate restructure indicator. $SIZE_t$ = Corporate level assets. See Appendix for detailed variable definitions. All continuous variables are winsorized at the 1st and 99th percentiles.

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table 6 reports the regression results for Eq. (3), namely the firm-level regression. H3 predicts a positive correlation between aggregate firm-level intersegment revenue and one-year-ahead firm-level operating profit. Consistent with this prediction, we find the coefficient of $INTREV$ to be positive and significant. The following results are also mostly consistent with our expectations: the coefficient of $EXTREV$

Table 6
The association between aggregate intersegment revenues and future firm-level earnings, and analyst forecast error.

Explanatory variable	Dependent variable =	
	$EARN_{t+1}$	FE_{t+1}
	(1)	(2)
Main variable:		
$INTREV_t$	0.0234**	-0.0196***
Control variables—firm level:		
$EXTREV_t$	0.0282***	-0.0157***
EXP_t	-0.0232***	0.0148***
$CHGSAL_t$	0.0405***	-0.0086
$SIZE_t$	0.0076***	-0.0056***
BTM_t	-0.0580***	0.0280***
LEV_t	-0.0084***	0.0031**
$MA&REST_t$	-0.0285***	0.0150***
Intercept	Yes	Yes
Year fixed effect	Yes	Yes
N	2801	2801
R^2	0.260	0.162
adj. R^2	0.254	0.155

Note to Table 6: Table 6 presents the coefficient estimates for the following regression models:

$$EARN_{t+1} = \beta_0 + \beta_1 \times INTREV_t + \beta_2 \times EXTREV_t + \beta_3 \times EXP_t + \beta_4 \times CHGSAL_t + \beta_5 \times SIZE_t + \beta_6 \times BTM_t + \beta_7 \times LEV_t + \beta_8 \times MA&REST_t$$

$$FE_{t+1} = \beta_0 + \beta_1 \times INTREV_t + \beta_2 \times EXTREV_t + \beta_3 \times EXP_t + \beta_4 \times CHGSAL_t + \beta_5 \times SIZE_t + \beta_6 \times BTM_t + \beta_7 \times LEV_t + \beta_8 \times MA&REST_t$$

We estimate the coefficient in each specification with ordinary least squares. Standard errors in the regression results are corrected for firm clustering effect. Variable definitions are as follows: $EARN_{t+1}$ = Corporate level earnings. FE_{t+1} = Analyst forecast error. $INTREV_t$ = Aggregate intersegment revenue. $EXTREV_t$ = Aggregate segment external revenue. EXP_t = Aggregate segment total expense. $CHGSAL_t$ = Change in external revenue. $SIZE_t$ = Corporate level assets. BTM_t = Book-to-market ratio. LEV_t = Financial leverage. $MA&REST_t$ = Merger & acquisition and corporate restructure indicator. See Appendix for detailed variable definitions. All continuous variables are winsorized at the 1st and 99th percentiles.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

(EXP) is positive (negative), suggesting that firm-level external revenues (expenses) positively (negatively) predict future earnings. In addition, current sales growth and firm size are positively associated with future earnings, while book-to-market, leverage and merger, acquisition, and restructuring events are negatively associated with future earnings.

6. Additional test

In the previous sections, we predicted and showed that aggregate intersegment revenue is positively associated with a firm's future earnings. However, it is unknown whether financial statement users already incorporate information about intersegment revenues when assessing the earnings prospects of a firm. To provide evidence on this, we focus on a group of more sophisticated financial statement users, financial analysts, and examine whether their earnings forecasts

are correlated with intersegment revenues. Specifically, we estimate the following model:

$$FE_{t+1} = \beta_0 + \beta_1 \times INTREV_t + \beta_2 \times EXTREV_t + \beta_3 \times EXP_t + \beta_4 \times CHGSAL_t + \beta_5 \times SIZE_t + \beta_6 \times BTM_t + \beta_7 \times LEV_t + \beta_8 \times MA&REST_t \quad (4)$$

where:

FE_{t+1} : Analyst forecast error, defined as the average of analysts' annual earnings forecasts for the year $t + 1$ minus actual earnings (Compustat annual item: PI), scaled by total assets at the end of year t (Compustat annual item: AT). We obtain analysts' forecasts from the I/B/E/S unadjusted summary (I/B/E/S item: $VALUE \times SHOUT$) published in the quarter immediately after the earnings announcement for year t .

