How are competitor and competition types related to disclosure content? : evidence from segment-level disclosure in Japanese firms

Abstract

This paper focuses on the association between the multidimensional characteristics of product market competition and disclosure. The theorized negative relationship between competition and disclosure has yielded empirically mixed evidence. These inconclusive results can be attributed to the multiple dimensions of competition. Thus, this paper clarifies some of the characteristics of competition: competitor type and competition type. Competitor type consists of potential or existing competitors; their expected response could provide different benefits and costs of disclosure. Likewise, competition types can be categorized into technology, employee productivity, and product portfolio reorganization. This disaggregation approach follows the argument that the appropriate link between competition type and disclosure content is necessary when analyzing the effect of competition. The analysis partly reveals that the relationship with disclosure is altered depending on competitor type. However, the result is no longer confirmed once the disclosure status of competitors is considered. In contrast, the three competition types fail to show expected associations in their corresponding disclosure. This paper extends the literature about proprietary costs by investigating multiple aspects of product market competition on segment-level information. In addition, the findings suggest that a proper identification method is necessary to isolate strategic nondisclosure from missing information reflecting business characteristics.

Keywords

Product market competition, proprietary costs, competitor types, competition types, segment information

1. Introduction

This paper examines the relationship between product market competition and disclosure in the context of segment information in Japanese firms. Specifically, it considers the multidimensional nature of the competition, including with whom a particular firm competes (*competitor type*) and in which domain (*competition type*).

Researchers have focused on the relationship between competition and disclosure, as a firm's disclosure choice is one possible response to competition pressure (Karuna 2023). Internal information about strategy and value can incur costs if it leaks through disclosure and competitors take it to their own advantage (*proprietary costs*, Verrecchia 1983). These costs may encourage firms to hide their business-related information in the case of intense competition. However, the empirical findings investigating this proposition have been mixed, even when the focal information is the same¹. Some argue that this inconsistency may result from the multiple dimensions of competition (Li 2010; Cao et al. 2018; Karuna 2023).

One dimension deals with the competitor type: whether the firm is primarily exposed to potential or existing competitors (Suijs 2005; Li 2010; Karuna 2023). While potential competitors need to bear entry costs to enter the market, existing rivals can ignore them when determining future strategies (Li 2010). Given the potential benefit of disclosure to deter entry, there could be a positive relationship between potential competition and disclosure.

Another dimension of competition focuses on the specific type of competition that a firm encounters (Cao et al. 2018; Liang 2024). A firm is subject to competition from various aspects, including technology, employee productivity, and companywide product portfolio reorganization. Importantly, these disparate competition types create disparate information needs, suggesting that not all disclosed information presents expected negative relationships with competition. Instead, disclosure decisions would factor in the effect on competition only when the information matters to an important competition type a firm faces.

This paper attempts to integrate these two dimensions—competitor type and competition type—to comprehensively describe the relationship between competition and disclosure. On the one hand, the competitor-type viewpoint often overlooks the competition area. On the other hand, given the research design, the competition-type viewpoint rarely focuses on a particular competitor type. In addition, the competition types that have been investigated require further expansion. Therefore, this paper combines these aspects of the

¹ For example, for segment disclosure of U.S. firms, Ettredge et al. (2006) find a negatice relationshop between competition and dislocure transperancy. In contrast, Berger and Hann (2007) do not find evidence of competition deterring segment disclosure.

competition to present a more comprehensive view of the strategic disclosure choices of firms in product market competition.

This analysis utilizes segment information to investigate the multidimensionality of competition for the following two reasons. First, the information is likely related to proprietary costs. The segment information provides a detailed quantitative business description by disaggregating the companywide performance into each segment level. This characteristic can make it more sensitive to competition pressure and proprietary costs. This sensitivity will make segment information suitable for observing the relationship between competition level and disclosure. Accordingly, previous studies have demonstrated the effect of competition on this information (e.g., Tsakumis, Doupnik, and Seese 2006; Aboud and Roberts 2018).

The second rationale is that the segment information can help measure the competitive environment more accurately. Although some studies employ companywide industry code (i.e., a single code for a single firm), this method is inadequate for capturing the competition status of diversified firms that engage in multiple industries (Cao et al. 2018; Liang 2024). Therefore, this paper instead utilizes segment-level industry classification to create industry-wide variables.

This paper employs segment information of Japanese firms due to the prevalence of diversified companies compared to the U.S. and other countries. According to Ataullah et al. (2022), the percentage of firms with multiple segments in distinct industries is 82.74% in Japan, which is about double that of the U.S. (41.28%, in Table 2). The pervasiveness of diversified firms in Japan can create different disclosure motivations from other countries where most firms are concentrated in a single segment. The dominance of multi-segment firms could restrict managers from discretionally hiding information because investors would easily compare the disclosure level with other diversified firms. However, the rich information environment could also allow firms to circumvent disclosure demand (Liang, 2024). Consequently, the impact of the higher ratio of firms with multiple businesses on disclosure remains unclear and worth investigating.

The analysis finds weak evidence that supports the argument that competitor type has a distinct relationship with disclosure. Specifically, the likelihood of disclosure of research and development (R&D) expenditure is positively associated with potential competition, but it becomes negative when the pressure of existing competition heightens. This result is in line with Karuna's (2023) finding. However, the association cannot be found in other disclosure contents, namely, the number of employees and overall segment information. Moreover, the initial evidence of R&D expenditure becomes insignificant after accounting for the disclosure status of other firms in the same industry. In contrast, the analysis of competition types (technological competition, employee productivity competition, and overall product portfolio reorganization competition) does not confirm the necessity of the link between the type and disclosure content, which is inconsistent with the previous studies (Cao et al. 2018; Liang 2024). The insignificant results may be due to the imprecise identification of competition type and related disclosure content.

This paper makes several contributions to the literature. First, it contributes to the studies about the relationship between competition and disclosure. Their complex characteristics have been pointed out, and several modifications and identifications have been made. This paper aims to expand the existing knowledge by combining some dimensions of competition and suggesting potential avenues for further development. Furthermore, the findings indicate the need for more accurate isolation techniques between discretional disclosure decisions and underlying business characteristics. Second, it adds evidence to the research about segment disclosure. The existing literature regards segment disclosure as where both capital and product market players impose benefits and costs of disclosure, which prompts disclosing firms to consider both markets (André, Filip, and Moldovan 2016; Aboud and Roberts 2018). This paper provides an additional perspective on the effect of product market competition: its discouraging effect can vary with the context of competition and its relation with disclosure content.

The remainder of the paper is organized as follows. Section 2 reviews the literature and develops hypotheses. Section 3 provides the research design of the analysis. Section 4 presents descriptive statistics and the results of the empirical analysis. Section 5 concludes this paper.

