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# Firm Boundaries and Voluntary Disclosure

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**ABSTRACT:** We study how vertical integration shapes firms' public disclosures. Theory suggests that firms can use public disclosure to coordinate with supply chain partners and predicts a substitution between vertical integration and public disclosure of future strategic plans, since the internalization of production reduces the need to publicly coordinate. Using data on the extent of vertical integration, we find that firms that become more vertically integrated reduce their public disclosures about their product strategies and that the reduction is most pronounced for vertically integrated firms with greater internalization of production and those with the largest informational and strategic frictions along the supply chain.

**JEL Classifications:** D83; G14; L14; M41.

**Keywords:** firm boundaries; vertical integration; product disclosure; coordination role of disclosure.

## I. INTRODUCTION

A long literature examines the role of firms' voluntary disclosures in facilitating monitoring and valuation by capital providers or withholding public information from competitors (see Beyer, Cohen, Lys, and Walther 2010 for a review). However, little is known about how firms use their disclosures to coordinate with noninvestor stakeholders. One particularly important set of noninvestor stakeholders consists of firms' supply chain partners, which are particularly prone to information-related agency conflicts (Alchian and Demsetz 1972). We study how vertical integration, as an alternative to arm's length contracting, shapes firms' voluntary disclosure of information that can be useful for resolving these agency conflicts with supply chain partners.

Theoretical studies suggest that public disclosure can facilitate contracting relationships, both by adding credibility to private communications and signaling to contracting partners who lack credible private communication channels. For example, Ferreira and Rezende (2007) consider how disclosing firm's strategy can serve as a commitment device for

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managers to maintain their strategic plans, which allows supply chain partners to invest according to the disclosing firm's strategic commitments. The notion that firms have incentives to disclose information publicly is predicated on firms' inability to privately communicate credibly with their current and potential suppliers and customers; otherwise, public disclosure would be redundant and would not facilitate coordination (Gigler 1994). Although supply chain partners can exchange information privately (e.g., about sales expectations, new product developments, etc.), public information can facilitate communication between partners to the extent the disclosure is considered more credible given the costs resulting from untruthful public disclosure (e.g., legal fines; Skinner 1997).[1]

Although disclosure is theoretically useful for coordinating along the supply chain, the internalization of transactions within firm boundaries partially eliminates information problems between customers and suppliers—e.g., due to more aligned interests between managers and a reliance on internal communication systems. Consequently, internalizing production along the supply chain—i.e., vertical integration—tends to reduce the benefits of public disclosure for coordination between suppliers and customers. Therefore, we predict that increased vertical integration is associated with less voluntary public disclosure.

To study this question, we collect information about firms' vertical integration using the measure developed by Frésard, Hoberg, and Phillips (2020). A primary benefit of this measure is that it is based on 10-K discussions largely intended to capture the internalization of production along the supply chain. We validate that our measure of vertical integration captures the internalization of production inputs along the supply chain—rather than solely capturing the transfer of shared intangible capital, like managerial oversight, that many vertical linkages are used for (see, e.g., Atalay, Hortaçsu, and Syverson 2014, who find that nearly half of upstream establishments do not ship output to downstream units inside of the firm). To do so, we first show that a one standard deviation increase in vertical integration is associated with a 6.57 percent within-firm increase in intersegment sales. Moreover, we find that a one standard deviation increase in vertical integration is also associated with a 5.34 percent decrease in the download activity of a firm's SEC filings by its suppliers and customers (Breuer, Hombach, and Muller 2023), consistent with vertical integration reducing the demand for public disclosures by supply chain partners.[2]

Next, we examine the extent to which vertical integration relates to the *supply* of public information. We focus on firms' voluntary product strategy disclosures, since these can be particularly informative for the decisions of supply chain partners. In this context, disclosure serves two main purposes. First, it can help smooth the development of new production strategies. For example, a supplier that anticipates making a new product can make the necessary investment earlier. Second, product disclosure can also reveal information about a firm's comparative advantage and production capacity, thereby signaling its ability to fulfill implicit contractual claims.

Using two measures of product disclosures—based on textual analysis of annual reports and press releases—for a sample of 62,202 firm-year observations from 1997 through 2017, we find that, holding constant the number of supply chain partners, vertical integration is negatively correlated with both product disclosure measures: a one standard deviation increase in vertical integration is associated with a 4.49 percent within-firm reduction in product-related disclosure. Moreover, research on vertical integration shows that many firms use vertically linked segments both to transfer intangible production inputs—e.g., shared management practices (e.g., Atalay et al. 2014)—in addition to transferring inputs along the supply chain (e.g., Atalay, Hortaçsu, Li, and Syverson 2019). Given the setting analyzed by Ferreira and Rezende (2007), we expect and find that our results are most pronounced when vertical integration is used to transfer production inputs along the supply chain. Overall, these results are consistent with our prediction that vertical integration reduces firms' needs to use public disclosures for supply-chain coordination.

One threat to our inferences is that firms may jointly decide their vertical integration and disclosure strategies. For instance, recent accounting studies show that competition from potential entrants can have different effects on firms' disclosure (Burks, Cuny, Gerakos, and Granja 2018) and *vice versa* (Granja 2018). We perform two sets of cross-sectional tests to better attribute the decrease in disclosure to a reduction in the usefulness of disclosure for supply chain coordination following the internalization of production. In our first set of tests, we examine whether our results vary as predicted by Ferreira and Rezende (2007)—i.e., that the value of specific investments and managerial career concerns moderate this relation, proxied by (1) investment intensity and (2) shorter term CEOs, respectively. Using each of these measures, we find consistent evidence that the reduction in product disclosure following vertical integration is more pronounced for firms with greater relationship-specific investment and managers with stronger career concerns.

[1] Illustrating the role of shared information about overall product strategy in facilitating supply chain coordination, the chief procurement officer at Mondi Group recently highlighted the importance of transparency with suppliers, acknowledging that "supplier-enabled innovation means that you build working relationships with selected suppliers, with full transparency around areas of innovation where you match, so you can enhance innovation together." The complete interview is available at https://viewer.joomag.com/ide-online-magazine-febrero-2018/0703929001517936334?page=154

[2] These findings are also consistent with the notion that information sharing helps facilitate cooperation between supply chain partners for nonvertically integrated companies (e.g., Cachon and Fisher 2000; Lee et al. 2000).

We then examine whether the reduction in disclosure following an increase in vertical integration varies with the credibility of firms' communication (Gigler 1994) and expect our results to be muted when firms' public communication channels are less credible. We find that the reduction in product disclosure following vertical integration is less pronounced when firms have less credible public disclosures, as proxied by a recent intentional financial misstatement by managers. We also find that the reduction in product disclosure following increased vertical integration is more pronounced at firms that can less credibly communicate privately with supply chain partners, as proxied by the duration of supply chain relationships.

We conduct three additional analyses to rule out concerns over potential alternative explanations. First, we separate our press release disclosure measure into its strategic- and production-related components, since vertical integration ostensibly reduces the benefits of product disclosures in alleviating these strategic and production frictions in particular (e.g., Ferreira and Rezende 2007; Shamir and Shin 2016). Consistent with our expectation, we find that both disclosure measures are negatively correlated with vertical integration. Second, we examine alternative disclosures that are less likely to enhance coordination among supply chain partners—i.e., management earnings forecasts and their various properties (e.g., accuracy)—and find no relation with firms' vertical integration for measures of managers' private information embedded in earnings forecasts. Finally, we show that vertical integration does not reduce downloads of SEC filings by nonsupply chain partners (i.e., horizontal rivals) or investors. These results suggest that our findings are not driven by a reduction in investor information demand for disclosure from vertically integrated firms.

Finally, to corroborate our inference that vertical integration reduces voluntary disclosure, we exploit a natural experiment that unexpectedly forces firms to outsource part of their operations. We rely on the incidence of major natural disasters that disrupt firms' production (e.g., Barrot and Sauvagnat 2016). We find that, following a major natural disaster, firms are (1) more likely to contract with new suppliers and (2) more likely to voluntarily disclose product-related information using our two measures of product disclosure in annual reports and press releases. Moreover, these effects of natural disasters occur immediately after their occurrence and do not exhibit any pretrends. Overall, these results are further consistent with the notion that a firm's degree of vertical integration reduces the need for providing voluntary disclosure.

Our paper contributes to the literature on how industrial organization shapes disclosure decisions. An emerging disclosure literature draws more prominently from the industrial organization literature that highlights how interfirm contracts appear to be a key determinant of disclosure decisions beyond the traditional valuation and monitoring channels. These studies identify how voluntary disclosure can contribute to horizontal coordination among industry peers (Bourveau, She, and Žaldokas 2020; Bertomeu, Evans, Feng, and Tseng 2021; Kepler 2021). In these studies, disclosure helps achieve a cooperative equilibrium that departs from a perfectly competitive one. Unlike these studies, ours builds on economic theory pertaining to frictions around relationship-specific investments. Our study contributes to this recent literature by suggesting that vertical integration reduces the need for supply chain coordination through public disclosures about products.

We also contribute to the accounting literature that examines the role of nonshareholder stakeholders in shaping disclosures. Although the vast majority of the empirical disclosure literature focuses on capital providers or competitors as the primary audiences for disclosures, our results illuminate a novel and important additional audience—current and potential suppliers who wish to better understand firms' future production and technological capacities. In this way, our results relate to recent literature on the role of disclosure in government relationships (e.g., Bova, Dou, and Hope 2015; Samuels 2021; Huang 2022), customers' proprietary cost concerns (e.g., Cho, Kim, and Zang 2020; Chen, Tian, and Yu 2022; Chiu, Jiu, and Yu 2022), supply chain bargaining positions (e.g., Cen, Chen, Hou, and Richardson 2018; Hribar, Melessa, Volant, and Wilde 2022), and facilitating communication of earnings and sales forecasts to suppliers (Crawford, Huang, Li, and Yang 2020).[3] Our study contributes to this line of work by studying the largely unexamined role of public disclosure in facilitating cooperation among supply chain partners.

This paper is organized as follows. Section II provides our conceptual underpinnings. Section III describes our data and research designs. Section IV discusses results from validating our proxies for vertical integration. Sections V and VI discuss our main results, and Section VII discusses additional analyses. Section VIII concludes.

## II. BACKGROUND AND CONCEPTUAL FRAMEWORK

Information sharing among supply chain partners is critical due to the information asymmetry inherent in relationships between customers and suppliers (Baiman and Rajan 2002). For example, customers of an intermediate firm in the supply chain may directly interact with finished-product end users and thus possess more precise information about

[3] In the context of our study, public disclosure not only helps reduce the cost of communication but also helps improve coordination by mitigating informational problems and inducing more relationship-specific investments, consistent with the theoretical argument of Ferreira and Rezende (2007).

market demand. In addition, imperfect information about a contracting partner's behavior increases concerns about opportunism by business partners—e.g., reneging on contractual obligations (Holmström 1979). Thus, information sharing helps facilitate coordination and monitoring in supply chain collaborations.

One feasible way to share information along the supply chain is via public disclosure. Although firms can arguably communicate privately with partners (e.g., Bushee, Keusch, and Kim-Gina 2021a; Bushee, Kim-Gina, and Leung 2021b), public disclosure may still be useful for coordinating production, as information conveyed publicly can be more credible than private communications, since public disclosures are subject to litigation and reputation considerations (e.g., Skinner 1997).[4] Thus, private and public disclosures can be complementary in supply chain relationships. For instance, public disclosure underscores the credibility of information conveyed through private channels.

Several studies provide a theoretical framework highlighting the potential coordination role of public disclosure. Bertomeu and Liang (2015) find that firms coordinating their strategies can use public disclosure to respond to demand fluctuations. By publicly disclosing to business partners, a firm can credibly signal its strategy and other firms can better respond in their own production decisions. The discloser anticipates its partners' actions and considers them when deciding whether to disclose in the first place—thus product-market benefits arise from disclosure.[5] Ferreira and Rezende (2007) assume that information about managers' intended future investment and strategic choices is "soft" (i.e., not perfectly credible) and show that public disclosure increases the credibility of the information about corporate strategy and serves as a commitment device, even in the presence of private communication, which in turn encourages contractual partners to make relationship-specific investments.

To test our predictions, we focus on public voluntary disclosure about product-related strategies, as such information can be particularly useful in supply chain contracting—e.g., by facilitating collaboration around different stages of product development, including the planning, research, design, development, manufacturing, and commercialization of products. Specifically, product information serves two roles. On one hand, the exchange of product information smooths the development of product strategies and the creation of production synergies; for example, it may allow a supplier to invest earlier in anticipation of its clients' product announcements (Cachon and Fisher 2000; Lee, So, and Tang 2000). On the other hand, product achievement helps drive a firm's competitive advantage and production capacity (Chaney, Devinney, and Winer 1991; Calantone and Schatzel 2000). Therefore, product disclosure signals a firm's ability to fulfill its contractual claims.

Thus, theoretical and anecdotal evidence both support the notion that, by publicly disclosing information to supply chain partners, firms can credibly signal their production strategy, allowing the partners to better coordinate their own production decisions. However, this need for public disclosure in coordinating production is predicated on the presence of current or potential vertical contracting relationships. Thus, if firms reduce their reliance on supply chain partners as part of their production process, then public disclosure becomes redundant and is no longer valuable for coordination. Therefore, the internalization of transactions along the supply chain eliminates information problems between customers and suppliers, given the relationship-specific investments entailed by the relationship.[6] Vertical integrations like this tend to reduce the benefits of public disclosure for coordinating with suppliers and customers.[7]

Theories of firm boundaries emphasize that vertical integration facilitates efficient transfers of knowledge, including research and development of products (Arrow 1975; Riordan and Sappington 1987).[8] To the extent that coordination with supply chain partners shapes firms' public disclosures, exchanging information within firm boundaries as part of vertically integrated production should reduce the coordination benefits of public disclosure. Therefore, we predict that vertical integration is associated with less voluntary disclosure, as we expect vertically integrated firms to substitute public disclosure with intrafirm exchange of information that would be otherwise useful for coordination (see Figure 1 for an illustration of these forces in contrast to other classic disclosure forces).

Classic theories of disclosure (e.g., Dye 1985; Verrecchia 1990) suggest that both increases in managers' private information and investors' uncertainty should lead to more voluntary disclosure—both can be thought of as

[4] Another reason is that public disclosure can be more cost effective in the presence of many current and potential supply chain partners that are all concerned about the firm's future business plans to meet their own production needs (Dedman and Lennox 2009; Crawford et al. 2020).