A zero coefficient for $INTREV$ suggests that analysts correctly incorporate information on intersegment revenues; otherwise, a positive (negative) coefficient suggests that analysts overreact (underreact) to intersegment revenues. The second column of Table 6 reports the regression results. We find that the coefficient of $INTREV$ is negative, suggesting that analysts generally underreact to intersegment revenues. The coefficient of external sales ($EXTREV$) is also negative, but that of total expense (EXP) is positive, consistent with the findings of previous studies that have documented that analysts generally underreact to past earnings-related information (Abarbanell, 1991). Overall, our findings suggest that analysts may be able to improve their forecasts by incorporating information about intersegment revenues.

7. Concluding remarks

This study investigated the degree to which a specific component of segmental disclosure, intersegment transactions, informs future segment-level and firm-level profitability in the context of the implementation of FAS 131. At the segment level, we found a positive association between intersegment revenues and one-year-ahead segment operating profits. When examining how proprietary costs and agency costs affect the degree to which intersegment revenues inform future segment-level earnings, we used a segment's abnormal profit relative to industry peers and found that the informativeness of intersegment revenues decreases agency costs, whereas proprietary costs show no effect in this regard.

We also found that the aggregate intersegment revenue reported by a firm is positively associated with future firm-level earnings, suggesting that intensive intersegment transactions are indicative of future value creation. When examining whether financial analysts' earnings forecasts incorporate information on current aggregate intersegment revenue, we showed that analyst forecast error is negatively correlated with aggregate intersegment revenue, suggesting that analysts generally underreact to such revenue.

Overall, our results provide support for FAS 131 in that the mandated disclosure of intersegment transactions may benefit financial statement users when assessing the financial prospects of a segment or firm. Our results also indicate that when using intersegment revenues to assess a segment's future performance, financial statement users should consider the effect of proprietary costs.

Appendix 1. Segment disclosure and segment reconciliation template

The following is an segment disclosure example of a hypothetical firm, Diversified Company, following the suggested format for presenting information about reported segment profit or loss and segment assets (see FASB ASC 280-10-50-22 and 280-10-50-25). The same type

	Auto parts	Motor vessels	Software	Electronics	Finance	All other	Totals
Revenues from external customers	\$ 3000	\$ 5000	\$ 9500	\$ 12,000	\$ 5000	\$ 1000 ^(a)	\$ 35,500
Intersegment revenues	–	–	3000	1500	–	–	4500
Interest revenue	450	800	1000	1500	–	–	3750
Interest expense	350	600	700	1100	–	–	2750
Net interest revenue ^(b)	–	–	–	–	1000	–	1000
Depreciation and amortization	200	100	50	1500	1100	–	2950
Segment profit	200	70	900	2300	500	100	4070
<i>Other significant noncash items:</i>							
Cost in excess of billings on long-term contracts	–	200	–	–	–	–	200
Segments assets	2000	5000	3000	12,000	57,000	2000	8100
Expenditures for segment assets	300	700	500	800	600	–	2900

(a) Revenue from segments below the quantitative thresholds is attributable to four operating segments of Diversified Company. Those segments include a small real estate business, an electronics equipment rental business, a software consulting practice, and a warehouse leasing operation. None of those segments has ever met any of the quantitative thresholds for determining reportable segments.

(b) The finance segment derives a majority of its revenue from interest. In addition, management primarily relies on net interest revenue, not the gross revenue and expense amounts, in managing that segment. Therefore, as permitted by paragraph 280-10-50-22, only the net amount is disclosed.

of information is required for each year for which an income statement is presented.

Diversified Company does not allocate income taxes or unusual items to segments. Not all segments have significant noncash items other than depreciation and amortization in reported profit or loss. The amounts in this Example are assumed to be the amounts in reports used by the chief operating decision maker. In addition to segment profit or loss and segment assets disclosure, Diversified Company report reconciliations of reportable segment revenues, profit or loss, and assets, to the public entity's consolidated totals (see FASB ASC 280-10-50-30(a) through (c)). Reconciliations also are required to be shown for every other significant item of information disclosed (see FASB ASC 280-10-50-30(d)). For example, if Diversified Company disclosed segment liabilities, they are required to be reconciled to total consolidated liabilities. The public entity's financial statements are assumed not to include discontinued operations. As discussed in the illustration in FASB ASC 280-10-55-47, the public entity recognizes and measures pension expense of its segments based on cash payments to the pension plan, and it does not allocate certain items to its segments.