2. Literature Review and Hypotheses Development

The discussion on disclosure starts from the *unraveling result* or *disclosure principle*, a theory that explains the situation where management voluntarily discloses all private information (Milgrom 1981). The principle assumes that (1) if management does not disclose any information, investors will interpret it negatively and revise their value estimation downward, and (2) management rationally expects this reaction in advance. Under this assumption, managements have an incentive for voluntary disclosure to distinguish themselves from those with unfavorable information.

In reality, however, the unraveling result seems implausible. The violation suggests that there are disclosure determinants that impose frictions on disclosure and ultimately prevent firms from achieving perfect transparency. Management would make disclosure decisions based on their motivations, external environments, benefits, and costs (Healy and Palepu 2001; Beyer et al. 2010). This paper focuses on costs imposed by firms' information related to their business and competence.

This type of disclosure cost, known as *proprietary costs*, has been postulated to be negatively related to disclosure (Verrecchia 1983). The theory demonstrates a threshold for disclosure contingent on the disclosure costs, which limits disclosure to those beyond the threshold. Higher proprietary costs establish higher disclosure thresholds and enable less disclosure without impairing investors' interpretation of firm value. These costs are frequently linked with segment-level information because this detailed information can reveal the structure and performance of each business unit compared to the companywide financial statements.

In contrast, prior research has empirically reached inconsistent conclusions about the relationship between proprietary costs and disclosure, even when concentrating on segment information. On the one hand, some researchers have found consistent results with the prediction (Tsakumis, Doupnik, and Seese 2006; Ettredge et al. 2006; Aboud and Roberts 2018). For example, firms decrease their disclosure ratio in individual countries (Tsakumis, Doupnik, and Seese 2006; Aboud and Roberts 2018) or reduce disclosure transparency (measured by the range of reported segment profits) (Ettredge et al. 2006) when they face intense competition and higher proprietary costs. On the other hand, other studies do not support these results (Berger and Hann 2007; André, Filip, and Moldovan 2016). Moreover, results are divergent even in the same analysis with altered measurements of disclosure² (Aboud and Roberts 2018).

These inconclusive empirical results have been attributed to several factors. The following sections introduce them and develop the hypothesis of this paper.

Competitor type and disclosure

The first aspect is the balance of benefits and costs of disclosure, which is influenced by the competitor type. Different types of competitors will bring different magnitudes of benefits and costs of disclosure to incumbent firms and potentially alter their disclosure decisions (Karuna 2023). This notion challenges the conventional prediction that a consistent negative relationship exists between the level of competition and the extent of disclosure. The competitor types can be classified into two categories: potential competitors and existing competitors. Potential competitors, or potential entrants, are firms seeking to enter the industry where the incumbent firms operate. The existing competitors are firms that have already established a presence in the industry and are attempting to expand their market share.

The pressure of entry from potential competitors can prompt the incumbent firms to expand voluntary disclosure to stave off entry (Suijs 2005; Li 2020; Karuna 2023). The extensive business-related information possibly lowers the prospect of profitability estimated by

 $^{^2}$ When Aboud and Robers (2018) measure the level of segment disclosure as the disclosure ratios in sales categorized in individual countries, they find a negative relationship with the competition level. However, when they proxy disclosure as the percentage of account items included in their unique list, they cannot find a significant relationship with the competition.

potential entrants, thereby ultimately deterring the intention to enter (Karuna 2023). Without such information that tells the harsh reality, potential entrants may overestimate future profits and decide to enter the market (Li 2010). Consequently, it can be expected that the threat posed by potential competitors is positively associated with the level of disclosure.

In contrast, for existing competitors, this disclosure expansion tactic can harm the incumbent firm, as the recipients can leverage the disclosed information to enhance their competitiveness (Karuna 2023). This unfavorable response from existing competitors can discourage incumbent firms from disclosing their business information. Furthermore, this detrimental reaction will likely intensify as existing competition increases. Therefore, the threat posed by existing competitors is expected to be negatively related to disclosure, which contrasts with the potential competitors.

Against these predicted contrasting relationships, the empirical examinations yield inconclusive results. Li (2010) yields a result that agrees with the predictions in the context of profit and investment forecasts. However, despite the similar disclosure variables with Li (2010), Ali, Klasa, and Yeung (2014) do not find a significant relationship between the threat from potential entrants and disclosure. Utilizing segment-level disclosure, Karuna (2023) examines the relationship between the two types of competitors and disclosure. Karuna (2023) finds evidence that supports the opposite effects of competitor types in the likelihood of disclosure of R&D expenditures. However, this pattern is not observed in other disclosure contents (the number of employees). These discrepancies may be due to the influence of another dimension of competition, which is discussed next.

Competition type and disclosure

Another aspect is the type of competition. Companies face various kinds of competition, likely impacting the priority of their attention to disclosed information. In other words, the relationship between competition and disclosure likely depends on the dimension of competition companies are interested in (Cao et al. 2018; Liang 2024). Given this characteristic, the previous discussion about competitor type and disclosure may additionally have to consider competition type.

Cao et al. (2018) propose three elements that can contribute to generating *proprietary disclosure costs* (p.99). The first one is the *alignment*, which represents the extent to which the disclosed information values to the rivals in the particular competitive context (p.121, Appendix A). They emphasize the importance of this element and specifically focus on the context of technological competition in their analysis. Cao et al. (2018) define *technological peer pressure (TPP)* as the relative technological development of rival firms, which is quantified by R&D expenditure. To align disclosure with this particular form of competition, they employ product-

related press releases as disclosure products. Their analysis demonstrates a consistent negative relationship between *TPP* and product-related disclosure across several specifications. Similarly, Liang (2024) finds a negative relationship between the intensity of advertising competition and the disclosure of advertising expenses.

The downside, however, is that they select competition peers from the defined current industry and cannot completely address the threat posed by potential entrants. Their measurement is based on the degree of overlap in sales across the reported segments and does not directly account for the likelihood of entry into the respective competition area. Accordingly, their results may solely reflect a specific part of the competitor type and not capture a comprehensive competition landscape. While Liang (2024) examines some variables related to the potential competition, they do not directly measure the threat of potential advertising rivalry. The threat of potential entry would vary with competition types; for example, the current technological competition seems to pose intense pressure of new entry on incumbent firms. In this situation, incumbent firms need to pay attention to potential competitors as well as their existing rivals. Hence, concurrently considering competitor and competition types should be worthwhile when investigating proprietary disclosure costs.

Hypotheses development

As a baseline of this paper's analysis, the first hypothesis follows Karuna's (2023) findings. Karuna's (2023) research design sets itself apart from Li (2010) and Ali, Klasa, and Yeung (2014) in that it combines the level of competition posed by the two competitor types into one variable. The approach would properly reflect the balance of the two competitors in each firm rather than measuring both effects separately. Up to a certain level of competition, where potential competitors dominate existing ones, the incumbent firms can benefit from increased disclosure by deterring entry. However, beyond a certain level of competition, where existing competitors put intense pressure relative to potential ones, the costs of disclosure start to exceed the benefits. Therefore, the following hypothesis is stated:

H1: Competition has an inverted U-shaped relationship with segment-level disclosure.