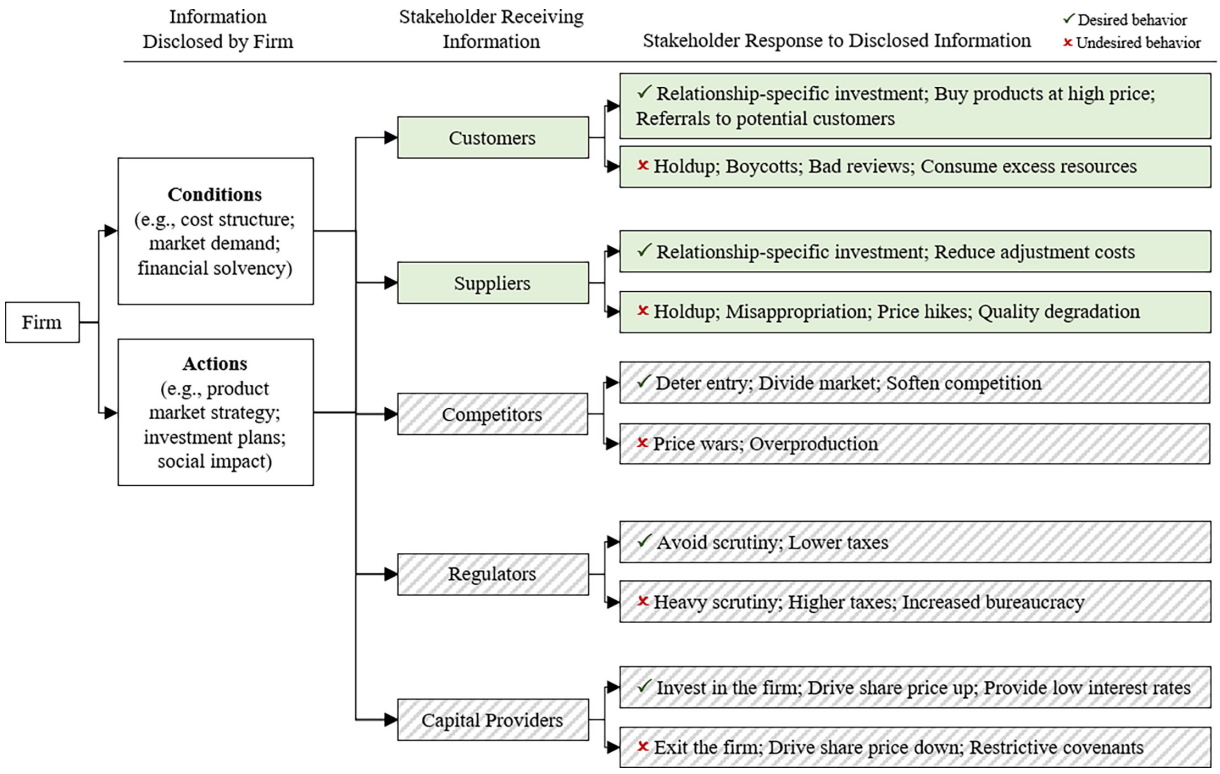
[5] Other theoretical studies in accounting examine the incentives to voluntarily disclose information in the context of client-supplier relationships while focusing on the demand for inputs based on assumptions about customer demand functions (e.g., Arya, Mittendorf, and Yoon 2019).

[6] One notable example of a supply chain relationship with such information problems occurred between General Motors and Fisher Body—which involved a ten-year contract that specified pricing along with General Motors purchasing a 60 percent interest in Fisher. The parties were unable to resolve their interfirm information "holdup" problems (Klein 2007), which ultimately led to a merger between them—i.e., full vertical integration.

[7] This reduction in disclosure benefits does not arise from a reduced number of transacting parties (e.g., Crawford et al. 2020) but rather because of the specificity of the investment entailed by supply-chain relationships, although the number of potential transacting parties can exacerbate this problem by changing the parties' bargaining power (e.g., Baiman and Rajan 2002).

[8] The increased efficiency of information sharing could be due to better execution of intrafirm information transfers (Teece 1982), the reduction in the concern about outsiders' exploiting information (e.g., to bargain for favorable contract terms (Zhang 2002), and the concern about leaking proprietary information (Demski, Lewis, Yao, and Yildirim 1999).

**FIGURE 1**
**Conceptual Framework**




This figure illustrates our conceptual framework of disclosure choices firms can make to major corporate stakeholders: Competitors, Customers, Suppliers, Employees, Regulators, and Capital Providers. Our study focuses on those boxes shaded in green (Customers and Suppliers). (The full-color version is available online.)

countervailing forces that we would expect to find if disclosure did not facilitate supply-chain coordination. Thus, the existence of these forces in our setting would weaken our results.

## III. MEASURES, SAMPLE SELECTION, AND RESEARCH DESIGN

### Measure of Vertical Integration

Our empirical strategy requires variation in the degree of vertical integration for U.S. public firms. To obtain this variation, we rely on the vertical integration score recently developed by Frésard et al. (2020).[9] This vertical integration score (*VI*) reflects the degree to which a firm's products span vertically related markets. It is constructed by linking firms' product descriptions in annual reports to product vocabularies from the Bureau of Economic Analysis (BEA) Input-Output (IO) tables. The intuition is as follows. The BEA IO tables report the vertical relatedness between any IO commodity pairs. By mapping products of a firm, reported in annual reports, to their respective IO commodities, one can assess the extent to which these products are vertically related based on the degree of vertical relatedness reported in the BEA IO tables. Because annual reports are updated annually, the score varies across years.[10]

[9] We are grateful to the authors of Frésard et al. (2020) for making their data publicly available.

[10] This measure is constructed in three primary steps. First, the BEA IO tables allow the computation of the vertical relatedness between each commodities pair, captured by a matrix $V$ with dimension $C \times C$ ($C$ is the number of commodities). Element $V_{c,d}$ is bounded between 0 and 1, with a larger value indicating a stronger vertical relationship between commodities $c$ and $d$. Second, each firm-year is linked to IO commodities by computing the cosine similarity between the given firm's business description and the textual description of each BEA commodity, generating a vector $B$ with entry $B_c$ (column $c$) representing the cosine similarity with IO commodity $c$. Finally, the degree of vertical integration ($VI$) is computed as $B \times V \times B'$.

Compared with other proxies, such as whether a firm pursues vertical M&A, the vertical integration score *VI* is advantageous for two main reasons. First, a firm can integrate its supply chain in various ways. For example, firms may purchase product lines from upstream firms or directly invest in upstream manufacturing plants, which are often unobservable to researchers. Relying on a single type of event will not fully reflect the degree of integration of firms' business. Second, *VI* is a continuous measure with meaningful crossfirm and within-firm variation. Compared with a discrete measure, such as whether a firm has two segments that are vertically related, *VI* allows us to track the evolution of firms' boundaries over time and relate it to the variation of their product disclosures.

## Measures of Product Disclosure

### *Management Discussion and Analysis (MD&A) Product Disclosure*

We calculate our first voluntary product disclosure measure using firms' annual reports. Research has established that annual reports constitute an important outlet through which managers communicate with stakeholders (e.g., Brown and Tucker 2011; Lehavy, Li, and Merkley 2011). Annual reports typically contain significant discussion of firms' strategies in areas such as product and technology development (Entwistle 1999; Merkley 2014; Cao, Ma, Tucker, and Wan 2018; Chen et al. 2022).

To compute our measure, we first download the annual reports of U.S. public firms from SEC EDGAR. Next, we count the number of sentences in which a firm uses product-related keywords/phrases (product-related sentences) in the MD&A section.[11] Our list of product-related keywords and phrases follows Merkley (2014). Although Merkley (2014) labels his measure as "R&D disclosure," the list reflects different stages of production, including the research in production, clinical trials, product development, and commercialization.[12] Therefore, the measure is well suited for studying firms' overall product disclosures, as found in recent research (Cao et al. 2018). We exclude MD&A sections with less than 250 words from our sample. Finally, to account for the length of the MD&A section, which is correlated highly with firm size and complexity (and to ensure that our results are not driven by a change in the overall amount of disclosure firms provide but rather the product-related components *per se*), we scale the number of product-related sentences by the total number of sentences of the MD&A sections to obtain our disclosure measure, *MD&A ProductDisc*.

### *Press Release (PR) Product Disclosure*

We calculate our second voluntary product disclosure measure using firm-initiated press releases coded and commercialized via RavenPack.[13] Press releases obtained from this data provider have been widely used in recent accounting studies (e.g., Drake, Guest, and Twedt 2014) and often discuss firms' product-related strategies.

We follow prior studies and use the PR Edition database to collect firm-initiated press releases issued on the four main newswires (i.e., PRNewswire, Business Wire, MarketWire, and Globe Newswire) (e.g., Chapman 2018). We require a relevance score of 100, a global event novelty score of 100, and a news-style press release. RavenPack classifies press releases into a set of predefined event categories. To identify product-related disclosure, we start with all press releases under the collection (RavenPack GROUP) "products-services," which consists of 29 classes of events (RavenPack TYPE). We remove four classes of events that are unlikely to be relevant to product strategy—namely "business combination," "award," "government-contract," and "business-contract." We define *PR ProductDisc* as the natural logarithm of 1 plus the number of press releases initiated by firms during the 12 months following the fiscal year-end.

## Sample Selection

To build our sample, we begin with all nonfinancial firms covered by the Compustat database from 1997 to 2017. The sample period spans from 1997 to 2017, due to the availability of the measure of vertical integration provided by Frésard et al. (2020). We next combine our Compustat sample with our *VI* and *MD&A ProductDisc* measures. We further require observations to have data available on control variables listed in Section III "Research Design" and obtained from the CRSP database, Thomson Reuters, and I/B/E/S. This procedure results in a final baseline sample of 62,202 firm-year observations covering 8,216 unique public firms. When using our alternative disclosure measure, *PR*

[11] Our results are robust to constructing our product disclosure measure based on the combination of the MD&A Section and Section 1 of annual reports.
[12] We provide examples of product-related sentences from our textual analysis in Appendix B.
[13] One complementary feature of this data source is that it contrasts with our MD&A measure, which has been developed by academics.

**TABLE 1**

**Summary Statistics**

| Variable | n | Mean | Std. Dev. | P25 | P50 | P75 |
|---|---|---|---|---|---|---|
| **Dependent Variables** | | | | | | |
| *MD&A ProductDisc* | 62,202 | 0.019 | 0.034 | 0.000 | 0.003 | 0.026 |
| *PR ProductDisc* | 38,623 | 0.401 | 0.671 | 0.000 | 0.000 | 0.693 |
| *Inter-segment Sales* | 62,202 | 0.517 | 1.500 | 0.000 | 0.000 | 0.000 |
| *PubInfo Acq* | 28,495 | 0.689 | 1.124 | 0.000 | 0.000 | 1.099 |
| **Independent Variables** | | | | | | |
| *VI* | 62,202 | 0.011 | 0.011 | 0.003 | 0.008 | 0.015 |
| *Vertical Segments* | 62,202 | 0.017 | 0.071 | 0.000 | 0.000 | 0.000 |
| *Size* | 62,202 | 5.996 | 1.959 | 4.516 | 5.872 | 7.358 |
| *ROA* | 62,202 | −0.037 | 0.235 | −0.042 | 0.030 | 0.072 |
| *Leverage* | 62,202 | 0.187 | 0.204 | 0.001 | 0.132 | 0.306 |
| *Return Volatility* | 62,202 | 0.036 | 0.020 | 0.022 | 0.032 | 0.046 |
| *CFO Volatility* | 62,202 | 0.030 | 0.046 | 0.009 | 0.016 | 0.032 |
| *MTB* | 62,202 | 1.853 | 1.723 | 0.862 | 1.274 | 2.118 |
| *Advertising* | 62,202 | 0.011 | 0.031 | 0.000 | 0.000 | 0.005 |
| *Tangibility* | 62,202 | 0.268 | 0.240 | 0.078 | 0.184 | 0.396 |
| *InstOwn* | 62,202 | 0.509 | 0.317 | 0.224 | 0.522 | 0.783 |
| *Analyst Following* | 62,202 | 1.548 | 0.954 | 0.693 | 1.609 | 2.303 |
| *R&D Intensity* | 62,202 | 0.058 | 0.114 | 0.000 | 0.001 | 0.068 |
| Ln(1+#*Patents*) | 62,202 | 0.694 | 1.286 | 0.000 | 0.000 | 0.693 |
| Ln(1+#*SCPartner*) | 62,202 | 1.397 | 1.276 | 0.000 | 1.099 | 2.303 |
| *HHI* | 61,506 | 0.281 | 0.266 | 0.092 | 0.176 | 0.378 |
| *Fluidity* | 61,506 | 6.804 | 3.414 | 4.245 | 6.149 | 8.738 |
| **Cross-Sectional Variables** | | | | | | |
| *R&D-to-Sales* | 62,202 | 0.324 | 1.584 | 0.000 | 0.001 | 0.079 |
| *CEO Tenure* | 26,667 | 7.690 | 7.415 | 3.000 | 6.000 | 11.000 |
| *CEO Age* | 26,528 | 55.615 | 7.266 | 51.000 | 56.000 | 60.000 |
| *IntraTrade Increase* | 62,202 | 0.155 | 0.362 | 0.000 | 0.000 | 1.000 |
| *Restatement* | 62,202 | 0.078 | 0.268 | 0.000 | 0.000 | 0.000 |
| *Duration* | 21,634 | 4.688 | 5.160 | 1.000 | 3.000 | 6.667 |
| **Placebo Dependent Variables** | | | | | | |
| *Issuance* | 62,202 | 0.391 | 0.488 | 0.000 | 0.000 | 1.000 |
| *Frequency* | 62,202 | 0.631 | 0.842 | 0.000 | 0.000 | 1.386 |
| *Forecast Error* | 23,831 | 0.026 | 0.076 | 0.002 | 0.005 | 0.018 |
| *Forecast Precision* | 24,328 | 3.105 | 0.437 | 3.000 | 3.000 | 3.222 |

This table summarizes the statistics of the main variables.
Variable definition is in Appendix A.

*ProductDisc*, our sample shrinks to 38,623 firm-year observations from 5,280 unique public firms. This sample attrition occurs because, although the sample period begins in 1997, press releases were unavailable from RavenPack until 2004 and because not all U.S. publicly listed firms are covered in RavenPack.

Table 1 displays the descriptive statistics of the variables we use. We Winsorize all continuous variables at the top and bottom 1 percent of the distribution. By definition, like Frésard et al. (2020), our *VI* variable has a mean value of 0.011 and standard deviation of 0.011, which represents a sizable variation in the degree of vertical integration. Turning to our disclosure measures, the mean value of *MD&A ProductDisc* is 0.019 and the total number of sentences in MD&A is 321 (untabulated), which implies that the average firm discloses slightly more than six product-related sentences in the MD&A section. Finally, on average, firms in our sample initiate 1.4 product-related press releases each year.

### Research Design

To examine the relation between the degree of a firm's vertical integration and its product disclosure choices, we estimate the following ordinary least squares (OLS) regression:

$$Disclosure_{i,t+1} = \beta_0 VI_{i,t} + \beta_1 X_{i,t-1} + \tau_t + v_i + \epsilon_{i,t}, \quad (1)$$

where $i$ and $t$ index firm and year, respectively. The key independent variable of our interest, $VI_{i,t}$, is the degree of firm $i$'s vertical integration in fiscal year $t$. The dependent variable, $Disclosure_{i,t+1}$, refers to one of our two measures of firm $i$'s product disclosure choices. The MD&A-based product disclosure (*MD&A ProductDisc*) is measured using the annual report of fiscal year $t$, which is often disclosed to the public after the fiscal year-end. The press release-based product disclosure (*PR ProductDisc*) is measured using a one-year window following the fiscal year-end. One benefit of our *PR ProductDisc* measure is that it is not measured based on annual reports—as our *MD&A ProductDisc* measure is—mitigating concerns about the lack of time-series variation in annual report disclosures. We include year fixed effects ($\tau_t$) to rule out macro-level factors related to corporate disclosure policies and firm fixed effects ($v_i$) to control for time-invariant firm characteristics and time-invariant components on firms' competitive environment. Since the measure of vertical integration is constructed at the firm level, we cluster standard errors at that level.

To rule out time-varying, firm-specific factors, we control for a set of covariates that relate fundamentally to firms' disclosure policies and could correlate with firms' vertical integration (e.g., Merkley 2014). First, to control for firms' information environment, which shapes the demand for disclosures, we include the number of analysts following the firm (*Analyst Following*) and the percentage of institutional ownership (*InstOwn*). Second, we control for information uncertainty, as proxied by the standard deviation of daily stock returns during the year (*Return Volatility*) and that of operational cash flows during the past 20 quarters (*CFO Volatility*). We do so because outsiders might demand more disclosures in the presence of greater information uncertainty and information uncertainty might be correlated with organizational structure (Ferracuti 2022). Next, we include firm size (*Size*), return on assets (*ROA*), leverage ratio (*Leverage*), market-to-book ratio (*MTB*), advertising expense (*Advertising*), and the fraction of tangible assets (*Tangibility*) to control for firm fundamental performance, reliance on debts, growth opportunity, product marketing strategy, and investment mix. Conditional on the level of outsourcing, more partners may generate economies of scale associated with disclosure (as in Crawford et al. 2020), which could generate a second-order impact on voluntary disclosure. Thus, we include the natural logarithm of 1 plus the number of suppliers and customers (*#SCPartner*).[14] Finally, we include R&D intensity (*R&D Intensity*) and output (Ln(1+*#Patents*)) to control for changes in production and technological activities that might vary with both product disclosure and vertical integration. Appendix A defines all variables used in our tests.