Revenues	
Total revenues for reportable segments	\$539,000
Other revenues	1000
Elimination of intersegment revenues	(4500)
Total consolidated revenues	\$35,500
Profit or loss	
Total profit or gross for reportable segments	\$3970
Other profit or loss	100
Elimination of intersegment profits	(500)
Unallocated amounts:	
Litigation settlement received	500
Other corporate expenses	(750)
Adjustment to pension expense on consolidation	(250)
Income before income taxes and extraordinary items	\$3070
Assets	
Total assets for reportable segments	\$79,000
Other assets	2000
Elimination of receivables from corporate headquarters	(1000)
Goodwill not allocated to segments	4000
Other unallocated amounts	1000
Consolidated total	\$85,000

Appendix 2. Variable definition (in alphabetic order)

Variable	Definition
BTM_t	Book-to-market ratio, defined as the book value of equity over the market value of common equity (Compustat annual item: $(PRCC_F \times CSHO) / CEQ$)
$CHGSAL_t$	Change in external revenue, calculated as the natural logarithm of the ratio of current to prior year corporate level external revenue (Compustat annual item: SALE).
$CHGSAL_{Segment, t}$	Change in segment external revenue, calculated as the natural logarithm of the ratio of current to prior year segment external revenue (Compustat segment item: SALES).
$EARN_{t+1}$	Corporate level earnings, defined as pre-tax income in year $t + 1$ (Compustat annual item: PI) divided by total assets at the end of year t (Compustat annual item: AT).
$EARN_{Segment, t+1}$	Segment level earnings, defined as operating profit in year $t + 1$ (Compustat segment item: OPS) divided by segment assets at the end of year t (Compustat segment item: IAS).
EXP_t	Aggregate segment total expense, calculated as the sum of segments' revenues in year t minus segment earnings (Compustat segment item: SALES + INTSEG – OPS), scaled by the sum of the segments' assets at the end of year $t - 1$ (Compustat segment item: IAS).
$EXP_{Segment, t}$	Segment total expense, calculated as segment total revenue in year t minus segment earnings (Compustat segment item: SALES + INTSEG – OPS), scaled by segment assets at the end of year $t - 1$ (Compustat segment item: IAS).
$EXTREV_t$	Aggregate segment external revenue, defined as the sum of external revenue in year t (Compustat segment item: SALES) divided by the sum of segment assets at the end of year $t - 1$.
$EXTREV_{Segment, t}$	Segment external revenue in year t , defined as external revenue (Compustat segment item: SALES) divided by segment assets at the end of year $t - 1$ (Compustat segment item: IAS).
FE_{t+1}	Analyst forecast error, defined as the average of analysts' annual earnings forecasts for the year $t + 1$ minus actual earnings (Compustat annual item: PI), scaled by total assets at the end of year t (Compustat annual item: AT). We obtain analysts forecast from I/B/E/S unadjusted summary (I/B/E/S item: VALUE × SHOUT) published in the quarter immediately after earnings announcement for year t .
$INTREV_t$	Aggregate intersegment revenue, defined as the sum intersegment revenue in year t (Compustat segment item: INTSEG) divided by the sum of segment assets at the end of year $t - 1$ (Compustat segment item: IAS).
$INTREV_{Segment, t}$	Intersegment revenue, defined as intersegment revenue in year t (Compustat segment item: INTSEG) divided by segment assets at the end of year $t - 1$ (Compustat segment item: IAS).
LEV_t	Financial leverage, defined as the long term debt over the book value of equity (Compustat annual item: DLTT / CEQ).
$MA&REST_t$	Merger & acquisition and corporate restructure indicator, defined as an indicator that equals 1 if absolute value of merger

Appendix 2 (continued)

Variable	Definition
$REP_{High, t}$	and acquisition cost (Compustat annual item: AQP) or restructuring charges (Compustat annual item: RCP) is greater than one million dollars, and 0 if otherwise. High segment operation performance relative to its industry peers, defined as an indicator that equals 1 if the segment-level return on assets is greater than the upper quintile of the return on assets distribution within the same industry, and equals 0 if otherwise. The segment-level return on assets is defined as operating profit in year t (Compustat segment item: OPS) divided by segment assets at the end of year $t - 1$ (Compustat segment item: IAS). The return on assets of the industry peers is calculated as income before extraordinary item in year t (Compustat item: IB) divided by total assets at the end of year $t - 1$ (Compustat item: AT).
$REP_{Low, t}$	Low segment operation performance relative to its industry peers, defined as an indicator that equals 1 if the segment-level return on assets is lower than the lower quintile of the return on assets distribution within the same industry, and equals 0 if otherwise. The segment-level return on assets is defined as operating profit in year t (Compustat segment item: OPS) divided by segment assets at the end of year $t - 1$ (Compustat segment item: IAS). The return on assets of the industry peers is calculated as income before extraordinary item in year t (Compustat item: IB) divided by total assets at the end of year $t - 1$ (Compustat item: AT).
$SIZE_t$	Corporate level assets, defined as the natural logarithm of firm assets (Compustat annual item: AT).
$SIZE_{segment, t}$	Segment level assets, defined as the natural logarithm of segment assets (Compustat segment item: IAS).

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