Meanwhile, given Cao et al. (2018) and Liang's (2024) argument, the initial hypothesis likely holds only when competition types are considered. Therefore, the subsequent hypotheses specify the links between competition and disclosure.

The first type of competition is technological, similar to Cao et al. (2018). Technology is a key to competitiveness in Japan, and its importance has been surging due to the intense competition with foreign countries (Japanese Business Federation 2024). The intensity of

competition could affect the budget allocation across the business portfolio (Zschocke et al. 2014), which would become public through segment information. Thus, firms particularly sensitive to technological competition would strategically make disclosure decisions. Given this argument, the following hypothesis is stated:

H1a: The relationship in H1 is observed in the link between technological competition and technology-related disclosure.

It should be noted, however, that not all companies engage with competition based on technological dimensions. In fact, in Cao et al. (2018), the number of observations is reduced by about a quarter due to zero R&D stocks (13,512 observations are omitted from the initial 42,710 in Table 1). This paper, thus, attempts to capture other types of competition. The second type of competition is employee productivity, which concerns the extent to which firms' competitiveness relies on the skills and capabilities of the workforce. Firms competing in this domain may monitor rivals' hiring activities in each segment to adjust their recruiting and allocation plans. In that case, the information about human capital allocation would become meaningful, and it would be carefully determined whether to disclose it from a strategic perspective. Thus, the following hypothesis is proposed:

H1b: The relationship in H1 is observed in the link between employee productivity competition and employee-related disclosure.

The final aspect of the competition lies in companywide product portfolio reorganization (PPR), which refers to the activities to reshape the overall segments of each firm to restore its profitability. Product portfolio management aims to maximize the portfolio value by meeting future customers' needs and accomplishing sustained market growth (Heising 2012). Heising (2012) argues that to achieve this objective, firms must coordinate their overall business strategies, a combination of products, and resource allocation. This activity can involve properly preparing for future competitive environments because misjudging the effect of competition would result in severe damage to firms' value (Zschocke et al. 2014). One potential means of scrutinizing rivals' companywide structures is segment-level information, where other firms report their portfolio components and resource allocation. This informativeness could impose severe costs on firms facing a pressing need to reconstruct their portfolio caused by a sales decline in the existing segments. Thus, the following hypothesis is stated: H1c: The relationship in H1 is observed in the link between companywide product portfolio reorganization competition and overall segment-level disclosure.

To summarize the perspectives utilized in the hypothesis development, Figure 1 illustrates the dimensions of competition a firm considers when determining disclosure.



Figure 1. The dimensions of product market competition

3. Research Design

3.1 Sample Selection

The analysis focuses on general business firms in Japan with a fiscal year between 1999 and 2023. The sample period is limited due to the data available from the database for segment-level foreign sales. All data is collected from Nikkei NEEDS-FinancialQUEST on an annual basis. To construct variables for segment-level competition, firms whose segments entail no four-digit Japan Standard Industrial Classification are excluded from the sample. This construction method also omits firms that segment their business geographically, which lacks the industrial classification code.

Following Karuna (2023), this selection process eliminates observations that the recorded segment sales or costs are either zero or negative. It also deletes observations with negative R&D expenditures and the number of employees to construct dependent variables. Requiring at least one dependent variable and a primary competition variable (described later), the final sample results in 57,607 observations spanning 86 industries. All Japanese yen items are adjusted by the Consumer Price Index (CPI) 2020 to account for the effect of inflation. All independent variables are winsorized at the 1st and 99th percentiles to mitigate the effect of outliers.

3.2 Variables

Dependent variables: Segment-level disclosure

This analysis uses three disclosure contents—R&D expenditure, number of employees, and overall segment-level disclosure—to investigate firms' disclosure decisions under product market competition. These contents are suitable for the research objectives because of the discretion firms could exercise in whether to disclose or to what extent they transparently disclose. For R&D expenditures and the number of employees, although the Japanese generally accepted accounting principle (GAAP) requires firms to disclose their values by assigning each segment, it also allows them to present as companywide shared resources by totaling up some segments. Furthermore, the standard admits flexible definitions of each number. In addition to the specific accounting items, the overall segment information also leaves managers with discretion in some respects. Appendix C provides a detailed explanation of their discretionary natures.

This paper focuses on R&D expenditures and the number of employees due to their informational nature. These measures partially represent forward-looking information about firms' value creation ability (Karuna 2023). Prior research suggests that R&D and human capital expenditures are associated with future firm values³ (Eberhart, Maxwell, and Siddique 2004; Regier and Rouen 2023). Therefore, segment-level reporting possibly enables rivals to react to the information more effectively than backward-looking information (Karuna 2023).

The following paragraphs outline the construction method of dependent variables, which develops from Karuna's (2023) methodology.

Disclosure of research and development expenditure. This paper sets two variables to test firms' intentions and discretion regarding R&D disclosure. The first variable assesses the likelihood of segment-level R&D expenditure disclosure. This status is captured by an indicator variable equal to one if a firm discloses R&D expenditures for a segment and zero otherwise. In the case of firms with multiple segments, the indicator variables are assigned to an individual segment. The segment-level values are averaged into a firm-level value by using the proportion of a segment's sales to the total sales by each firm and year as a weight. The value, hence, could be continuous, ranging from zero to one instead of a dichotomous variable. The variable is labeled as *RDDISC*.

The challenge caused by this method is that it does not distinguish whether the firm intentionally conceals the information or indeed does not spend the R&D expenditure on that

³ It may be conceivable that human capital expenditures are not directly related to the number of employees. Some companies may increase compensation while maintaining a constant workforce. However, it would be reasonable to assume that the individual pay increase is constrained at a certain point and management may in turn allocate compensation budget to new workers in order to enhance their capacity for value creation. In this point, the number of employees can work as a sign of investement for future firm-value.

particular segment. To address this issue, this paper introduces another indicator variable that captures the relevant disclosure level of a firm⁴. In addition to a firm disclosing the R&D expenditure of a segment, the new variable also takes a value of 1 if a firm and all of its competitors do not disclose the expenditure, assuming that this situation indicates a lack of R&D activities across the industry. In contrast, it takes a value of 0 if other rivals disclose the information while a firm does not. The segment-level industry is defined by the primary code assigned to each segment⁵. The rivals are identified as those sharing the same middle-class industry code (two-digit code) at each particular segment and each year. The values are totaled using the same method as *RDDISC*. This variable is called *RDCOM*. This identification could help differentiate managers' intention to disclose from actual business characteristics.