## IV. PROXY VALIDATION TESTS

Before investigating the impact of firms' vertical integration on the *supply* of voluntary disclosure, we validate that our key variable *VI*, developed by Frésard et al. (2020), does in fact capture variation in intrafirm transactions. To do so, we perform two analyses: one using intersegment sales and one that considers the nature of the new disclosure equilibrium—and in particular the demand for disclosures by suppliers and customers—for firms that become vertically integrated.

First, we obtain data on firms' time-varying intersegment sales (*INTSEG*) from the Compustat Segment database and define *Inter-segment Sales* as the natural logarithm of 1 plus the amount of intersegment "eliminations," which represent revenues generated from sales to other businesses or geographic segments within a firm. Conceptually, we posit that a firm that is more vertically integrated and relies less on arm's length contracting should have more intersegment transactions. We examine the relation between the degree of vertical integration and intersegment sales by regressing *Inter-segment Sales* on *VI*. Table 2, Panel A presents our results. In column (1), we include industry-year fixed effects to control for time-varying factors in a firm's primary industry (e.g., market demand) that might affect the degree of intersegment sales. The coefficient on *VI* is positive and statistically significant at the 1 percent level, suggesting that more vertically integrated firms do have more intersegment sales. In column (2), the coefficient on *VI* remains positive and statistically significant at the 5 percent level after including firm fixed effects. Results indicate that a one standard deviation within-firm increase in vertical integration leads to a 6.57 percent within-firm increase in intersegment sales. Collectively, the results from Table 2, Panel A indicate that our measure of *VI* captures the internalization of production along supply chains.

[14] To identify a firm's supply chain network, we use both the Compustat Customer Segment database and Factset Revere database: both have been used widely elsewhere (e.g., Barrot and Sauvagnat 2016; Gofman, Segal, and Wu 2020; She 2022).

**TABLE 2**

**Proxy Validation Tests: Vertical Integration, Production Internalization, and Public Information Acquisition**

**Panel A: *VI* and Intersegment Transactions**

| | *Inter-segment Sales* | |
|---|---|---|
| | **(1)** | **(2)** |
| *VI* | 10.052*** | 5.130** |
| | (2.501) | (2.196) |
| *Size* | 0.264*** | 0.140*** |
| | (0.020) | (0.022) |
| *ROA* | −0.191*** | −0.007 |
| | (0.037) | (0.023) |
| *Leverage* | −0.429*** | −0.178*** |
| | (0.092) | (0.061) |
| *Return Volatility* | 0.469 | 1.171*** |
| | (0.674) | (0.419) |
| *CFO Volatility* | −0.176 | −0.167 |
| | (0.140) | (0.126) |
| *MTB* | −0.003 | 0.015*** |
| | (0.006) | (0.005) |
| *Advertising* | 0.482 | 0.339 |
| | (0.444) | (0.369) |
| *Tangibility* | −0.181* | −0.242** |
| | (0.106) | (0.116) |
| *InstOwn* | −0.156** | −0.098** |
| | (0.070) | (0.048) |
| *Analyst Following* | −0.062*** | −0.020 |
| | (0.022) | (0.015) |
| Ln(1+#*SC Partners*) | 0.057*** | 0.053*** |
| | (0.020) | (0.014) |
| *R&D Intensity* | 0.409*** | 0.327*** |
| | (0.100) | (0.067) |
| Ln(1+#*Patents*) | 0.032 | 0.020 |
| | (0.027) | (0.017) |
| Industry-Year FE | Yes | Yes |
| Firm FE | No | Yes |
| Obs. | 62,202 | 62,202 |
| Adjusted $R^2$ | 0.192 | 0.631 |
| Mean Dep. Var. | 0.528 | 0.528 |
| Within-FE Std. Dev. | 1.402 | 0.859 |

*(continued on next page)*

Second, we validate the notion that supply chain partners of nonvertically integrated firms use public disclosure for coordination purposes, whereas vertical integration reduces the demand for public disclosure. In particular, compared with vertically integrated firms, we expect nonvertically integrated ones' public disclosures to be acquired more frequently by their supply chain partners. As a result, we predict that a change in a firm's degree of vertical integration will lead to a new disclosure equilibrium characterized by less consumption of the firm's public information by its supply chain partners.

To test this conjecture, we follow the methodology of Bernard, Blackburne, and Thornock (2020) and use the SEC EDGAR Log File Data Set. This dataset provides information on the searches and downloads of a firm's public SEC filings and allows us to track the acquisition of public information by supply chain partners. We consider all types of SEC

**TABLE 2 (continued)**

**Panel B: *VI* and Public Information Acquisition by Suppliers and Customers**

| | *PubInfo Acq* | |
|---|---|---|
| | **(1)** | **(2)** |
| *VI* | −4.497*** | −3.220** |
| | (0.997) | (1.640) |
| *Size* | 0.239*** | 0.204*** |
| | (0.012) | (0.024) |
| *ROA* | −0.106** | −0.068* |
| | (0.044) | (0.039) |
| *Leverage* | 0.034 | 0.065 |
| | (0.060) | (0.063) |
| *Return Volatility* | 1.076* | 1.594*** |
| | (0.627) | (0.501) |
| *CFO Volatility* | 0.878*** | 0.365 |
| | (0.209) | (0.270) |
| *MTB* | 0.047*** | 0.027*** |
| | (0.007) | (0.007) |
| *Advertising* | 0.448 | 0.763 |
| | (0.352) | (0.507) |
| *Tangibility* | 0.193*** | 0.153 |
| | (0.055) | (0.123) |
| *InstOwn* | −0.337*** | −0.148*** |
| | (0.044) | (0.049) |
| *Analyst Following* | −0.035** | 0.021 |
| | (0.016) | (0.015) |
| Ln(1+#*SC Partners*) | 0.342*** | 0.151*** |
| | (0.012) | (0.011) |
| *R&D Intensity* | 0.405*** | 0.404*** |
| | (0.128) | (0.155) |
| Ln(1+#*Patents*) | 0.062*** | 0.040*** |
| | (0.012) | (0.015) |
| Firm FE | No | Yes |
| Year FE | Yes | Yes |
| Obs. | 28,495 | 28,495 |
| Adjusted $R^2$ | 0.360 | 0.624 |
| Mean Dep. Var. | 0.689 | 0.689 |
| Within-FE Std. Dev. | 1.100 | 0.654 |

*, **, *** Indicate significance levels of 10 percent, 5 percent, and 1 percent, respectively.
Panel A shows the results of the relationship between vertical integration and intersegment sales from 1997 to 2017. The dependent variable is *Inter-segment Sales*, measured as the natural logarithm of 1 plus the amount of intersegment elimination. Column (1) reports results controlling for industry-year fixed effects, and column (2) reports results controlling for firm and industry-year fixed effects. Panel B shows the results of the effect of vertical integration on public information acquisition by suppliers and customers. The dependent variable is *PubInfo Acq*, measured by the log of 1 plus the number of SEC filings downloaded from the EDGAR database by a firm's suppliers and customers in a year. Column (1) controls for year fixed effects, and column (2) controls for firm and year fixed effects. All continuous variables are Winsorized at the 1 percent and 99 percent levels. Standard errors are clustered at the firm level and displayed in parentheses.

Variable Definitions:
*VI* = degree of vertical integration of the firm.
Variable definitions are in Appendix A.

filings (e.g., 10-K, 8-K, proxy statements) for these analyses, as each could convey information useful to supply chain partners. We define *PubInfo Acq*—the information acquired by suppliers and customers—as the natural logarithm of 1 plus the frequency of a firm's SEC filings being downloaded by its suppliers and customers in a year.[15] The SEC EDGAR Log File Data Set is available from early 2003 to mid-2017, and therefore, we restrict the sample to 2003–2016. The final sample consists of 28,495 firm-year observations.

We examine the relation between the degree of vertical integration and the acquisition of public information by supply chain partners by regressing *PubInfo Acq* on *VI*. Our results are tabulated in Table 2, Panel B. In column (1), we include year fixed effects along with the control variables, as described in Section III "Research Design."[16] We find a negative and statistically significant cross-sectional correlation between *VI* and *PubInfo Acq*, suggesting that independent supply chain partners demand more public information (in untabulated results, we find that, on average, 20 percent of a focal firm's supply chain partners download the focal firm's SEC filings over our sample period). In column (2), we further include firm fixed effects and find that the coefficient on *VI* remains negative and statistically significant at the 5 percent level, suggesting that supply chain partners increase the demand for a firm's public disclosures when the firm becomes less vertically integrated.[17] In terms of economic significance, the estimated coefficients indicate that a one standard deviation increase in vertical integration reduces suppliers' and customers' public information acquisition by 5.42 percent, relative to the within-firm variation. This magnitude is also economically significant compared with other important drivers of information acquisition. For example, Bernard et al. (2020) find that a one standard deviation increase in investment opportunities (proxied for by market-to-book ratio) increases the downloads of a firm's SEC filings by 5 percent. This association is consistent with our overall expectation that, in equilibrium, more vertical integration reduces the supply and demand for public disclosure. Together, the results in Table 2 help validate the notion that supply chain partners can and do rely on public disclosure that facilitates coordination.

## V. VERTICAL INTEGRATION AND VOLUNTARY DISCLOSURE

### Baseline Results

In this section, we present results from our baseline research design examining the effect of vertical integration on firms' public, voluntary product disclosures. We tabulate our results in Table 3, Panel A. In columns (1)–(3), we present our results using our MD&A-based product disclosure measure.[18] In column (1), our specification includes only year fixed effects to exploit the cross-sectional correlation between vertical integration and MD&A product disclosure. Consistent with our prediction, the coefficient on *VI* is negatively associated with *MD&A ProductDisc* and is statistically significant at the 1 percent level, suggesting that more vertically integrated firms provide less public discussion about products. In column (2), we add firm fixed effects to control for time-invariant firm characteristics. The coefficient on *VI* continues to be negative and statistically significant at the 1 percent level, suggesting that firms reduce their disclosures about product strategies following a within-firm increase in vertical integration. In column (3), we include firm characteristics along with R&D intensity and outputs (patents) to control for firms' adjustment of technological and production activities. Both the statistical significance and the magnitude of the effect resemble that in column (2). Notably, as expected, we find a positive correlation between product disclosure and both R&D expenses and the number of patents. This indicates that, on average, managers tend to provide more product disclosure when their firms are doing more product R&D.

In columns (4)–(6) of Table 3, Panel A, we re-estimate our Equation (1) by replacing our dependent variable with *PR ProductDisc*, our second product voluntary disclosure measure. As in our findings from the first three columns, we

[15] We thank Terrence Blackburne for sharing the data on the annual search of SEC filings between Compustat firms. We identify suppliers and customers of a firm using both the FactSet Revere database and Compustat Segment database and exclude firms that are not covered by these databases.

[16] For parsimony, henceforth, we do not report coefficients on control variables.

[17] To assuage concerns about a mechanical effect driven by a potential reduction in the number of regulatory filings, we perform two additional untabulated analyses. First, we do not find any evidence of an analogous negative correlation between vertical integration and the number of regulatory filings on EDGAR. This result is consistent with the notion that firms do not stop disclosing altogether but rather reduce the extent of product disclosures in their filings. Second, we find that the relation between *VI* and *PubInfo Acq* is robust to controlling for the number of SEC filings in a given year.

[18] An alternative to using firms' MD&A for assessing public voluntary product disclosures by management would be to rely on statements and discussions during firms' earnings conference calls. In untabulated results, we follow the same product disclosure measurement methodology as for *MD&A ProductDisc* but apply it to transcripts from conference calls. Our findings are quantitatively similar—i.e., coefficients of the same sign and degree of statistical significance—using the product disclosure in earnings calls as a dependent variable.

**TABLE 3**

**Vertical Integration and Voluntary Disclosure**

**Panel A: Main Results**

| | *MD&A ProductDisc* | | | *PR ProductDisc* | | |
|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| *VI* | −0.662*** | −0.052*** | −0.049*** | −5.901*** | −1.449** | −1.466** |
| | (0.031) | (0.016) | (0.015) | (0.662) | (0.690) | (0.687) |
| *Size* | | | 0.001*** | | | 0.011 |
| | | | (0.000) | | | (0.009) |
| *ROA* | | | 0.004*** | | | 0.024 |
| | | | (0.001) | | | (0.023) |
| *Leverage* | | | −0.006*** | | | 0.016 |
| | | | (0.001) | | | (0.030) |
| *Return Volatility* | | | 0.042*** | | | 0.189 |
| | | | (0.007) | | | (0.250) |
| *CFO Volatility* | | | 0.027*** | | | −0.058 |
| | | | (0.005) | | | (0.122) |
| *MTB* | | | 0.001*** | | | 0.004 |
| | | | (0.000) | | | (0.003) |
| *Advertising* | | | −0.009 | | | 0.438* |
| | | | (0.006) | | | (0.266) |
| *Tangibility* | | | −0.001 | | | −0.089* |
| | | | (0.001) | | | (0.050) |
| *InstOwn* | | | 0.000 | | | −0.173*** |
| | | | (0.001) | | | (0.021) |
| *Analyst Following* | | | −0.000 | | | 0.003 |
| | | | (0.000) | | | (0.008) |
| Ln(1+#*SC Partners*) | | | −0.000 | | | 0.013** |
| | | | (0.000) | | | (0.005) |
| *R&D Intensity* | | | 0.028*** | | | −0.024 |
| | | | (0.004) | | | (0.082) |
| Ln(1+#*Patents*) | | | 0.001*** | | | 0.022** |
| | | | (0.000) | | | (0.009) |
| Firm FE | No | Yes | Yes | No | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 62,202 | 62,202 | 62,202 | 38,623 | 38,623 | 38,623 |
| Adjusted $R^2$ | 0.050 | 0.864 | 0.868 | 0.028 | 0.604 | 0.606 |
| Mean Dep. Var. | 0.019 | 0.019 | 0.019 | 0.401 | 0.401 | 0.401 |
| Within-FE Std. Dev. | 0.033 | 0.012 | 0.012 | 0.665 | 0.396 | 0.396 |

*(continued on next page)*

document a negative and statistically significant association between *VI* and *PR ProductDisc* across all specifications with varying sets of covariates and fixed effects.[19] Overall, the results in Table 3, Panel A indicate that a reduction in the

[19] We also examine whether the reductions in disclosure we observe are most pronounced among firms experiencing the largest increases in vertical integration, which we expect to experience the greatest reduction in the coordination benefits of disclosure with supply chain partners (e.g., Armstrong et al. 2019; Kepler 2021). To implement these tests, we create two indicator variables, *Large VI Growth* and *Moderate VI Growth*, based on whether the growth in a firm's vertical integration in a given year falls within the top quartile and between the 50th and 75th percentiles of the distribution of *VI*, respectively. We then regress the change in product disclosure on both indicators and changes in controls. In untabulated results, we find that changes in product disclosure are negatively correlated with both *Large VI Growth* and *Moderate VI Growth* and the coefficient of *Large VI Growth* is larger than that of *Moderate VI Growth*, suggesting that both large and moderate increases in vertical integration would reduce the coordination benefits of voluntary disclosure.