Disclosure of the number of employees. Similar to R&D expenditures, this paper uses two variables to quantify whether a firm strategically discloses information about the number of employees. The employees can include full-time and part-time personnel, but the precise definitions and scopes of employees are left to each firm. The first variable is *EMPDISC*, which is equal to one if a firm discloses the number of employees at a specific segment and zero otherwise. The treatment of firms with multiple segments is the same as that of *RDDISC*.

To extract the discretional behavior from actual variation of human resource allocation, this paper tries to construct some additional variables. One variable follows a similar method as *RDCOM*: it takes a value of one if at each segment and each year, (1) a firm discloses the number of employees, or (2) a firm and all of its competitors within the industry do not disclose the information. If a firm does not disclose but at least one of its rivals does, zero value is assigned to that segment. This indicator value of each segment is aggregated with the weight, which is the proportion of segment sales to total firm sales. The variable is denoted as *EMPCOM*. The other variable utilizes the volume of assets allocated per capita. If the value is significantly higher than the industry standard, it may indicate that the firm manipulates the disclosed number to conceal unfavorable information. If the value exceeds the third quartile in each industry and each year, the segment gets the value of zero, assuming to conceal accurate information; otherwise, it gets one. The summed method is the same as before. The variable is defined as *ASEMP*.

The overall segment disclosure. The final disclosure content is the overall segment disclosure. Prior literature has struggled to measure the level of this information from various

⁴ It should be noted that Karuna (2023) attempts to quantify the level of R&D expenditure by dividing the amount by the firm-level total assets. However, the resulting value may represent the actual investment level for each firm that responds to competition level. The separation of real activities from strategic disclosure decisions, including real earnings managements, could require more sophisticated approach. Therefore, this paper does not follow his approach and instead proposes another measurement. ⁵ The database assigns a maximum of three industry codes for one segment.

perspectives, including whether the proxy reflects the quantity or the quality of disclosure (André, Filip, and Moldovan 2016). This paper focuses on the fineness of the two revenue segmentation types—reportable segments or entity-wide foreign sales information—to especially investigate the relationship between the level of PPR competition and related disclosure. The idea of fineness relies on Leung and Verriest (2015) and Kobbi-Fakhfakh, Shabou, and Pigé's (2020) method of utilizing foreign revenue information.

The reportable segments generally comprise business structures. Thus, assuming that each segment engages in one industry would be reasonable. However, the database sometimes assigns more than one distinct industry code to one segment. This paper leverages this difference between the number of different two-digit codes assigned to segments and the number of segments in a firm. Specifically, the number of codes assigned to segment. The resulting variable, *REPFINENESS*, is the ratio of the number of segments to the number of industry codes. A value close to one means that the number of codes is close to the number of segments, indicating that firms disclose transparent information. In contrast, if a firm aggregates multiple businesses into a single disclosed segment, the denominator increases, and the total value decreases.

Following Kobbi-Fakhfakh, Shabou, and Pigé (2020), the revenue of foreign countries is categorized from the broad "Foreign" unit to the single "country" or "jurisdiction" unit based on the labels of firms' reporting. The second variable utilizes this categorization to weigh each foreign revenue and construct *GEOFINENESS*. Similar to *REPFINENESS*, the larger value suggests the finer geographic disclosure.

The detailed construction process of *REPFINENESS* and *GEOFINENESS* is provided in Appendix B.

Main independent variables: Competition measures

The competition measures employed in this paper follow Karuna (2023) because the author identifies the limitation of conventional competition measurement. Karuna (2023) explains that the standard proxy of competition, industry concentration, may not accurately reflect the degree of competition. In contrast to the conventional assumption of decreased competition, greater industry concentration can also result from increased competition⁶ (Karuna 2023). Consequently, it suffers from an endogeneity issue. To cope with this problem, Karuna (2023) proposes other measurements along with controlling industry concentration.

⁶ For example, when intense price competition forces some firms to exit or merge, the industry concentration *increases*. Conversely, when an appealing market attracts numerous entrants, the industry concentration *decreases* but competition intensifies (Karuna 2023).

The first variable represents product substitutability, defined as "the extent to which close substitutes exist for a particular product in an industry" (Karuna 2023, p.149). This level is represented as the price-cost margin at a segment level. The price-cost margin is calculated as industry operating profit divided by industry sales. These industry-level values are computed by taking the sum of the value of each segment based on the primary two-digit codes in each year. For firms with multiple segments, each segment-level price-cost margin is combined into firm-level value by weighting each value with a proportion of the segment's sales to a firm's total sales each year. To positively correlate the value with product substitutability, the firm-level value is multiplied by -1, finally defined as *SUB*. The higher *SUB* indicates the higher product substitutability and, thus, the intense price competition a firm faces.

The second variable is market size, defined as "the level of demand for a particular product in a given industry" (Karuna 2023, p.150). The market size has been associated with the attractiveness of the market and intense price competition. The value is proxied by the log-transformed industrial segment sales at the two-digit industry code. The aggregation process for a firm-level value is the same as *SUB*. The variable, labeled *MKTSIZE*, positively correlates with the competition level.

Finally, the third variable is entry costs, defined as "costs that firms incur to enter an industry" (Karuna 2023, p.150). The costs may work as an entry barrier, which can help lower the potential competition. To measure these costs, this paper calculates the weighted average value of the segment-level total assets across the industry⁷. The industry-level summation is based on the two-digit industry code and weighted by each segment's market share in this industry. The market share is computed by dividing the segment sales figure by the industry's total sales. The procedure to total each segment's entry costs to firm-level entry costs repeats that of *SUB* and *MKTSIZE*. The costs are log-transformed and multiplied by -1 to positively associate with potential competition. The eventual value is labeled *ENTRY*, and the larger value represents lower entry costs and intense potential competition.

In the analysis, these three variables—*SUB*, *MKTSIZE*, *ENTRY*—are aggregated into one variable to comprehensively capture the level of product market competition (Karuna 2023). The aggregated variable, *COMPEINTEX*, is computed by averaging the percentile rankings of the three competition variables. *COMPEINTEX* is positively related to the intensity

⁷ It is important to note that while Karuna (2023) utilizes the sum of the cost of property, plant, and equipment (PP&E) and intangibles at the firm level to measure entry costs, this paper instead utilizes the total assets at each segment level. This difference stems from the fact that the accounting standard does not mandate the disaggregation of the components of assets at the level of segment disclosure. Given that many firms operate across multiple industries, it might not be appropriate to assign the entire PP&E and intangibles to a single firm-level industry. Therefore, this paper modifies Karuna's (2023) approach by positing that segment-level assets represent the entry costs of the industry more accurately than firm-level assets. However, it should be noted that the total assets may also include those that are not directly relevent to entry costs.

of a firm's overall competition in general. Meanwhile, the variable would have nonmonotonic relationships with disclosure, if any, due to the contrasting effect from competitors (potential and existing competitors).

Control variables

Firstly, this paper controls the industry concentration using a four-firm concentration ratio (*CONC*). The variable is calculated based on the sales of individual segments each year. *CONC* refers to the sum of the proportions occupied by the top four firms in the two-digit industry classification.

Other control variables are included in the analysis to control a set of factors that likely affect the disclosure. Information demand from foreign investors would encourage firms to disclose (Barako, Hancock, and Izan 2006; Khlif and Souissi 2010). Thus, the ratio of foreign investors (*FORINV*) is included in the analysis. The ratio is the number of shares owned by foreign institutions divided by the number of shares issued at the end of the period (excluding treasury shares). In addition, variables for firm-level characteristics are controlled. Specifically, the natural log of total assets (*ASSETS*), market-to-book ratio (*MTB*), log of R&D intensity (*RD*), the sum of the change in total debt and equity finance (*EXTFINANCE*), leverage ratio (*LEV*), the ratio of institutional investors (*INSTINV*), and foreign sales ratio (*FORSALE*). The specific definitions of all variables are explained in Appendix A.

3.3 Analysis Models

The baseline hypothesis of this paper (H1) is based on the prediction that the relationship between competition and disclosure depends on the competitor type. To examine this hypothesis, this paper conducts piecewise linear continuous (spline) regressions in accordance with the method employed by Karuna (2023). The regressions set the breakpoints (knots) at the 33rd and 67th percentiles of an aggregate competition index (*COMPEINDEX*).

All regressions utilize tobit models ranging from zero to one at the firm-year level because all dependent variables can take continuous values within that range. The regression model is represented by Equation (1) below. Robust standard errors are computed by clustering at the companywide industry level to which a firm belongs.

DISCLOSURE PROXY_{i,t} = $\alpha + \beta_1 COMPEINDEX_{i,t} + \beta_2 CONC_{i,t} + \beta_3 ASSETS_{i,t} + \beta_4 MTB_{i,t} + \beta_5 RD_{i,t} + \beta_6 EXTFINANCE_{i,t} + \beta_7 LEV_{i,t} + \beta_8 INSTINV_{i,t} + \beta_9 FORINV_{i,t} + \beta_{10} FORSALE_{i,t} + year dummy + \varepsilon...(1)$

The variable *DISCLOSURE PROXY*_{*i*,*t*} represents the seven dependent variables of firm i and year t (*RDDISC*_{*i*,*t*},*EMPDISC*_{*i*,*t*},*RDCOM*_{*i*,*t*},*EMPCOM*_{*i*,*t*},*ASEMP*_{*i*,*t*},*REPFINENESS*_{*i*,*t*}, or *GEOFINENESS*_{*i*,*t*}). This paper mainly focuses on β_1 , which represents how the competition level is related to disclosure. Hypothesis 1 predicts a positive β_1 up to a certain level of competition, after which it is predicted to turn negative. As industry concentration (*CONC*) may result from various competitive situations, β_2 does not introduce any prediction (Karuna 2023).

Note that the above predictions can be conditional on the context of competition and disclosure, as demonstrated by Cao et al. (2018) and Liang (2024). Accordingly, this paper subsequently conducts subsample analyses by categorizing samples according to the type of competition. The method is described in section 4.2.

4. Results

4.1 Descriptive Statistics

Table 1 presents the descriptive statistics of the variables. The mean values of *RDDISC* and *EMPDISC* indicate that about 30% and 80% of firms in the samples disclose R&D expenditure and the number of employees at the segment level. While the value of *RDDISC* is similar to Karuna (2023) (0.36), that of *EMPDISC* is higher than his report (0.62). The mean *RDCOM* (over 55%) and *EMPDISC* (about 85%) are higher than their original variables, implying that some companies do not allocate each resource to segments in the first place. *REPFINENESS* and *GEOFINENESS* present average values of less than one (0.750 and 0.669, respectively), which indicates that not all companies report segment information with maximum transparency. The competition level of each firm and year (*COMPEINDEX*) disperses.

Table 2 presents the correlation matrix. By construction, a strong and positive correlation is shown between *RDDISC* and *RDCOM* and between *EMPDISC*, *EMPCOM*, and *ASEMP*. The variable for competition, *COMPEINDEX*, is not strongly correlated with the disclosure variables, which could imply a nonlinear relationship between competition and disclosure. The industry concentration variable (*CONC*) is negatively related to *COMPEINDEX* (-0.323), while it is positively, albeit weakly, related to product substitutability (*SUB*, 0.063). This contradiction possibly supports the notion that industry concentration is affected by competition characteristics and, thus, may be inappropriate for measuring the degree of competition.

Table 1. Descriptive statistics

Variable	Ν	Mean	p25	p50	p75	SD
RDDISC	57,607	0.303	0.000	0.000	0.878	0.435
EMPDISC	57,607	0.819	0.949	1.000	1.000	0.373
RDCOM	57,607	0.567	0.023	0.768	0.992	0.430
EMPCOM	57,607	0.842	0.957	1.000	1.000	0.346
ASEMP	57,607	0.624	0.000	0.898	1.000	0.434
REPFINENESS	57,607	0.750	0.600	0.750	1.000	0.202
GEOFINENESS	20,124	0.669	0.567	0.750	0.779	0.218
COMPEINDEX	57,607	50.246	42.112	51.829	60.249	13.697
SUB	57,607	-0.069	-0.087	-0.065	-0.043	0.036
MKTSIZE	57,607	15.737	15.052	15.899	16.626	1.157
ENTRY	57,607	-13.022	-13.549	-13.019	-12.461	1.117
CONC	57,607	0.420	0.305	0.400	0.527	0.156
ASSETS	57,538	10.669	9.451	10.528	11.756	1.806
MTB	36,415	-0.138	-0.594	-0.195	0.253	0.660
RD	57,607	-2.781	-4.784	-3.202	0.000	2.571
EXTFINANCE	55,406	0.284	-0.161	0.011	0.153	1.482
LEV	57,538	0.531	0.369	0.534	0.692	0.214
INSTINV	57,607	0.189	0.063	0.166	0.297	0.149
FORINV	57,607	0.092	0.006	0.041	0.140	0.116
FORSALE	57,607	0.125	0.000	0.000	0.190	0.210

4.2 Main Analysis

Baseline analysis: the relationship between competitor type and disclosure

Table 3 provides the results for the baseline regression models of Equation (1). The number of observations declines from the entire sample primarily due to the fact that one variable, *EXTFINANCE*, necessitates the use of its lagged observations. Additionally, one of the dependent variables, *GEOFINENESS*, also causes a reduction in sample size, presumably because only a portion of Japanese firms generate revenues outside the domestic country.