**TABLE 3 (continued)**

**Panel B: Alternative Measure—Vertically Related Segments**

| | *MD&A ProductDisc* | | | *PR ProductDisc* | | |
|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| *Vertical Segments* | −0.042*** | −0.003* | −0.002* | −0.360*** | −0.208*** | −0.201*** |
| | (0.002) | (0.001) | (0.001) | (0.096) | (0.073) | (0.073) |
| Controls | No | No | Yes | No | No | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | No | Yes | Yes | No | Yes | Yes |
| Obs. | 62,202 | 62,202 | 62,202 | 38,623 | 38,623 | 38,623 |
| Adjusted $R^2$ | 0.013 | 0.864 | 0.868 | 0.021 | 0.604 | 0.606 |
| Mean Dep. Var. | 0.019 | 0.019 | 0.019 | 0.401 | 0.401 | 0.401 |
| Within-FE Std. Dev. | 0.033 | 0.012 | 0.012 | 0.665 | 0.396 | 0.396 |

**Panel C: The Importance of Production Internalization**

| | *MD&A ProductDisc* | | | *PR ProductDisc* | | |
|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| *VI* | −0.035** | −0.033** | −0.035** | −1.059 | −1.053 | −1.055 |
| | (0.017) | (0.016) | (0.016) | (0.707) | (0.704) | (0.702) |
| *IntraTrade Increase* × *VI* | −0.064*** | −0.058*** | −0.041** | −1.621** | −1.713** | −1.428* |
| | (0.021) | (0.021) | (0.021) | (0.817) | (0.819) | (0.840) |
| *IntraTrade Increase* | 0.001** | 0.001** | −0.005*** | 0.020 | 0.021 | −0.074 |
| | (0.000) | (0.000) | (0.002) | (0.020) | (0.020) | (0.072) |
| Controls | No | Yes | Yes | No | Yes | Yes |
| *VI* × Controls | No | No | Yes | No | No | Yes |
| Firm and Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 62,202 | 62,202 | 62,202 | 38,623 | 38,623 | 38,623 |
| Adjusted $R^2$ | 0.864 | 0.868 | 0.868 | 0.604 | 0.606 | 0.606 |
| Mean Dep. Var. | 0.019 | 0.019 | 0.019 | 0.401 | 0.401 | 0.401 |
| Within-FE Std. Dev. | 0.012 | 0.012 | 0.012 | 0.396 | 0.396 | 0.396 |

*(continued on next page)*

number of contracting stakeholders (suppliers and customers) through vertical integration is associated with a decrease in product-related voluntary disclosure.[20]

The estimated coefficients are economically meaningful. In absolute terms, our results indicate that a one standard deviation increase in vertical integration reduces product disclosure in MD&A by 4.49 percent and in press releases by 4.07 percent relative to the within-firm variation. We use the within-firm variation as the benchmark because we include firm fixed effects and are interested in within-firm changes of disclosures driven by vertical integration (Breuer and deHaan 2023). Furthermore, the estimated coefficients are economically comparable with other important determinants of voluntary disclosure documented in the literature. For example, going back to the seminal paper on product-market disclosure, Merkley (2014) shows that a one standard deviation increase in return on assets (ROA) reduces product disclosure in MD&A by 1.15 percent (= 0.24 × 0.048). Following the same approach, our estimates indicate that a one standard deviation increase in vertical integration by an average firm reduces MD&A disclosure by 2.84 percent (= 0.011 × 0.049/0.019) relative to sample mean and press release disclosure by 1.61 percent (= 0.011 × 1.466), which are economically comparable with the effect of ROA.

[20] Ultimately, we expect the coordination benefits of disclosure to enhance value for firms that rely more on arm's length transactions. To provide suggestive evidence of this, we regress Tobin's *q* on an indicator for firm years in the bottom-quartile *VI* (*Low VI*), an indicator for firm years in the top quartile of product disclosure measure (*High Product Disclosure*), and their interaction term while controlling for the same set of covariates and industry × year fixed effects. In untabulated analyses, we find that the interaction term between *Low VI* and *High Product Disclosure* is positive and statistically significant at conventional levels. These results are consistent with the notion that the least vertically integrated firms are the ones that benefit the most from using disclosure to coordinate with supply chain partners.

**TABLE 3 (continued)**

**Panel D: Additional Fixed Effects and Controls**

| | *MD&A ProductDisc* | | | | *PR ProductDisc* | | | |
|---|---|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** |
| *VI* | −0.030** | −0.038*** | −0.048*** | −0.064*** | −1.621** | −1.548** | −1.485** | −1.519** |
| | (0.014) | (0.015) | (0.015) | (0.016) | (0.693) | (0.695) | (0.689) | (0.734) |
| *HHI* | | | | 0.001 | | | | 0.017 |
| | | | | (0.000) | | | | (0.018) |
| *Fluidity* | | | | 0.001*** | | | | 0.005** |
| | | | | (0.000) | | | | (0.002) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | No | No | No | No | No | No | No | No |
| Year-Industry FE | Yes | No | No | No | Yes | No | No | No |
| Year-Size FE | No | Yes | No | No | No | Yes | No | No |
| Year-Profitability FE | No | No | Yes | No | No | No | Yes | No |
| Obs. | 62,202 | 62,202 | 62,202 | 61,506 | 38,623 | 38,623 | 38,623 | 38,234 |
| Adjusted $R^2$ | 0.879 | 0.869 | 0.869 | 0.868 | 0.615 | 0.607 | 0.606 | 0.605 |
| Mean Dep. Var. | 0.019 | 0.019 | 0.019 | 0.019 | 0.401 | 0.401 | 0.401 | 0.401 |
| Within-FE Std. Dev. | 0.011 | 0.011 | 0.011 | 0.012 | 0.375 | 0.395 | 0.396 | 0.396 |

*, **, *** Indicate significance levels of 10 percent, 5 percent, and 1 percent, respectively.
This table shows the results of the relationship between vertical integration and firm disclosure from 1997 to 2017. The dependent variable is *MD&A ProductDisc* and *PR ProductDisc*. In Panels A and B, columns (1) and (4) control for year fixed effects. The other columns control for firm and year fixed effects. In Panel A, the key independent variable is *VI*, which is the degree of vertical integration of the firm. In Panel B, the key independent variable is the intersegment vertical relatedness (*Vertical Segments*), which is measured as the total sales by all vertically related secondary segments scaled by a firm's total sales. Panel C explores the cross-sectional variation according to the degree of production internalization. *IntraTrade Increase* is a binary that equals 1 if the average intersegment sales in year [0,+4] is greater than the average intersegment sales in year [−4,−1]. Columns (1) and (4) report results controlling for only firm and year fixed effects; columns (2) and (5) further control for the same firm characteristics as those in Table 3, Panel A; and columns (3) and (6) further include the interaction term between *VI* and firm characteristics. Panel D reports the results of robustness analyses. Columns (1) and (5), columns (2) and (6), and columns (3) and (7) control for firm and industry-year, firm and size-year, and firm and profitability-year fixed effects, respectively. Columns (4) and (8) control for time varying the Herfindahl-Hirschman Index of the Text-based Network Industry Classification (*HHI*) and product market fluidity (*Fluidity*). All continuous variables are Winsorized at the 1 percent and 99 percent levels. Standard errors are clustered at the firm level and displayed in parentheses.
Variable definitions are in Appendix A.

### Alternative Measure of Vertical Integration

We next re-estimate our baseline results after using an alternative measure of vertical integration based on the existence of vertically integrated segments (Fan and Goyal 2006). The goal of this analysis is to provide further support for the interpretation of our baseline results that production internalization via vertical integration reduces the need for public disclosure to coordinate supply chain transactions.

To construct this measure, we start with the Compustat historical segment database and, for each firm-year, classify the North American Industry Classification System (NAICS) segment with the largest sales as the primary segment and other NAICS segments as secondary ones. We then use the 2007 Input-Output USE table to identify the vertical relationship between the primary segment and each secondary segment.[21] Specifically, for industry pair *i*-*j*, we compute $A1$ as the purchase by *j* from *i* scaled by *j*'s total inputs and $A2$ as the purchase by *i* from *j* scaled by *i*'s total inputs. If $max(A1,A2) > 5$ percent, then industry *i* and *j* are vertically related. The intersegment vertical relatedness (*Vertical Segments*) is defined as the total sales by all vertically related secondary segments scaled by a firm's total sales, that is, the fraction of firm sales generated from vertically related segments.

We then re-estimate our Equation (1) by replacing our main variable of interest, *VI*, with our measure of intersegment transactions, *Vertical Segments*. We report the results in Table 3, Panel B. We find that *Vertical Segments* relates

[21] We use the 2007 table because it is the midpoint of our sample period; results are qualitatively similar if we use the 1997 table instead.

negatively to both MD&A and press release product disclosures across all specifications, suggesting that the internalization of production operations is indeed the mechanism being captured by our empirical strategy.

**The Primacy of Production Internalization**

Research on vertical integration from the industrial organization literature shows that firms use vertically linked segments both to facilitate a more efficient exchange of intangible inputs—e.g., shared management practices, intellectual property (e.g., Atalay et al. 2014; Bilir and Morales 2020)—in addition to transferring inputs along the supply chain and facilitating productive efficiencies (e.g., Levin and Tadelis 2010; Atalay et al. 2019). Our measure of vertical integration may pick up both rationales for vertical integration. However, one may view the predictions from Ferreira and Rezende (2007) to apply more so to coordination of tangible production inputs rather than the efficient internal exchange of intangible capital. To rule out that our baseline results are entirely driven by vertical integration related to a transfer of intangible capital and show that at least a portion of our measure captures variation in tangible production, we examine the extent to which the reduction in disclosure for vertically integrated firms we observe is more pronounced when vertical integration involves the actual internalization of production.

To implement these tests, we develop a new measure of within-firm increases in trade to capture time-varying increases in the internalization of production *per se*. Specifically, for each firm in year $t$, we define *IntraTrade Increase* as a binary variable that equals 1 if the average intersegment sales in years [$t$, $t$+4] exceed the average intersegment sales in years [$t-4$, $t-1$]. We then re-estimate our Equation (1) by adding *IntraTrade Increase* and its interaction term with *VI*.

We report the results in Table 3, Panel C. Columns (1)–(3) present the results using *MD&A ProductDisc* as the dependent variable. We find that the interaction term *IntraTrade Increase* × *VI* is negative and significant at the 1 percent level, suggesting that the effect of vertical integration on product disclosure strengthens when vertical integration leads to the internalization of production. In column (2), we find that the results remain robust after adding control variables to our specifications. Finally, results in column (3) remain robust when we interact each of our covariates with our *VI* measure to account for within-firm correlation between firm characteristics and the decision to change firms' boundaries that might also correlate with disclosure choices. Columns (4)–(6) repeat the analyses using *PR ProductDisc* as the dependent variable. We continue to find a stronger effect of vertical integration on product disclosure among firms with an increase in within-firm trade. Overall, these results are consistent with our empirical tests plausibly capturing the impact of vertical integration on product market disclosure when vertical integration involves the internalization of tangible assets.

**Additional Fixed Effects and Controls**

One general threat to the interpretation of our reduced-form correlations is that our results could be driven by omitted factors. In this section, we discuss and attempt to rule out some factors, including time-varying industry shocks and changes in firm characteristics that jointly affect disclosure incentives—such as the commonly studied proprietary costs explanation for reduced disclosure (Lang and Sul 2014).

First, common industry shocks simultaneously may alter the optimal levels of both vertical integration and disclosure. For example, a technological shock in an industry might, on one hand, increase the demand for integration to coordinate production whereas on the other hand increase the costs of leaking product knowledge to rivals. To account for such potential time-varying, industry-confounding events, we replace our year fixed effects with industry-year fixed effects in our model. The results of this specification are reported in columns (1) and (5) of Table 3, Panel D for our MD&A and press release measures, respectively. Across all specifications, the coefficient on *VI* remains negative and statistically significant.

Second, in many cases, the scale of a firm's operations grows with its degree of vertical integration (e.g., as firms outsource production to expand into new geographic markets). Thus, we include year times terciles of firm-size fixed effects to ensure that our results are not driven by heterogeneous trends among large firms (Barrot and Sauvagnat 2016). Results are reported in columns (2) and (6) of Table 3, Panel D. Across all specifications, the coefficient on *VI* remains negative and statistically significant.

Third, we include year times terciles of profitability fixed effects to control for heterogeneous trends among profitable firms. These fixed effects help control for—among other things—time-varying exposure to investigations by antitrust regulators that could drive both vertical integration and disclosures (e.g., Oh 2023). We report our results in columns (3) and (7) of Table 3, Panel D. Across all specifications, the coefficient on *VI* remains negative and statistically significant.

Finally, we acknowledge that proprietary disclosure costs are a potentially important factor and are also difficult to reliably measure (Lang and Sul 2014). In our setting, the nature of firms' competitive environments may provide incentives to simultaneously modify firm boundaries and reduce public disclosure. We account for this concern in several ways. First, we include firm fixed effects in our baseline specifications to account for the prevalent time-invariant dimension of firms' competitive environment (Lang and Sul 2014). Second, we include time-varying controls for factors that drive disclosure costs stemming from changes in proprietary technology in our regressions (e.g., R&D intensity and patenting). Third, we further augmented our baseline model with additional time-varying control variables related to industry competition among incumbents (i.e., industry concentration; Lang and Sul 2014) and product market entry threats (i.e., changes in rivals' products relative to the focal firm's or greater "product fluidity"; Hoberg, Phillips, and Prabhala 2014). The results, tabulated in columns (4) and (8) of Table 3, Panel D, suggest that our main results still hold.[22] These findings are inconsistent with vertical integration increasing proprietary disclosure costs.

## VI. CROSS-SECTIONAL TESTS

### Investment Specificity and Managerial Career Concerns

In our next set of tests, we focus on how the reduced coordination role of product disclosures in vertically integrated firms is moderated by the importance of voluntary disclosure to a firm and its management in coordinating with supply chain partners. In particular, as suggested by Ferreira and Rezende (2007), we expect the decrease in voluntary disclosure to be more pronounced for firms that rely more on relationship-specific investments as well as for managers with stronger career concerns. The intuition here is that the costs associated with a counterparty's reneging on past announcements strengthen when a firm and its supply chain partners must spend more on relationship-specific investments. This, in turn, gives rise to greater demand for public disclosure as a commitment device. Moreover, public disclosure is more credible and thereby functions as a better commitment device when it is costly for managers to change their decisions after publicly announcing them. Therefore, we expect the reduction in voluntary disclosure to be more pronounced for firms with highly specific investments and managers with greater career concerns. To test this prediction, we re-estimate our Equation (1) after interacting *VI* with measures of investment specificity and managerial career concerns.[23]

To test this prediction, we use the degree of differentiated inputs and R&D investment intensity to approximate investment specificity (e.g., Costello 2013). Columns (1) and (4) of Table 4, Panel A report results using R&D intensity as a partitioning variable when estimating the relation between *VI* and *MD&A ProductDisc* and *PR ProductDisc*, respectively. In particular, *High Specificity* is defined as a binary variable that equals 1 if the firm's ratio of R&D to sales and the degree of input differentiation (Giannetti, Burkart, and Ellingsen 2011) are both above the respective sample median. We find the interaction term *High Specificity* × *VI* is negative and statistically significant at the conventional levels, suggesting that the effect of vertical integration on product disclosure strengthens when investment specificity is higher. In columns (2) and (5), our results remain robust to adding control variables to our specifications. Finally, in columns (3) and (6), we interact each of our covariates with our *VI* measure. Our results remain robust.

In addition, studies find that younger CEOs and those with shorter tenure tend to have greater career concerns (e.g. Brickley, Linck, and Coles 1999). We define *High Career Concern* as a binary variable that equals 1 if the CEO's age or tenure is below the respective sample median and then interact this measure with *VI*. We repeat the same specifications as Panel A and report results in Table 4, Panel B. We find the coefficient on *High Specificity* × *VI* to be negatively significant across all specifications, suggesting that the negative association between vertical integration and voluntary product disclosure is more pronounced when CEOs have greater career concerns.