In column 1, the coefficients of *COMPEINDEX* reveal a nonmonotonic relationship between competition and disclosure only about the unadjusted R&D expenditure disclosure (*RDDISC*). The sign of the coefficients flips from positive (0.016) to negative at the third tercile (-0.030), both of which are significant at the 1 percent level. This relationship is in line with Karuna's (2023) finding.

	naum									
	1	2	3	4	5	6	7	8	9	10
1. RDDISC	1.000									
2. EMPDISC	0.265	1.000								
3. RDCOM	0.616	0.152	1.000							
4. EMPCOM	0.243	0.927	0.214	1.000						
5. ASEMP	0.198	0.659	0.147	0.611	1.000					
6. REPFINENESS	0.036	-0.018	-0.008	0.003	-0.034	1.000				
7. GEOFINENESS	0.005	0.038	-0.010	0.051	0.044	0.086	1.000			
8. COMPINDEX	0.101	0.083	0.037	0.082	0.045	0.018	0.004	1.000		
9. SUB	0.047	0.056	0.099	0.095	0.098	-0.007	0.095	0.644	1.000	
10. MKTSIZE	0.229	0.073	-0.041	0.062	0.033	0.052	0.068	0.283	0.037	1.000
11. ENTRY	-0.118	-0.008	0.001	-0.002	-0.025	0.013	-0.052	0.322	0.030	-0.554
12. CONC	-0.117	-0.012	0.072	0.016	0.021	-0.073	0.024	-0.323	0.063	-0.326
13. ASSETS	0.187	-0.004	0.151	0.011	-0.059	-0.176	-0.166	0.019	0.090	0.151
14. MTB	-0.010	-0.064	0.027	-0.049	-0.052	-0.015	-0.007	-0.129	-0.146	-0.015
15. RD	-0.413	-0.083	-0.078	-0.070	-0.043	-0.010	0.036	-0.141	-0.085	-0.213
16. EXTFINANCE	-0.008	-0.023	-0.010	-0.023	-0.025	0.009	0.006	-0.022	-0.034	-0.034
17. LEV	-0.117	-0.060	0.030	-0.038	-0.016	-0.059	0.024	0.001	0.162	-0.015
18. INSTINV	0.274	0.136	0.118	0.083	0.080	-0.136	-0.103	0.064	0.075	0.133
19. FORINV	0.117	-0.021	0.038	-0.036	-0.092	-0.082	-0.061	-0.051	-0.104	0.080
20. FORSALE	0.297	0.012	0.096	0.013	-0.001	0.050	0.136	0.071	-0.001	0.271
	11	12	13	14	15	16	17	18	19	20
11. ENTRY	1.000									
12. CONC	-0.197	1.000								
13. ASSETS	-0.227	-0.044	1.000							
14. MTB	0.024	-0.022	0.167	1.000						
15. RD	0.112	0.097	-0.190	0.088	1.000					
16. EXTFINANCE	0.005	0.001	-0.008	0.025	0.015	1.000				
17. LEV	-0.074	0.013	0.145	0.170	0.075	0.008	1.000			
18. INSTINV	-0.129	-0.079	0.624	0.110	-0.224	-0.024	-0.011	1.000		
19. FORINV	-0.101	-0.029	0.520	0.260	-0.082	0.023	-0.158	0.387	1.000	
20. FORSALE	-0.200	-0.091	0.325	0.136	-0.146	0.008	-0.097	0.311	0.362	1.000

Notes: Table 2 presents the Pierson correlation matrix. The correlation coefficients that are statistically significant at 1 percent are in bold.

	Dependent variable						
Independent variable	RDDISC	EMPDISC	RDCOM	EMPCOM	ASEMP	REPFINENESS	GEOFINENESS
COMPINDEX							
\leq 33rd percentile	0.016***	-0.001	0.000	-0.001	-0.002	0.000	0.003
	(0.006)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
33rd percentile <							
\leq 67th percentile	-0.000	0.004***	0.007**	0.004***	0.005**	-0.001	-0.001
	(0.006)	(0.001)	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)
> 67th percentile	-0.030***	0.002	-0.008	0.002	-0.004	-0.000	0.002
	(0.007)	(0.001)	(0.006)	(0.001)	(0.003)	(0.001)	(0.001)
CONC	-0.435	0.069*	0.448***	0.088**	0.264***	-0.177***	0.048
	(0.309)	(0.042)	(0.115)	(0.041)	(0.080)	(0.063)	(0.054)
ASSETS	-0.007	-0.033***	0.008	-0.031***	-0.063***	-0.033***	-0.034***
	(0.021)	(0.006)	(0.008)	(0.005)	(0.009)	(0.004)	(0.005)
MTB	0.020	-0.018*	0.031	-0.017*	-0.024	0.007	-0.020***
	(0.032)	(0.010)	(0.023)	(0.009)	(0.015)	(0.008)	(0.008)
RD	-0.208***	-0.005*	-0.008	-0.005*	-0.000	-0.008**	0.000
	(0.017)	(0.003)	(0.006)	(0.002)	(0.004)	(0.003)	(0.003)
EXTFINANCE	0.004	-0.003*	0.003*	-0.003*	-0.001	0.000	0.001
	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
LEV	-0.626***	-0.111***	-0.057	-0.097***	-0.004	-0.087***	0.055*
	(0.135)	(0.040)	(0.051)	(0.037)	(0.050)	(0.029)	(0.031)
INSTINV	0.796***	0.044	0.263***	0.040	0.214***	-0.154***	-0.030
	(0.185)	(0.041)	(0.088)	(0.038)	(0.065)	(0.045)	(0.048)
FORINV	-0.266	-0.175***	-0.148	-0.144***	-0.315***	-0.033	0.174***
	(0.205)	(0.057)	(0.097)	(0.055)	(0.097)	(0.048)	(0.062)
FORSALE	1.058***	0.051	0.111	0.048	0.099*	0.182***	0.221***
	(0.157)	(0.032)	(0.070)	(0.031)	(0.051)	(0.034)	(0.038)
Intercept	-0.971***	1.399***	0.242**	1.367***	1.395***	1.387***	0.894***
	(0.370)	(0.079)	(0.121)	(0.074)	(0.123)	(0.081)	(0.096)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.150	0.064	0.017	0.068	0.059	0.115	23.885
Ν	35,172	35,172	35,172	35,172	35,172	35,172	15,177

Table 3. Regression analysis of competitor type and disclosure content

Notes: Table 3 shows the results of the tobit regression analysis. ***, **, and * denote significance at the 1%, 5%, and 10% levels,

respectively. The parentheses show clustered standard error at the two-digit industry level.

However, this inverted U-shape relationship does not hold in columns 2 to 7 of the other variables. The coefficients of variables representing disclosures of R&D expenditures or the number of employees are only significant at the middle tercile, and the low and high terciles do not show a clear relationship with disclosure. Notably, *RDCOM*, which incorporates the likelihood of R&D investments, vanishes the previous nonlinear relationship observed at *RDDISC*. This discrepancy could be attributed to the possibility that industry characteristics correlate with both R&D expenditures and competition levels^{8,9}.