Collectively, these findings are consistent with the theoretical prediction by Ferreira and Rezende (2007) that the demand for public disclosure as a commitment device to coordinate supply chain transactions is greater when partners make more relationship-specific investments and when managers have stronger career concerns.

[22] Moreover, with regard to an increase in proprietary costs, our primary analyses report similar results for disclosures that are more likely to be proprietary (e.g., demand and production information from press releases) and disclosures that are likely to be nonproprietary (e.g., the MD&A section of the annual report; Lang and Sul 2014; Glaeser 2018) but can nevertheless serve a coordination role in supply chains.

[23] Our main specifications control for the number of supply chain partners—i.e., both suppliers and customers—which may relate directly to the specificity of investment. For instance, vertical integration reduces the need for external contracting, leading to a negative relation between VI and the number of supply chain partners, but any moderating (i.e., interactive) effect depends on whether the remaining suppliers following vertical integration have information demands that are stronger or weaker than the information demand of the suppliers dropped from the production chain following vertical integration.

**TABLE 4**

**Cross-Sectional Tests: Investment Specificity and Manager Career Concerns**

**Panel A: Specificity of Investment**

| | *MD&A ProductDisc* | | | *PR ProductDisc* | | |
|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| *VI* | −0.047** | −0.042** | −0.391*** | −0.732 | −0.729 | −0.683 |
| | (0.019) | (0.018) | (0.083) | (0.757) | (0.761) | (3.424) |
| *High Specificity* × *VI* | −0.085** | −0.072** | −0.069** | −3.052** | −3.176** | −2.869** |
| | (0.037) | (0.035) | (0.034) | (1.441) | (1.426) | (1.337) |
| *High Specificity* | 0.005*** | 0.004*** | 0.004*** | 0.056 | 0.059 | 0.053 |
| | (0.001) | (0.001) | (0.001) | (0.039) | (0.039) | (0.039) |
| Controls | No | Yes | Yes | No | Yes | Yes |
| *VI* × Controls | No | No | Yes | No | No | Yes |
| Firm and Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 52,856 | 52,856 | 52,856 | 32,669 | 32,669 | 32,669 |
| Adjusted $R^2$ | 0.861 | 0.865 | 0.866 | 0.607 | 0.609 | 0.609 |
| Mean Dep. Var. | 0.022 | 0.022 | 0.022 | 0.442 | 0.442 | 0.442 |
| Within-FE Std. Dev. | 0.012 | 0.012 | 0.012 | 0.412 | 0.412 | 0.412 |

**Panel B: Manager Career Concerns**

| | *MD&A ProductDisc* | | | *PR ProductDisc* | | |
|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| *VI* | −0.041* | −0.032 | −0.194** | −0.376 | −0.379 | 6.109 |
| | (0.021) | (0.021) | (0.092) | (1.145) | (1.135) | (5.763) |
| *High Career Concerns* × *VI* | −0.034* | −0.036** | −0.035** | −2.593*** | −2.567*** | −2.573*** |
| | (0.018) | (0.018) | (0.018) | (0.905) | (0.892) | (0.913) |
| *High Career Concerns* | 0.001* | 0.001** | 0.001** | 0.051*** | 0.051*** | 0.051*** |
| | (0.000) | (0.000) | (0.000) | (0.019) | (0.019) | (0.019) |
| Controls | No | Yes | Yes | No | Yes | Yes |
| *VI* × Controls | No | No | Yes | No | No | Yes |
| Firm and Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 26,667 | 26,667 | 26,667 | 19,339 | 19,339 | 19,339 |
| Adjusted $R^2$ | 0.825 | 0.831 | 0.831 | 0.624 | 0.627 | 0.627 |
| Mean Dep. Var. | 0.013 | 0.013 | 0.013 | 0.506 | 0.506 | 0.506 |
| Within-FE Std. Dev. | 0.009 | 0.009 | 0.009 | 0.436 | 0.436 | 0.436 |

*, **, *** Indicate significance levels of 10 percent, 5 percent, and 1 percent, respectively.
This table shows the results of the relationship between vertical integration and firm disclosure from 1997 to 2017, conditional on the importance of strategy disclosures. The dependent variable is *MD&A ProductDisc* in columns (1)–(3) and *PR ProductDisc* in columns (4)–(6). Columns (1) and (4) report results controlling for only firm and year fixed effects, columns (2) and (5) further control for the same firm characteristics as those in Table 3, and columns (3) and (6) further include the interaction term between *VI* and firm characteristics. All continuous variables are Winsorized at the 1 percent and 99 percent levels. Standard errors are clustered at the firm level and displayed in parentheses.

Variable Definitions:
*VI* = degree of vertical integration of the firm;
*High Specificity* = binary that equals 1 if the firm's ratio of R&D to sales and degree of input differentiation are above the sample median; and
*High Career Concern* = binary that equals 1 if the CEO's age is below the sample median or if the CEO's tenure is below the sample median.
Variable definitions are in Appendix A.

## Credibility of Communication Channels

### *Credibility of Public Disclosure*

In our next set of tests, we focus on how the reduced coordination role of product disclosures in vertically integrated firms is moderated by the credibility of the firm's public disclosures. The intuition here is that public disclosure is less

**TABLE 5**

**Cross-Sectional Tests: Credibility of Communication Channels**

**Panel A: Credibility of Public Disclosure—Financial Restatements**

| | *MD&A ProductDisc* | | | *PR ProductDisc* | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *VI* | −0.060*** | −0.055*** | −0.293*** | −1.697** | −1.706** | −1.280 |
| | (0.016) | (0.016) | (0.070) | (0.695) | (0.692) | (2.888) |
| *Restatement* × *VI* | 0.087*** | 0.069*** | 0.039** | 1.528** | 1.482** | 1.423* |
| | (0.019) | (0.019) | (0.017) | (0.752) | (0.747) | (0.753) |
| *Restatement* | −0.001*** | −0.001*** | −0.001** | −0.016 | −0.015 | −0.015 |
| | (0.000) | (0.000) | (0.000) | (0.012) | (0.012) | (0.012) |
| Controls | No | Yes | Yes | No | Yes | Yes |
| *VI* × Controls | No | No | Yes | No | No | Yes |
| Firm and Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 62,202 | 62,202 | 62,202 | 38,623 | 38,623 | 38,623 |
| Adjusted $R^2$ | 0.864 | 0.868 | 0.868 | 0.604 | 0.606 | 0.606 |
| Mean Dep. Var. | 0.019 | 0.019 | 0.019 | 0.401 | 0.401 | 0.401 |
| Within-FE Std. Dev. | 0.012 | 0.012 | 0.012 | 0.396 | 0.396 | 0.396 |

*(continued on next page)*

likely to facilitate coordination with a firm's suppliers and customers when public disclosure is less credible. We expect the reduction in voluntary disclosure to be less pronounced for firms with less credible public disclosures. To test this prediction, we re-estimate our Equation (1) after interacting *VI* with measures of the credibility of public disclosure.

We measure the credibility of public disclosure using variables that capture the lower credibility of a firm's public disclosures and expect a less negative association between vertical integration and public product disclosure. The literature suggests that public financial reports that are restated are less reliable (e.g., Armstrong, Glaeser, and Kepler 2019); thus, we use financial restatements as our first measure of the credibility of public disclosure.[24] This suggests that firms with misstated financial reports are less likely to use their public disclosures to coordinate credibly with supply chain partners.

Table 5, Panel A reports results from using financial restatements as a partitioning variable. Specifically, we define *Restatement* as a binary variable indicating the announcement of financial restatements or the firm was under SEC investigations in the preceding three years to proxy for low credibility of public disclosure. Across both dependent variables, we find that *Restatement* × *VI* is positively significant across the specifications, suggesting that the relation between vertical integration and public product disclosure is less pronounced for firms with less credible financial reports.

### *Credibility of Private Communication*

Our second set of cross-sectional tests considers firms' reliance on public disclosures to coordinate with supply chain partners. If the negative relation between disclosure and the degree of vertical integration is due to a shift away from public disclosure to coordinate with supply chain partners following vertical integration, then we expect our results to be concentrated among firms more likely to rely on public disclosure in the absence of vertical integration. We predict that nonintegrated firms will rely more on public disclosure when the information conveyed through private channels is less credible.

Our primary proxy for the credibility of private information is the relationship duration between the firm and its supply chain partners. We posit that a longer relationship facilitates trust that reduces the concerns about opportunism by counterparties (McMillan and Woodruff 1999; Banerjee and Duflo 2000). Using the Compustat Segments database, for each firm-year, we compute the weighted average of the duration between a firm and its current counterparties during the year. We compute weights based on the transaction volume between a firm and its counterparties. We develop a

[24] We find qualitatively similar results (untabulated) if we use firms under investigation by the SEC for securities violations as a measure of the credibility of public disclosure (Blackburne, Kepler, Quinn, and Taylor 2021).

**TABLE 5 (continued)**

**Panel B: Credibility of Private Disclosure—Supply Chain Relationship Duration**

| | *MD&A ProductDisc* | | | *PR ProductDisc* | | |
|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| *VI* | −0.042 | −0.042 | −0.507*** | −1.180 | −1.258 | −2.372 |
| | (0.028) | (0.028) | (0.135) | (1.461) | (1.443) | (5.486) |
| *Short Duration* × *VI* | −0.067** | −0.054** | −0.042* | −1.993* | −2.092* | −2.258** |
| | (0.028) | (0.028) | (0.025) | (1.114) | (1.107) | (1.094) |
| *Short Duration* | 0.001** | 0.001 | 0.001 | 0.038* | 0.041** | 0.041** |
| | (0.001) | (0.001) | (0.001) | (0.020) | (0.020) | (0.020) |
| Controls | No | Yes | Yes | No | Yes | Yes |
| *VI* × Controls | No | No | Yes | No | No | Yes |
| Firm and Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 21,634 | 21,634 | 21,634 | 14,209 | 14,209 | 14,209 |
| Adjusted $R^2$ | 0.881 | 0.883 | 0.884 | 0.663 | 0.666 | 0.666 |
| Mean Dep. Var. | 0.021 | 0.021 | 0.021 | 0.513 | 0.513 | 0.513 |
| Within-FE Std. Dev. | 0.011 | 0.011 | 0.011 | 0.411 | 0.411 | 0.411 |

*, **, *** Indicate significance levels of 10 percent, 5 percent, and 1 percent, respectively.
This table shows the results of the relationship between vertical integration and firm disclosure from 1997 to 2017, conditional on credibility of public and private communication channels in Panels A and B, respectively. The dependent variable is *MD&A ProductDisc* in columns (1)–(3) and *PR ProductDisc* in columns (4)–(6). Columns (1) and (4) report results controlling for only firm and year fixed effects, columns (2) and (5) further control for the firm characteristics as those in Table 3, and columns (3) and (6) further include the interaction term between *VI* and firm characteristics. All continuous variables are Winsorized at the 1 percent and 99 percent levels. Standard errors are clustered at the firm level and displayed in parentheses.

Variable Definitions:
*VI* = degree of vertical integration of the firm;
*Restatement* = binary that equals 1 if the firm has financial restatement that is not coded as errors by Audit Analytics in three years before entering year *t*; and
*Short Duration* = binary variable that equals 1 if weighted-average duration of supply chain relationship is smaller than the yearly median and 0 otherwise.
Variable definitions are in Appendix A.

binary variable, *Short Duration*, that equals 1 if the weighted average duration of supply chain relationship is less than the sample median and 0 otherwise.[25]

Table 5, Panel B presents results. Across all specifications, the coefficient on *Short Duration* × *VI* is consistently negative and statistically significant across both measures of voluntary disclosure. This indicates that the effect of *VI* on disclosure is more pronounced for short-term relationships.

## VII. ADDITIONAL ANALYSES

### Information Frictions Related to Strategy and Production

Our results thus far suggest that vertical integration is associated with less voluntary product disclosure. Next, we expand our empirical analysis to understand which type of information frictions along the supply chain voluntary product disclosure mitigates. Broadly speaking, the literature has identified two main frictions, which we label *strategy* and *production*. In terms of the former frictions, supply chain partners make relationship-specific investments to support the manufacturer's strategy. However, they operate in an environment of incomplete contracts (Tirole 1999). Strategic investments made under incomplete contracts can lead to a "holdup problem," whereby contracting partners can collect information-specific rents, which leads these firms to underinvest in the relationship in the first place.

One solution, which is also consistent with our cross-sectional tests in Section VI "Investment Specificity and Managerial Career Concerns," is to combine private communication with costly, credible public disclosure (Ferreira and Rezende 2007).

[25] We find qualitatively similar results (untabulated) if we use firm age as a measure of the credibility of private communication.

Thus, we predict that vertical integration reduces the need for product disclosures intended to solve holdup problems. Indeed, economic theory predicts that vertical integration mitigates underinvestment in relation-specific investments (Klein, Crawford, and Alchian 1978) and that this can also be achieved by facilitating the exchange of relevant information (e.g., Monteverde 1995; Atalay et al. 2014).

In terms of production frictions, information differentials along the supply chain exist because, for instance, distributors are better informed than manufacturers about final consumer demand. Moreover, distributors and manufacturers face asymmetric over/underproduction costs (Lee, Padmanabhan, and Whang 1997; Armony and Plambeck 2005), leading distributors to inflate their demand forecasts. In such a case, the contracting solution again can involve private communication combined with costly public disclosure (Shamir and Shin 2016).[26] Thus, we predict that vertical integration reduces the need for product disclosure intended to alleviate this production challenge since economic theory predicts that vertical integration mitigates information asymmetry along the supply chain (Arrow 1975).

We test whether voluntary product disclosure related to strategy and production frictions is affected by a change in firms' vertical integration. To do so, we revise our disclosure measure based on press releases. RavenPack associates each press release within a list of predetermined topics, which we then use to classify each topic as either strategy or production using the commercialization of a product as the cutoff. Press releases that reveal information related to a firm's investment in a product before its commercialization, which is soft in nature and more directly tied to upstream and downstream investment decisions, are classified as strategy. Alternatively, press releases relevant to production capacity and inventory management once the product is already commercialized are classified as production.

Table 6 presents the results. As with our cross-sectional tests, we tabulate results with our baseline set of fixed effects both with and without control variables. Coefficient estimates on *VI* are negative and statistically significant at conventional levels for both the strategy and production categories. We interpret this result in two ways. First, these results confirm that firms operating at arm's length rely on voluntary product disclosure to mitigate information problems for both strategic and production frictions. Second, our results confirm that vertical integration reduces the need for voluntary product disclosure to coordinate along the supply chains to mitigate both kinds of frictions.

Collectively, these findings help mitigate the concern that vertical integration only facilitates the transfer of intangible capital. In particular, production disclosure, which reveals information about the manufacturing process after the product is ready for commercialization, is relatively less likely to capture the exchange of intangible capital (e.g., concepts like "know-how" from the strategy literature). Therefore, if vertical integration is associated with the flow of only intangible capital, it should not affect a firm's production disclosures. However, our results show that production disclosures also decrease significantly with *VI*, suggesting that vertical integration does capture the variation in the internalization of production more than just intangible capital.

### Capital Market-Based Alternative Explanations

Our results consistently indicate that vertical integration is associated with less voluntary product disclosure and that this effect strengthens when the credibility of firms' public disclosures is higher and the credibility of their private disclosure is lower. Standard models of voluntary disclosure suggest that a decrease in either managers' private information or investors' uncertainty can reduce public disclosure (e.g., Dye 1985; Verrecchia 1990). In the context of our setting, these forces would need to systematically vary with (1) firms' vertical integration, (2) the credibility of firms' public disclosures, and (3) the attributes leading to a greater reliance on private communication with supply chain partners. Although we consider this unlikely, we conduct several additional analyses to assuage concerns about alternative explanations for our inferences.

With regard to a decrease in managers' private information, we examine the relation between vertical integration and (1) management forecast issuance, (2) management forecast frequency, (3) management forecast accuracy, and (4) management forecast precision, respectively. We obtain the data from the I/B/E/S Guidance database and re-estimate our baseline specification with each of these forecast property variables as dependent variables and *VI* as the key independent variable. Table 7 shows that coefficients on *VI* are statistically indifferent from 0 across all specifications: we do not find any evidence of a relation between vertical integration and management forecast accuracy or precision, which is inconsistent with our prediction that vertical integration reduces managers' private information. These results are inconsistent with reductions in managers' private information driving the reductions in product disclosure that we observe.

[26] An alternative solution consists of establishing long-term private contracts (Costello 2013), which may contain recurring private disclosure (Pandey 2023).

**TABLE 6**

**Disclosure about Strategy versus Production**

| | *Strategy Disc* | | *Production Disc* | |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| *VI* | −0.482** | −0.534** | −1.128* | −1.106* |
| | (0.220) | (0.219) | (0.656) | (0.654) |
| *Size* | | 0.010** | | 0.004 |
| | | (0.004) | | (0.008) |
| *ROA* | | 0.020* | | 0.005 |
| | | (0.011) | | (0.021) |
| *Leverage* | | −0.012 | | 0.027 |
| | | (0.015) | | (0.026) |
| *Return Volatility* | | −0.081 | | 0.298 |
| | | (0.130) | | (0.221) |
| *CFO Volatility* | | 0.030 | | −0.079 |
| | | (0.080) | | (0.094) |
| *MTB* | | −0.002 | | 0.006** |
| | | (0.002) | | (0.003) |
| *Advertising* | | −0.114 | | 0.572** |
| | | (0.081) | | (0.258) |
| *Tangibility* | | −0.026 | | −0.066 |
| | | (0.021) | | (0.047) |
| *InstOwn* | | −0.047*** | | −0.140*** |
| | | (0.010) | | (0.018) |
| *Analyst Following* | | −0.002 | | 0.005 |
| | | (0.003) | | (0.007) |
| Ln(1+#*SC Partners*) | | 0.000 | | 0.014*** |
| | | (0.002) | | (0.005) |
| *R&D Intensity* | | 0.016 | | −0.035 |
| | | (0.052) | | (0.065) |
| Ln(1+#*Patents*) | | 0.004 | | 0.022*** |
| | | (0.004) | | (0.008) |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Obs. | 38,623 | 38,623 | 38,623 | 38,623 |
| Adjusted $R^2$ | 0.469 | 0.470 | 0.615 | 0.616 |
| Mean Dep. Var. | 0.074 | 0.074 | 0.344 | 0.344 |
| Within-FE Std. Dev. | 0.184 | 0.184 | 0.369 | 0.369 |

*, **, *** Indicate significance levels of 10 percent, 5 percent, and 1 percent, respectively.
This table shows the results of the relationship between vertical integration and firm disclosure from 1997 to 2017. The dependent variable is *Strategy Disc* in columns (1) and (2) and *Production Disc* in columns (3) and (4). All columns report results controlling for firm and year fixed effects. All continuous variables are Winsorized at the 1 percent and 99 percent levels. Standard errors are clustered at the firm level and displayed in parentheses.

Variable Definitions:
*VI* = degree of vertical integration of the firm.
Variable definitions are in Appendix A.

Another concern with our inferences is that our results reflect a decrease in investor uncertainty and therefore investor demand for product information, rather than a change in the demand for public information by supply chain partners. To rule this out, we examine the relation between firms' vertical integration and their financing needs. In untabulated analyses, we find that vertical integration is positively associated with current and subsequent equity issuance. Given the positive capital market consequences of firms' voluntary disclosure (Leuz and Verrecchia 2000;

**TABLE 7**

**Placebo Tests: Management Earnings Forecast Properties**

| | *Issuance* (1) | *Frequency* (2) | *Forecast Error* (3) | *Forecast Precision* (4) |
|---|---|---|---|---|
| *VI* | 0.134 | 0.059 | −0.047 | 0.670 |
| | (0.481) | (0.848) | (0.118) | (0.764) |
| *Size* | 0.065*** | 0.125*** | 0.003* | −0.035*** |
| | (0.006) | (0.011) | (0.002) | (0.011) |
| *ROA* | 0.122*** | 0.206*** | −0.029*** | 0.045 |
| | (0.013) | (0.022) | (0.007) | (0.034) |
| *Leverage* | −0.033* | −0.060* | 0.009** | 0.071** |
| | (0.019) | (0.035) | (0.005) | (0.036) |
| *Return Volatility* | −1.258*** | −2.590*** | 0.228*** | −0.542 |
| | (0.158) | (0.272) | (0.071) | (0.419) |
| *CFO Volatility* | 0.015 | 0.020 | −0.005 | −0.190 |
| | (0.061) | (0.105) | (0.053) | (0.210) |
| *MTB* | 0.008*** | 0.016*** | −0.002*** | 0.011*** |
| | (0.002) | (0.003) | (0.000) | (0.004) |
| *Advertising* | −0.243 | −0.380 | 0.012 | −0.079 |
| | (0.158) | (0.306) | (0.045) | (0.280) |
| *Tangibility* | −0.035 | −0.104* | 0.016* | −0.097 |
| | (0.032) | (0.060) | (0.009) | (0.072) |
| *InstOwn* | 0.071*** | 0.131*** | −0.004 | 0.042* |
| | (0.015) | (0.027) | (0.004) | (0.022) |
| *Analyst Following* | 0.077*** | 0.119*** | −0.007*** | 0.015* |
| | (0.005) | (0.009) | (0.001) | (0.009) |
| Ln(1+#*SC Partners*) | 0.009** | 0.030*** | 0.000 | 0.007 |
| | (0.004) | (0.007) | (0.001) | (0.006) |
| *R&D Intensity* | 0.179*** | 0.380*** | 0.018 | −0.217 |
| | (0.040) | (0.066) | (0.022) | (0.135) |
| Ln(1+#*Patents*) | −0.002 | −0.003 | 0.002** | −0.007 |
| | (0.005) | (0.009) | (0.001) | (0.006) |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Obs. | 62,202 | 62,202 | 23,831 | 24,328 |
| Adjusted $R^2$ | 0.536 | 0.622 | 0.620 | 0.211 |
| Mean Dep. Var. | 0.391 | 0.631 | 0.026 | 3.105 |
| Within-FE Std. Dev. | 0.321 | 0.521 | 0.042 | 0.350 |

*, **, *** Indicate significance levels of 10 percent, 5 percent, and 1 percent, respectively.
This table shows the results of the relationship between vertical integration and properties of management earnings forecasts from 1997 to 2017. The dependent variables in columns (1)–(4) are an indicator for firms with earnings forecasts, the frequency of earnings forecasts, the forecast errors, and the precision of earnings forecasts, respectively. All columns report results controlling for firm and year fixed effects. All continuous variables are Winsorized at the 1 percent and 99 percent levels. Standard errors are clustered at the firm level and displayed in parentheses.

Variable Definitions:
*VI* = degree of vertical integration of the firm.
Variable definitions are in Appendix A.

Leuz and Schrand 2009), greater reliance on equity markets should lead to an increase in the provision of voluntary disclosure and is inconsistent with capital market considerations driving our results.

As an alternative test to gauge whether demand for public disclosure changes for vertically integrated firms, in untabulated analyses, we examine two types of downloads by two different stakeholders that the literature suggests have

demand for firms' public disclosures: investors and horizontal rivals. Regarding investors, we find no relation between vertical integration and the downloading of firms' public filings. Regarding horizontal rivals (as indicated by the FactSet Revere database, which allows us to ensure that these firms are unlikely to have vertical supply chain relationships with the focal firms), we do not find any detectable correlation between *VI* and 10-K downloads by horizontal rivals. Collectively, these findings are inconsistent with vertical integration altering investors' or horizontal rivals' demand for public disclosure. Furthermore, given that investors are one of the primary audiences for many firm disclosures, any lingering demand for supply chain disclosure, coupled with the observed reduction, implies that the economic magnitudes we document are lower bounds on the role of disclosure in facilitating supply chain coordination.

**Evidence from a Natural Experiment: Natural Disasters**

To address potentially lingering endogeneity concerns, we take advantage of a natural experiment that provides arguably exogenous variation in firms' incentives to operate using arm's length transactions with supply chain partners.

This analysis assumes that firms with a production facility located in areas that experience a natural disaster are more likely to rely more on external suppliers, motivating them to increase voluntary disclosure for coordination. From the perspective of our research question, natural disasters that hit a firm's production facilities are unrelated to the firm's competitive environment (e.g., these tests are not confounded by any omitted factor related to proprietary disclosure costs). If, however, natural disasters impact a variety of factors that are jointly correlated with the degree of vertical integration and disclosure, then the results from these tests should be interpreted with caution. But they are nonetheless informative to the extent that they corroborate our prior tests.

To implement these tests, we first obtain the list of major natural disasters from Barrot and Sauvagnat (2016) and manually collect the counties affected by each one from the SHELDUS database (Spatial Hazard and Loss Database for the United States). We identify 4,545 county years hit by 25 major natural disasters from 1997 to 2013.[27] We then follow Hsu, Lee, Peng, and Yi (2018) and use the U.S. Environmental Protection Agency toxic emission data to identify the locations of firms' production facilities. To identify affected facilities, we use the list of facilities released by firms one year before a given natural disaster.[28] We classify a firm as a treatment firm if any of its facilities were ever hit by a major natural disaster and as a control firm otherwise. If a firm is hit by multiple major natural disasters in a five-year window, we keep the first event. Our final sample consists of 548 treatment firms and 539 firms that are never treated.

We then create a stacked sample to circumvent the potential biases in staggered event-study design implementations (e.g., Callaway and Sant'Anna 2021; Baker, Larcker, and Wang 2022). Specifically, for each cohort (i.e., the natural disaster event year), we keep the treatment firms and control firms (either never treated or have yet to be treated) over the [−3,+3] event window relative to the event year. We define *Hit* as a binary variable for treatment firms and *Post* as a binary variable for years after the natural disaster event year.

Table 8 reports results by estimating a stacked difference-in-differences regression and including the same set of controls as our primary result. In column (1) of Table 8, Panel B, we first explore changes in the number of suppliers.

**TABLE 8**

**Natural Disasters, Outsourcing, and Product Disclosure**

**Panel A: Descriptive Statistics**

| Variable | n | Mean | Std. Dev. | P25 | P50 | P75 |
|---|---|---|---|---|---|---|
| Ln(1+#*Suppliers*) | 14,617 | 1.316 | 1.382 | 0.000 | 1.099 | 2.303 |
| *MD&A ProductDisc* | 26,740 | 0.011 | 0.017 | 0.000 | 0.003 | 0.015 |
| *PR ProductDisc* | 12,658 | 0.492 | 0.787 | 0.000 | 0.000 | 0.693 |
| *Hit* | 26,740 | 0.182 | 0.386 | 0.000 | 0.000 | 0.000 |
| *Post* | 26,740 | 0.595 | 0.491 | 0.000 | 1.000 | 1.000 |

*(continued on next page)*

[27] These natural disasters include hurricanes, floods, wildfires, ice storms, blizzards, and tropical storms.
[28] We remove facilities that are not material to a firm year, i.e., a facility's share of production (based on emissions) is smaller by 5 percent.

**TABLE 8 (continued)**

**Panel B: Difference-in-Differences**

| | Ln(1+#*Suppliers*) | | *MD&A ProductDisc* | | *PR ProductDisc* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Hit* × *Post* | 0.076*** | | 0.001** | | 0.073*** | |
| | (0.022) | | (0.000) | | (0.026) | |
| *Hit* × *Pre(−3)* | | −0.007 | | 0.000 | | −0.008 |
| | | (0.025) | | (0.000) | | (0.036) |
| *Hit* × *Pre(−2)* | | −0.025 | | 0.000 | | −0.033 |
| | | (0.019) | | (0.000) | | (0.034) |
| *Hit* × *Post(0)* | | 0.042*** | | 0.001** | | 0.061** |
| | | (0.015) | | (0.000) | | (0.031) |
| *Hit* × *Post(+1)* | | 0.072*** | | 0.001** | | 0.064** |
| | | (0.020) | | (0.000) | | (0.032) |
| *Hit* × *Post(+2)* | | 0.065*** | | 0.001* | | 0.073** |
| | | (0.023) | | (0.000) | | (0.034) |
| *Hit* × *Post(+3)* | | 0.094*** | | 0.001** | | 0.049 |
| | | (0.030) | | (0.000) | | (0.037) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm-Cohort FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year-Cohort FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Obs. | 14,617 | 14,617 | 26,740 | 26,740 | 12,658 | 12,658 |
| Adjusted $R^2$ | 0.964 | 0.964 | 0.829 | 0.829 | 0.763 | 0.763 |
| Mean Dep. Var. | 1.316 | 1.316 | 0.011 | 0.011 | 0.492 | 0.492 |
| Within-FE Std. Dev. | 0.247 | 0.247 | 0.006 | 0.006 | 0.341 | 0.341 |

*, **, *** Indicate significance levels of 10 percent, 5 percent, and 1 percent, respectively.
This table shows the results of the effect of vertical integration on firm disclosure from 1997 to 2013, using a stacked cohort difference-in-differences regression. Panel A provides the descriptive statistics of variables used for the test. Panel B provides the regression results. Columns (1) and (2) show the validity test by relating *Hit* × *Post* to the number of suppliers (Ln(1+#*Suppliers*)). Columns (3)–(6) show the results on the relation between *Hit* × *Post* and (1) *MD&A ProductDisc* and (2) *PR ProductDisc*. All continuous variables are Winsorized at the 1 percent and 99 percent levels. Standard errors are clustered at the firm level and displayed in parentheses.

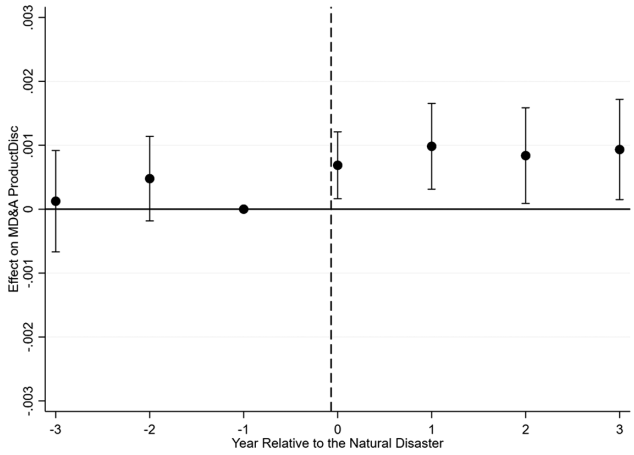
Variable Definitions:
*Hit* × *Post* = binary variable for years after any of the facilities of a firm are hit by a natural disaster.

We find the interaction term *Hit* × *Post* is significantly positive, which is consistent with the notion that firms affected by natural disasters do resort to using outside suppliers and enter contractual relationships with new suppliers. Columns (3) and (5) of Table 8, Panel B report results from using our two main product disclosure measures as the dependent variables—*MD&A ProductDisc* and *PR ProductDisc*, respectively. The coefficients of *Hit* × *Post* are significantly positive across both measures, suggesting that firms tend to increase their voluntary product disclosure after natural disasters.