Taken together, the results of Table 3 only partially support hypothesis 1. This conclusion may be attributed to the lack of perspective about various competition types. The subsequent analysis takes this aspect into account by categorizing the entire sample.

Subsample analysis: the relationship between competition type and disclosure

This section further examines whether the previous results about competitor type require the inclusion of competition type to establish a more precise relationship between competition and disclosure. Specifically, this paper selects three dimensions of competition: technological competition, employee productivity competition, and companywide product portfolio reorganization (PPR) competition.

The first type of competition, technological competition, refers to whether a firm competes with its peers by deploying technological resources and knowledge. This paper categorizes the entire sample into two groups: "high-tech firms" and "other firms," following Cao et al. (2018). Cao et al. (2018) define high-tech firms as those in the Pharmaceuticals, Computer Hardware, and Telecommunications Equipment industries¹⁰. These firms are likely more sensitive to rivals' R&D measures than non-high-tech firms. Thus, hypothesis H1a anticipates that high-tech firms demonstrate a nonmonotonic relationship with R&D expenditure disclosure.

⁸ The results do not qualitatively change when the tobit model is replaced by the linear probability model.
⁹ Another plausible factor that could influence the findings is the accounting framework of segment disclosure. The Japanese GAAP, a standard that the majority of Japanese companies use, has set a new framework that has been adopted since the fiscal year starting in April 2010. To examine the possible influence of different accounting regulations, the sample is divided by whether firms report segment information according to the new standard. The results demonstrate that the previous nonlinear result of R&D expenditure is confirmed only under the current segment information framework. However, other variables are not affected by the change in accounting standards.

¹⁰ In Japanese Industry Classification Code (three-digit), industry related to pharmastical is coded as 165 (Medicine), that related to computer hardware is coded as 303 (Electronic data processing machines, digital and hybrid computer, and peripheral equipment), and that related to telecommunications equipment is coded as 371 (Fixed telecommunications), 372 (Mobile telecommunications), or 391 (Computer programming and other software services).

The second type of competition involves employee productivity, which is measured by dividing the total sales by the number of workers¹¹ (Nguyen et al. 2019; Endale 2023). This paper divides the entire sample by the median value of each industry and year. A previous study confirms the association between labor productivity and firm profitability or performance (Nguyen et al. 2019). Thus, the above-median group could indicate greater importance of employee productivity for firm value than the low-median group. To this end, it would value segment-level employee information. If the above-median group presents an inverted U-shaped relationship with employee-related disclosure (the number of employees), this would support hypothesis H1b.

The third type of competition pertains to product portfolio reorganization (PPR), where companies fight for long-term survival with strategic restructures of business segments. In such circumstances, their PPR strategies can be vital, and product portfolio information, which largely overlaps with overall segment information, would require a strategic disclosure decision. The competition will intensify if the current components of the portfolio become obsolete and require reorganization. The pressure may prompt firms to inspect rivals' remaining potential while attempting to avoid disclosing their weaknesses in order to prevent exploitation by rivals.

This paper proxies the intensity of competition by the industry situation that would lead to pressure for reorganization. The pressure is identified by whether a given firm has segments whose industry declined in profitability from the previous year. If this is the case, the firm is labeled as "high PPR competition," which implies the urgent need for portfolio reorganization. The remaining firms are categorized as "low PPR competition." Hypothesis H1c is supported when the high PPR competition group presents a disclosure pattern of H1 regarding overall segment disclosure.

The results are shown in Table 4. For brevity, each panel presents the coefficients of *COMPEINDEX* by each tercile and the main control variable *CONC*. Panel A provides the results of the technological competition type. The coefficients show that the inverted U-shaped relationship in Table 3 (in *RDDISC*) is driven by firms that do not compete in high-tech industries. In fact, high-tech firms do not present a significantly positive relationship with R&D expenditure disclosure when the current level of competition is low (\leq 33rd percentile). Additionally, the results of *RDCOM* are still insignificant in both groups. Hence, hypothesis H1a is not supported.

¹¹ The number of companywide workers are disclosed in annual report independent on segment reporting status.

Panel A Technological competition and R&D expenditure disclosure					
		Depende	nt variable		
	RDDISC	RDDISC	RDCOM	RDCOM	
	High-Tech	Other	High-Tech	Other	
COMPINDEX					
\leq 33rd percentile	0.024	0.017***	0.004	0.001	
	(0.032)	(0.006)	(0.028)	(0.002)	
33rd percentile <	0.016*	-0.002	0.015*	0.006**	
\leq 67rd percentile					
	(0.009)	(0.005)	(0.008)	(0.003)	
> 67rd percentile	-0.028***	-0.029***	-0.015*	-0.008	
	(0.004)	(0.007)	(0.008)	(0.006)	
CONC	-0.867	-0.383	-0.401	0.459***	
	(0.646)	(0.289)	(0.439)	(0.113)	
Other controls	Yes	Yes	Yes	Yes	
Year Dummy	Yes	Yes	Yes	Yes	
Pseudo R ²	0.053	0.157	0.039	0.018	
Ν	1,360	33,812	1,360	33,812	

Table 4. Subsample analysis: the link between competition type and

disclosure content

Panel B Employee productivity competition and disclosure of the number of employees

	Dependent variable					
	EMPDISC	EMPDISC	EMPCOM	EMPCOM	ASEMP	ASEMP
		Not		Not		Not
	Competitive	competitive	Competitive	competitive	Competitive	competitive
COMPINDEX						
\leq 33rd percentile	-0.001	0.000	-0.001	0.000	-0.002	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
33rd percentile <						
\leq 67rd percentile	0.006***	0.002	0.006***	0.002	0.007***	0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
> 67rd percentile	0.002	0.002	0.002	0.002	-0.003	-0.002
	(0.002)	(0.002)	(0.001)	(0.002)	(0.004)	(0.003)
CONC	0.081	0.058	0.101*	0.084	0.357***	0.132
	(0.054)	(0.061)	(0.052)	(0.059)	(0.101)	(0.100)

(Table 4 Panel B continued)

Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.071	0.060	0.077	0.063	0.052	0.063
Ν	18,901	16,201	18,901	16,201	18,901	16,201

Panel C Product portfolio reorganization (PPR) competition and overall segment disclosure