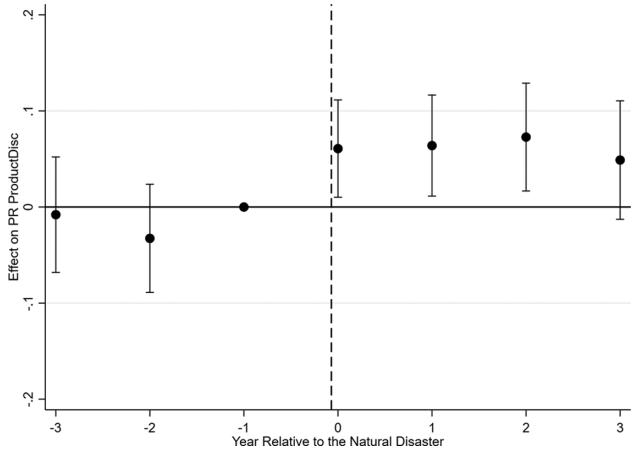
Our difference-in-differences analysis assumes that the trends we identify would be similar for treated and control firms in the absence of natural disasters (Angrist and Pischke 2013). To assess the reasonableness of this parallel-trends assumption, we perform a diagnostic test of firms' product disclosure choices in the preperiod and confirm that firms do not change their disclosure in the year before the natural disasters. To do so, we decompose the *Post* variable into year indicator variables that track the dynamic effects of natural disasters and set year $t-1$ to be the benchmark year. Columns (2), (4), and (6) of Table 8, Panel B report the dynamic effects on the number of suppliers and product disclosures, and Figure 2 illustrates these trends graphically. We find no differential trends across treatment and benchmark observations prior to the natural disasters, confirming the parallel-trends assumption. The effect on both the degree of vertical integration and product disclosure manifests only after natural disasters. Taken together, the results in Table 8 are consistent with our core inference that vertical integration portends a reduction in product disclosure.

**FIGURE 2**
**Trend Analysis of Natural Disasters on Voluntary Disclosure**

**Panel A: Dynamic Effects of Natural Disaster on *MD&A ProductDisc***




**Panel B: Dynamic Effects of Natural Disaster on *PR ProductDisc***




This figure plots the coefficients and 90 percent confidence intervals of coefficient estimates from regressing voluntary product disclosure on the interaction of *Hit* and separate year indicator variables that measure the dynamic effects each year of natural disasters over the [−3,+3] event window relative to the event year. We set year $t-1$ to be the benchmark year. Vertical dotted lines represent the event year when a major natural disaster hits any of a firm's facilities. Panels A and B report the results for *MD&A ProductDisc* and *PR ProductDisc*, respectively.

## VIII. CONCLUSION

Theories at the intersection of accounting and industrial organization suggest that public disclosure can facilitate coordination among partners along the supply chain. Applying these theories to how firm boundaries are shaped, we examine how vertical integration influences firms' public product disclosures. Vertical integration negates the coordination benefits of disclosure by creating a direct channel of private communication within firm boundaries.

Consistent with our predictions, we find that firms that become more vertically integrated reduce public disclosure about their products and that the reduction is (1) more pronounced for firms with higher relationship-specific investment and managerial career concerns, (2) less pronounced for vertically integrated firms in relationships that entail fewer credible public disclosures, (3) more pronounced among firms that rely more on public disclosures when private communication is less feasible *ex ante*, and (4) driven primarily by a reduction in disclosures related to firm strategy and expected production decisions. Finally, we use natural disasters that increase firms' reliance on contracting with outside suppliers as an exogenous shock to vertical integration and find consistent results that a decrease in vertical integration increases voluntary product disclosures.

Thus, although most of the disclosure literature focuses on the monitoring and valuation roles of public disclosure, our collective results provide evidence of another important role of public disclosure: facilitating coordination along the supply chain.

## REFERENCES


Alchian, A., and H. Demsetz. 1972. Production, information costs, and economic organization. *American Economic Review* 62: 777–795.

Angrist, J., and J. Pischke. 2013. *Mostly Harmless Econometrics: An Empiricists Companion*. Princeton, NJ: Princeton University.

Armony, M., and E. L. Plambeck. 2005. The impact of duplicate orders on demand estimation and capacity investment. *Management Science* 51 (10): 1505–1518. https://doi.org/10.1287/mnsc.1050.0371

Armstrong, C. S., S. Glaeser, and J. D. Kepler. 2019. Accounting quality and the transmission of monetary policy. *Journal of Accounting and Economics* 68 (2–3): 101265. https://doi.org/10.1016/j.jacceco.2019.101265

Arrow, K. J. 1975. Vertical integration and communication. *The Bell Journal of Economics* 6 (1): 173–183. https://doi.org/10.2307/3003220

Arya, A., B. Mittendorf, and D.-H. Yoon. 2019. Public disclosures in the presence of suppliers and competitors. *Contemporary Accounting Research* 36 (2): 758–772. https://doi.org/10.1111/1911-3846.12446

Atalay, E., A. Hortaçsu, and C. Syverson. 2014. Vertical integration and input flows. *American Economic Review* 104 (4): 1120–1148. https://doi.org/10.1257/aer.104.4.1120

Atalay, E., A. Hortaçsu, M. J. Li, and C. Syverson. 2019. How wide is the firm border? *The Quarterly Journal of Economics* 134 (4): 1845–1882. https://doi.org/10.1093/qje/qjz026

Baiman, S., and M. V. Rajan. 2002. The role of information and opportunism in the choice of buyer-supplier relationships. *Journal of Accounting Research* 40 (2): 247–278. https://doi.org/10.1111/1475-679X.00046

Baker, A. C., D. F. Larcker, and C. C. Y. Wang. 2022. How much should we trust staggered difference-in-differences estimates? *Journal of Financial Economics* 144 (2): 370–395. https://doi.org/10.1016/j.jfineco.2022.01.004

Banerjee, A. V., and E. Duflo. 2000. Reputation effects and the limits of contracting: A study of the Indian software industry. *The Quarterly Journal of Economics* 115 (3): 989–1017. https://doi.org/10.1162/003355300554962

Barrot, J.-N., and J. Sauvagnat. 2016. Input specificity and the propagation of idiosyncratic shocks in production networks. *The Quarterly Journal of Economics* 131 (3): 1543–1592. https://doi.org/10.1093/qje/qjw018

Bernard, D., T. Blackburne, and J. Thornock. 2020. Information flows among rivals and corporate investment. *Journal of Financial Economics* 136 (3): 760–779. https://doi.org/10.1016/j.jfineco.2019.11.008

Bertomeu, J., and P. J. Liang. 2015. Disclosure policy and industry fluctuations. *Management Science* 61 (6): 1292–1305. https://doi.org/10.1287/mnsc.2014.2003

Bertomeu, J., J. H. Evans III, M. Feng, and A. Tseng. 2021. Tacit collusion and voluntary disclosure: Theory and evidence from the U.S. automotive industry. *Management Science* 67 (3): 1851–1875. https://doi.org/10.1287/mnsc.2019.3531

Beyer, A., D. A. Cohen, T. Z. Lys, and B. R. Walther. 2010. The financial reporting environment: Review of the recent literature. *Journal of Accounting and Economics* 50 (2–3): 296–343. https://doi.org/10.1016/j.jacceco.2010.10.003

Bilir, L. K., and E. Morales. 2020. Innovation in the global firm. *Journal of Political Economy* 128 (4): 1566–1625. https://doi.org/10.1086/705418

Blackburne, T., J. D. Kepler, P. J. Quinn, and D. Taylor. 2021. Undisclosed SEC investigations. *Management Science* 67 (6): 3403–3418. https://doi.org/10.1287/mnsc.2020.3805

Bourveau, T., G. She, and A. Žaldokas. 2020. Corporate disclosure as a tacit coordination mechanism: Evidence from cartel enforcement regulations. *Journal of Accounting Research* 58 (2): 295–332. https://doi.org/10.1111/1475-679X.12301

Bova, F., Y. Dou, and O.-K. Hope. 2015. Employee ownership and firm disclosure. *Contemporary Accounting Research* 32 (2): 639–673. https://doi.org/10.1111/1911-3846.12084

Breuer, M., and E. deHaan. 2023. Using and interpreting fixed effects models. (Working paper). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3699777

Breuer, M., K. Hombach, and M. Muller. 2023. The economics of firms' public disclosure: Theory and evidence. (Working paper). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3037002

Brickley, J. A., J. S. Linck, and J. L. Coles. 1999. What happens to CEOs after they retire? New evidence on career concerns, horizon problems, and CEO incentives. *Journal of Financial Economics* 52 (3): 341–377. https://doi.org/10.1016/S0304-405X(99)00012-4

Brown, S. V., and J. W. Tucker. 2011. Large-sample evidence on firms' year-over-year MD&A modifications. *Journal of Accounting Research* 49 (2): 309–346. https://doi.org/10.1111/j.1475-679X.2010.00396.x

Burks, J. J., C. Cuny, J. Gerakos, and J. Granja. 2018. Competition and voluntary disclosure: Evidence from deregulation in the banking industry. *Review of Accounting Studies* 23 (4): 1471–1511. https://doi.org/10.1007/s11142-018-9463-1

Bushee, B. J., T. Keusch, and J. Kim-Gina. 2021a. Co-opetition and the firm's information environment. (Working paper). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3925687

Bushee, B. J., J. Kim-Gina, and E. Leung. 2021b. Public and private information channels along supply chains: Evidence from contractual private forecasts. (Working paper). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3736405

Cachon, G. P., and M. Fisher. 2000. Supply chain inventory management and the value of shared information. *Management Science* 46 (8): 1032–1048. https://doi.org/10.1287/mnsc.46.8.1032.12029

Calantone, R. J., and K. E.. Schatzel. 2000. Strategic foretelling: Communication-based antecedents of a firm's propensity to pre-announce. *Journal of Marketing* 64 (1): 17–30. https://doi.org/10.1509/jmkg.64.1.17.17990

Callaway, B., and P. H. C. Sant'Anna. 2021. Difference-in-differences with multiple time periods. *Journal of Econometrics* 225 (2): 200–230. https://doi.org/10.1016/j.jeconom.2020.12.001

Cao, S. S., G. Ma, J. W. Tucker, and C. Wan. 2018. Technological peer pressure and product disclosure. *The Accounting Review* 93 (6): 95–126. https://doi.org/10.2308/accr-52056

Cen, L., F. Chen, Y. Hou, and G. D. Richardson. 2018. Strategic disclosures of litigation loss contingencies when customer-supplier relationships are at risk. *The Accounting Review* 93 (2): 137–159. https://doi.org/10.2308/accr-51869

Chaney, P. K., T. M. Devinney, and R. S. Winer. 1991. The impact of new product introductions on the market value of firms. *The Journal of Business* 64 (4): 573–610. https://doi.org/10.1086/296552

Chapman, K. 2018. Earnings notifications, investor attention, and the earnings announcement premium. *Journal of Accounting and Economics* 66 (1): 222–243. https://doi.org/10.1016/j.jacceco.2018.05.002

Chen, G., X. Tian, and M. Yu. 2022. Redact to protect? Customers' incentive to protect information and suppliers' disclosure strategies. *Journal of Accounting and Economics* 74 (1): 101490. https://doi.org/10.1016/j.jacceco.2022.101490

Chiu, P.-C., L. Jiu, and P.-H. Yu. 2022. How do suppliers benefit from customers' voluntary disclosure? The effect of customers' earnings guidance on upstream firms' investment efficiency. *Journal of Accounting and Public Policy* 41 (1): 106880. https://doi.org/10.1016/j.jaccpubpol.2021.106880

Cho, Y. J., Y. Kim, and Y. Zang. 2020. Information externalities and voluntary disclosure: Evidence from a major customer's earnings announcement. *The Accounting Review* 95 (6): 73–96. https://doi.org/10.2308/tar-2017-0129

Costello, A. M. 2013. Mitigating incentive conflicts in inter-firm relationships: Evidence from long-term supply contracts. *Journal of Accounting and Economics* 56 (1): 19–39. https://doi.org/10.1016/j.jacceco.2013.02.001

Crawford, S., Y. Huang, N. Li, and Z. Yang. 2020. Customer concentration and public disclosure: Evidence from management earnings and sales forecasts. *Contemporary Accounting Research* 37 (1): 131–159. https://doi.org/10.1111/1911-3846.12526

Dedman, E., and C. Lennox. 2009. Perceived competition, profitability and the withholding of information about sales and the cost of sales. *Journal of Accounting and Economics* 48 (2–3): 210–230. https://doi.org/10.1016/j.jacceco.2009.07.003

Demski, J. S., T. R. Lewis, D. Yao, and H. Yildirim. 1999. Practices for managing information flows within organizations. *Journal of Law, Economics, and Organization* 15 (1): 107–131. https://doi.org/10.1093/jleo/15.1.107

Drake, M. S., N. M. Guest, and B. J. Twedt. 2014. The media and mispricing: The role of the business press in the pricing of accounting information. *The Accounting Review* 89 (5): 1673–1701. https://doi.org/10.2308/accr-50757

Dye, R. A. 1985. Disclosure of nonproprietary information. *Journal of Accounting Research* 23 (1): 123–145. https://doi.org/10.2307/2490910

Entwistle, G. M. 1999. Exploring the R&D disclosure environment. *Accounting Horizons* 13 (4): 323–342. https://doi.org/10.2308/acch.1999.13.4.323

Fan, J. P. H., and V. K. Goyal. 2006. On the patterns and wealth effects of vertical mergers. *The Journal of Business* 79 (2): 877–902. https://doi.org/10.1086/499141

Ferracuti, E. 2022. Information uncertainty and organizational design. *Journal of Accounting and Economics* 74 (1): 101493. https://doi.org/10.1016/j.jacceco.2022.101493

Ferreira, D., and M. Rezende. 2007. Corporate strategy and information disclosure. *The RAND Journal of Economics* 38 (1): 164–184. https://doi.org/10.1111/j.1756-2171.2007.tb00050.x

Frésard, L., G. Hoberg, and G. M. Phillips. 2020. Innovation activities and integration through vertical acquisitions. *The Review of Financial Studies* 33 (7): 2937–2976. https://doi.org/10.1093/rfs/hhz106

Giannetti, M., M. Burkart, and T. Ellingsen. 2011. What you sell is what you lend? Explaining trade credit contracts. *The Review of Financial Studies* 24 (4): 1261–1298. https://doi.org/10.1093/rfs/hhn096

Gigler, F. 1994. Self-enforcing voluntary disclosures. *Journal of Accounting Research* 32 (2): 224–240. https://doi.org/10.2307/2491283

Glaeser, S. 2018. The effects of proprietary information on corporate disclosure and transparency: Evidence from trade secrets. *Journal of Accounting and Economics* 66 (1): 163–193. https://doi.org/10.1016/j.jacceco.2018.04.002

Gofman, M., G. Segal, and Y. Wu. 2020. Production networks and stock returns: The role of vertical creative destruction. *The Review of Financial Studies* 33 (12): 5856–5905. https://doi.org/10.1093/rfs/hhaa034

Granja, J. 2018. Disclosure regulation in the commercial banking industry: Lessons from the National Banking Era. *Journal of Accounting Research* 56 (1): 173–216. https://doi.org/10.1111/1475-679X.12193

Hoberg, G., and S. K. Moon. 2017. Offshore activities and financial vs operational hedging. *Journal of Financial Economics* 125 (2): 217–244. https://doi.org/10.1016/j.jfineco.2017.05.003

Hoberg, G., G. Phillips, and N. Prabhala. 2014. Product market threats, payouts, and financial flexibility. *The Journal of Finance* 69 (1): 293–324. https://doi.org/10.1111/jofi.12050

Holmström, B. 1979. Moral hazard and observability. *Bell Journal of Economics* 10: 74–91.

Hribar, P., S. Melessa, D. H. H. Volant, and J. H. Wilde. 2022. Customer bargaining power and strategic financial reporting. (Working paper). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3696700

Hsu, P.-H., H.-H. Lee, S.-C. Peng, and L. Yi. 2018. Natural disasters, technology diversity, and operating performance. *The Review of Economics and Statistics* 100 (4): 619–630. https://doi.org/10.1162/rest_a_00738

Huang, Y. 2022. Government subsidies and corporate disclosure. *Journal of Accounting and Economics* 74 (1): 101480. https://doi.org/10.1016/j.jacceco.2022.101480

Kepler, J. D. 2021. Private communication among competitors and public disclosure. *Journal of Accounting and Economics* 71 (2–3): 101–387. https://doi.org/10.1016/j.jacceco.2021.101387

Klein, B. 2007. The economic lessons of Fisher Body–General Motors. *International Journal of the Economics of Business* 14 (1): 1–36. https://doi.org/10.1080/13571510601141112

Klein, B., R. G. Crawford, and A. A. Alchian. 1978. Vertical integration, appropriable rents, and the competitive contracting process. *The Journal of Law and Economics* 21 (2): 297–326. https://doi.org/10.1086/466922

Kogan, L., D. Papanikolaou, A. Seru, and N. Stoffman. 2017. Technological innovation, resource allocation, and growth. *The Quarterly Journal of Economics* 132 (2): 665–712. https://doi.org/10.1093/qje/qjw040

Lang, M., and E. Sul. 2014. Linking industry concentration to proprietary costs and disclosure: Challenges and opportunities. *Journal of Accounting and Economics* 58 (2–3): 265–274. https://doi.org/10.1016/j.jacceco.2014.08.008

Lee, H. L., V. Padmanabhan, and S. Whang. 1997. Information distortion in a supply chain: The bullwhip effect. *Management Science* 43 (4): 546–558. https://doi.org/10.1287/mnsc.43.4.546

Lee, H. L., K. C. So, and C. S. Tang. 2000. The value of information sharing in a two-level supply chain. *Management Science* 46 (5): 626–643. https://doi.org/10.1287/mnsc.46.5.626.12047

Lehavy, R., F. Li, and K. Merkley. 2011. The effect of annual report readability on analyst following and the properties of their earnings forecasts. *The Accounting Review* 86 (3): 1087–1115. https://doi.org/10.2308/accr.00000043

Leuz, C., and C. M. Schrand. 2009. Disclosure and the cost of capital: Evidence from firms' response to the Enron shock. (Working paper). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1319646

Leuz, C., and R. Verrecchia. 2000. The economic consequences of increased disclosure. *Journal of Accounting Research* 38: 91–124. https://doi.org/10.2307/2672910

Levin, J., and S. Tadelis. 2010. Contracting for government services: Theory and evidence from U.S. cities. *The Journal of Industrial Economics* 58 (3): 507–541. https://doi.org/10.1111/j.1467-6451.2010.00430.x

McMillan, J., and C. Woodruff. 1999. Interfirm relationships and informal credit in Vietnam. *The Quarterly Journal of Economics* 114 (4): 1285–1320. https://doi.org/10.1162/003355399556278

Merkley, K. J. 2014. Narrative disclosure and earnings performance: Evidence from R&D disclosures. *The Accounting Review* 89 (2): 725–757. https://doi.org/10.2308/accr-50649

Monteverde, K. 1995. Technical dialog as an incentive for vertical integration in the semiconductor industry. *Management Science* 41 (10): 1624–1638. https://doi.org/10.1287/mnsc.41.10.1624

Oh, J. 2023. Antitrust risk and voluntary M&A disclosure. (Working paper). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4381331

Pandey, V. 2023. Private disclosure contracts within supply chains and managerial learning from stock prices. (Working paper). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4397414

Riordan, M. H., and D. E. M. Sappington. 1987. Information, incentives, and organizational mode. *The Quarterly Journal of Economics* 102 (2): 243–263. https://doi.org/10.2307/1885062

Samuels, D. 2021. Government procurement and changes in firm transparency. *The Accounting Review* 96 (1): 401–430. https://doi.org/10.2308/tar-2018-0343

Shamir, N., and H. Shin. 2016. Public forecast information sharing in a market with competing supply chains. *Management Science* 62 (10): 2994–3022. https://doi.org/10.1287/mnsc.2015.2261

She, G. 2022. The real effects of mandatory nonfinancial disclosure: Evidence from supply chain transparency. *The Accounting Review* 97 (5): 399–425. https://doi.org/10.2308/TAR-2020-0178

Skinner, D. J. 1997. Earnings disclosures and stockholder lawsuits. *Journal of Accounting and Economics* 23 (3): 249–282. https://doi.org/10.1016/S0165-4101(97)00010-4

Teece, D. J. 1982. Towards an economic theory of the multiproduct firm. *Journal of Economic Behavior & Organization* 3 (1): 39–63. https://doi.org/10.1016/0167-2681(82)90003-8

Tirole, J. 1999. Incomplete contracts: Where do we stand? *Econometrica* 67 (4): 741–781. https://doi.org/10.1111/1468-0262.00052

Verrecchia, R. E. 1990. Information quality and discretionary disclosure. *Journal of Accounting and Economics* 12 (4): 365–380.

Zhang, H. 2002. Vertical information exchange in a supply chain with duopoly retailers. *Production and Operations Management* 11 (4): 531–546. https://doi.org/10.1111/j.1937-5956.2002.tb00476.x

## APPENDIX A

### Variable Definitions

| Variable | Definitions |
|---|---|
| **Dependent Variables** | |
| *MD&A ProductDisc* | The number of sentences with product-related phrases in the MD&A section of annual reports, scaled by the total number of sentences. |
| *PR ProductDisc* | The log of 1 plus the number of firm-initiated, product-related press releases in RavenPack database. |
| *Strategy Disc* | The natural logarithm of 1 plus the number of firm-initiated, product-related press releases that are more related to strategy coordination in RavenPack database. |
| *Production Disc* | The natural logarithm of 1 plus the number of firm-initiated, product-related press releases that are more related to production coordination in RavenPack database. |
| *Inter-segment Sales* | The natural logarithm of 1 plus the amount of inter-segment elimination, which represents revenues generated from sales to other business or geographic segments within a firm. |
| *PubInfo Acq* | The natural logarithm of 1 plus the number of SEC filings downloaded from the EDGAR database by firms' suppliers and customers in a year. We consider all types of SEC filings. A firm's suppliers and customers are identified using FactSet database. The variable is in the period of 2003–2016 due to data availability. |
| **Independent Variables** | |
| *VI* | The degree of vertical integration constructed by Frésard et al. (2020). |
| *Vertical Segments* | The inter-segment vertical relatedness measure using the 2007 Input-Output USE table. For industry pair *i-j*, we compute $A1$ as the purchase by *j* from *i* scaled by *j*'s total inputs and $A2$ as the purchase by *i* from *j* scaled by *i*'s total inputs. If $max(A1, A2) > 5$ percent, then industry *i* and *j* are vertically related. The inter-segment vertical relatedness is the total sales by all vertically related secondary segments scaled by a firm's total sales. |
| *Hit* | A binary variable for treatment firms, i.e., firms with any of their facilities hit by a natural disaster. |
| *Post* | A binary variable for years after the event year of an event-cohort. |
| *Size* | The natural logarithm of total assets. |
| *ROA* | Earnings before extraordinary items, scaled by total assets. |
| *Leverage* | The sum of short-term and long-term debt, scaled by total assets. |
| *Return Volatility* | The standard deviation of daily stock returns during the year. |
| *CFO Volatility* | The standard deviation of operating cash flows during the previous 20 quarters. |
| *MTB* | Market value of equity plus total liability scaled by total assets of the firm at fiscal year-end. |
| *Advertising* | The ratio of advertising expense to total assets. Missing value is set to 0. |
| *Tangibility* | The ratio of tangible assets to total assets. |
| *InstOwn* | The proportion of outstanding shares owned by institutional investors. |
| *Analyst Following* | The natural logarithm of 1 plus the number of analysts covering the firm. |
| *R&D Intensity* | The ratio of R&D expenditure to total assets. Missing value is set to 0. |
| *#Patents* | The number of patents filed in the year (Kogan, Papanikolaou, Seru, and Stoffman 2017). |
| *#SCPartners* | The number of suppliers and customers a firm has during the year. |
| **Cross-Sectional Variables** | |
| *R&D-to-Sales* | The ratio of R&D expenditure to sales. Missing value is set to 0. |
| *High Specificity* | A binary variable that equals 1 if the firm's ratio of R&D to sales and degree of input differentiation Giannetti et al. (2011) are both above the respective sample median. |
| *CEO Tenure* | The number of the CEO's service years at year *t*. |
| *CEO Age* | The age of the CEO at year *t*. |
| *High Career Concern* | A binary variable that equals 1 if the CEO's age is below the sample median or if the CEO's tenure is below the sample median. |
| *Restatement* | A binary variable that equals 1 if the firm issues a financial restatement that is not coded as an error by Audit Analytics in three years before entering year *t*. |
| *Duration* | The weighted-average duration of supply chain relationship based on the customer-supplier relationship database provided by Wharton Research Data Services. For each firm-year, we compute the weighted average of the duration between a firm and its current supply chain counterparties in the year. The weight is set to the transaction volume between a firm and its counterparties. |

*(continued on next page)*

**APPENDIX A (continued)**

| Variable | Definitions |
|---|---|
| *Short Duration* | A binary variable that equals 1 if the weighted-average duration of supply chain relationship is smaller than the yearly median and 0 otherwise. |
| **Additional Variables** | |
| *Issuance* | A binary variable that equals 1 if the firm issues at least one management earnings forecast at year *t*. |
| *Frequency* | The natural logarithm of 1 plus the number of management earnings forecast issued at year *t*. |
| *Forecast Error* | The average absolute value between forecasted management earnings forecast and actual earnings at year *t*, divided by the stock price at the beginning of year *t*. |
| *Forecast Precision* | The average value of an ordinal variable from 4 for point forecasts, 3 for range forecasts, 2 for open-ended forecasts, and 1 for qualitative forecasts at year *t*. |
| *HHI* | The Herfindahl-Hirschman Index (HHI) of the Text-based Network Industry Classifications (TNIC) (Hoberg and Moon 2017). |
| *Fluidity* | The 10-K-based product market fluidity (Hoberg et al. 2014). |

## APPENDIX B

### Examples of Product Disclosure

In this appendix, we provide examples of MD&A discussions and press releases to illustrate product-related discussion in firms' disclosures. For each example, we provide the name of the company, the date, and the link to the full statement. We added the emphases ourselves to highlight the specific content picked up by our measures.

#### MD&A Discussions

**[1] Arcadia Biosciences, Inc., December 31, 2016** (https://www.sec.gov/Archives/edgar/data/1469443/000156459017003724/rkda-10k_20161231.htm#ITEM_7_MANAGEMENTS_DISCUSSION_ANALYSIS_F)

Topic: Delivery Time and Product Focus

> *We have recently experienced delays in the review of many of our high value traits principally due to inaction from certain of these government regulatory authorities.* For example, in India, where regulators have not approved field trials for testing of GM traits for the last two years, we estimate the impact to the trait development and crop commercialization timelines of our license partner in India, Mahyco, could be at least two to three years. *Our highest near-term priorities include the expansion of the market for our SONOVA GLA products, bringing our non-GM traits in wheat quality and wheat yield to market, and working closely with our strategic partners to advance our yield trait in corn and soybeans.* In the U.S., we have partnered with Dow AgroSciences and Becks Hybrids for the development of yield traits in corn. (emphasis added)

**[2] Oragenics, Inc., December 31, 2014** (https://www.sec.gov/Archives/edgar/data/1174940/000119312515070177/d833684d10k.htm#tx833684_10)

Topic: Investment in Production

> In order to meet the challenge associated with producing sufficient quantities of MU1140 for our clinical trials and ultimately our commercialization efforts, *in June 2012, we entered into an exclusive channel collaboration agreement (the "Lantibiotic ECC") with Intrexon corporation ("Intrexon") for the development and commercialization of the native strain of MU1140 and related homologs using Intrexon's advanced transgene and cell engineering platforms.* We continue to pursue our research and development and collaboration efforts with Intrexon in accordance with the terms of the Lantibiotic ECC toward the development of the MU1140 molecule and potential derivatives of the molecule. (emphasis added)
>
> *We are working with third party manufacturers to produce additional quantities of designated homologs, based upon the developments achieved from our work with Intrexon and outside contractors*…We currently expect to have a pre Investigational New Drug ("IND") meeting with the FDA in the second half of 2015 and thereafter be in a position to file the IND for a first-in-human clinical study in 2016. We continue to work aggressively in the course of our research and development to meet these events. (emphasis added)

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**APPENDIX B (continued)**

**[3] Solazyme, Inc., December 31, 2014** (https://www.sec.gov/Archives/edgar/data/1311230/000155566715000031/solazyme10k2014-12x31.htm#s0D7FF20D754D969B9A32C92CD9B7BC04)
Topic: New Products and Market Penetration

> In the first quarter of 2011, *we began selling our consumer-focused Algenist® skin and personal care line in the Personal Care Products market. In the first quarter of 2014, we began manufacturing at commercial production scale, and we began selling intermediate and ingredient products. We expect to sell these intermediate and ingredients products broadly to customers in the Industrial Products and Food Products markets*…[W]e believe the sales volumes for the intermediate and ingredient products will be higher as we expand our large scale production. (emphasis added)

**[4] Alpha and Omega Semiconductor Limited, June 30, 2014** (https://www.sec.gov/Archives/edgar/data/1387467/000138746714000104/aosl630201410k.htm#sAF32E35D53195F15F1ED01147AC9E190)
Topic: Market Demand and Market Strategies

> The decrease in revenue of packaging and testing services as compared to last year was primarily due to reduced demand as a result of the declining PC market. *In response to the declining PC market, we have been executing and are continuing to execute strategies to diversify our product portfolio and penetrate into other market segments, which we believe would mitigate and eventually overcome the reduced demand resulting from the declining PC market.* During the fiscal year ended June 30, 2014, *we continued our diversification program by developing new silicon and packaging platforms to expand our serviceable available market, or SAM and offer higher performance products.* (emphasis added)

**Press Release**

**[1] Adtran, Inc., August 02, 2023** (https://www.businesswire.com/news/home/20230802224594/en/)
Topic: Product Announcement

> Adtran *today announced that Openreach, the UK's largest wholesale broadband network, has deployed its FSP 3000 open optical transport technology to enable its new Optical Spectrum Access 100 G Single enterprise service.* Openreach's new product offers a dedicated fiber link that empowers more UK businesses to harness point-to-point 100Gbit/s data transport. The solution also brings efficiency benefits that reduce capital and operational expenditure. (emphasis added)

**[2] Aterian, Inc., February 21, 2023** (https://ir.aterian.io/news-releases/news-release-details/aterian-announces-further-expansion-europe/)
Topic: Customer Demand and Market Penetration

> We are excited about the rapid progress we are making toward expanding our total addressable market. *We now sell approximately 90 products in Europe through Amazon and have been working closely with their team and other logistics partners to further scale our footprint. Expanding to Amazon Europe has been a strategic goal for Aterian given that Germany and the UK alone represent a $60B market with a promising growth trajectory.* While the last two years have slowed us down in terms of the number of products deployed, we made significant progress in setting up the necessary infrastructure required to scale. Now that shipping costs are finally normalized we are working hard to bring our best products to market. (emphasis added)

**[3] Fluence Energy, Inc., December 13, 2022** (https://ir.fluenceenergy.com/news-releases/news-release-details/fluence-design-and-manufacture-battery-packs-part-storage)
Topic: Product and Supply Chain Strategy

> Fluence Energy, Inc. ("Fluence") (NASDAQ: FLNC)…*today announced a strategic plan to develop Fluence-made battery packs, with production set to begin in early 2024 in the United States*…The development of a Fluence-built battery pack fits perfectly into our broader manufacturing and regional production strategy. Our main goals of this program are to provide increased flexibility for our customers, decrease supply chain disruptions, and ensure greater cost stability in a volatile market. This initiative is a key part of our ongoing strategy of investing in Fluence's global manufacturing and delivery infrastructure to best meet the needs of our regionally-diverse customers. (emphasis added)