	Dependent variable					
	REPFINENESS	REPFINENESS	GEOFINENESS	GEOFINENESS		
	Competitive	Not competitive	Competitive	Not competitive		
COMPINDEX						
\leq 33rd percentile	0.000	-0.001	0.003	0.002		
	(0.001)	(0.002)	(0.002)	(0.002)		
33rd percentile <	-0.001	-0.001	-0.001	-0.002		
\leq 67rd percentile						
	(0.001)	(0.002)	(0.001)	(0.001)		
> 67rd percentile	0.000	-0.002	0.002	0.002		
	(0.001)	(0.001)	(0.001)	(0.002)		
CONC	-0.140**	-0.258***	0.054	0.026		
	(0.059)	(0.079)	(0.060)	(0.049)		
Other controls	Yes	Yes	Yes	Yes		
Year Dummy	Yes	Yes	Yes	Yes		
Pseudo R ²	0.133	0.079	2.901	-1.134		
Ν	25,773	9,399	10,845	4,332		

Notes: Table 4 shows the results of the subsample analysis. The regression models are Equation (1). The whole sample is partitioned by (1) technological competition (Panel A), (2) employee productivity competition (Panel B), and (3) product portfolio reorganization (PPR) competition (Panel C), respectively. In Panel A, observations are classified as "high-tech firms" if the firm belongs to an industry related to pharmaceuticals, computer hardware, or telecommunications equipment and otherwise are classified as "other firms." In Panel B, observations are categorized based on labor productivity (total sales/the number of workers in a firm). If the productivity exceeds the median of the industry and year, the firm faces a competitive environment regarding employee productivity; otherwise, it is regarded as operating in a non-competitive environment. In Panel C, observations are divided according to the intensity of the PPR competition. If at least one segment of a firm operates in an industry whose profitability (operating profit/sales) declines from the previous year, the firm is regarded as being exposed to "high PPR competition."

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The parentheses show clustered standard error at the two-digit industry level.

Panels B and C present the results whose competition type is employee productivity and PPR, respectively. Both panels do not illustrate a clear pattern about the relationship between competition and disclosure at each competition level. One possible reason for these insignificances is the weak association between competition and disclosure types utilized in this study. For example, more information about employee productivity can be found in integrated reporting, in which companies illustrate the principles, initiatives, and outcomes of their workforce management. Likewise, rivals' intentions of product portfolio restructuring could be estimated more precisely from remarks from top management, medium-term business plans, and other forward-looking information. If another public information source provides valuable information, companies cannot conceal the information in the segment disclosure regardless of willingness (Berger and Hann 2007, p.872). Consequently, this segment-level information would lose its proprietary characteristics, making manipulating their disclosure level meaningless.

5. Conclusion

By using segment-level information in Japanese firms, this paper explores the multidimensionality of competition and its influence on disclosure contents. This breakdown approach is motivated by the inconclusive empirical research that investigates the relationship between proprietary costs and disclosure.

Product market competition encompasses two aspects: competitor type and competition type. The former depicts the players with whom a firm faces in the market, whereas the latter characterizes the domain of competition in which a firm operates. Some researchers predict and demonstrate the importance of these factors due to their various effects on disclosure (Li 2010; Cao et al. 2018; Karuna 2023; Liang 2024). However, previous studies have analyzed these dimensions independently, which could limit our understanding of the association between competition and disclosure to a partial one. Therefore, this paper attempts to concurrently consider both dimensions of competition to obtain a more comprehensive understanding.

The tobit regression analysis shows the different results between competitor and competition types. The relationship between competitor type and the likelihood of R&D expenditure disclosure supports the notion that different competitor types—potential or existing competitors—contradict the motivation for disclosure. In contrast, other disclosure contents (the number of employees or overall segment information) do not show significant relationships with competitor types. Furthermore, the significant association in R&D expenditure cannot be observed when the variable accounts for industry-wide disclosure status. Contrary to the competitor type, none of the competition types support the hypotheses that predict the importance of identifying the link between competition type and disclosure type.

The paper makes two contributions to the existing literature. Firstly, it suggests that several aspects of product market competition can simultaneously influence the strategic disclosure choice made by firms. The individual effects of these aspects have already been explored, and various characteristics have been demonstrated. This paper attempts to expand the existing knowledge by integrating multiple aspects in a single analysis. The overall ambiguous results of this paper would call for further sophistication in the operationalization of each factor. The requirement includes separating discretional disclosure decisions and reasonable disclosure status according to business characteristics. The other contribution lies in the literature about segment disclosure. The information has been examined from both capital market and product market perspectives. This paper adds evidence from the product market side that the theoretical negative relationship between proprietary costs and disclosure of competitiveness-related information likely depends on competitor and competition type. This perspective could help explain the inconclusive existing results in this line of research and induce further investigation.

While this paper makes these potential contributions, it is not without limitations. The first of these arises from the concern about the endogeneity of competition. This paper attempts to alleviate this problem by replacing one of the common proxies (industry concentration) with more sophisticated ones by following Karuna's (2023) approach. However, it is impossible to reject the possibility of omitted variables entirely. This shortcoming could be addressed by incorporating unexpected changes in the competition environment and other exogenous shocks.

The second limitation is the lack of consideration of other information simultaneously disclosed by firms. In annual reports, a firm provides information ranging from business strategies and R&D measures to nonfinancial information, including employee treatment, besides segment-level financial information. They often provide additional qualitative information and allow large amounts of discretion. In that context, it is questionable whether segment-level information still possesses crucial elements about the competitiveness of the individual firm. Future research should take the relevant materiality of each disclosed content into consideration.

Finally, the third limitation is the vague rationale for the link between competition type and disclosure content. The logic behind the connections is intuitive to a large extent, which probably leads to these ambiguous results in this paper. Further studies would prove fruitful in specifying how to determine competition type and related information.

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<u>Variable</u>	Definition	Method of Computation
Dependent var	riable	· · · · · · · · · · · · · · · · · · ·
RDDISC	Disclosure proxy for research and development expenditure at the segment level The value ranges from 0 to 1.	Assign each segment 1 if the segment discloses research and development expenditure and 0 otherwise. For firms with multiple segments, the dichotomous values are weighted by the proportion of the segment's sales to companywide sales and totaled.
EMPDISC	Disclosure proxy for the number of employees at the segment level The value ranges from 0 to 1.	Assign each segment 1 if the segment discloses the number of employees and 0 otherwise. For firms with multiple segments, the dichotomous values are weighted by the proportion of the segment's sales to companywide sales and totaled.
RDCOM	Relative disclosure proxy for research and development expenditure at the segment level The value ranges from 0 to 1.	Assign each segment 1 if (1) the segment discloses or (2) neither the segment nor other rivals' segments disclose research and development expenditure and 0 otherwise. For firms with multiple segments, the dichotomous values are weighted by the proportion of the segment's sales to companywide sales and totaled.
ЕМРСОМ	Relative disclosure proxy for the number of employees at the segment level The value ranges from 0 to 1.	Assign each segment 1 if (1) the segment discloses or (2) neither the segment nor other rivals' segments disclose the number of employees and 0 otherwise. For firms with multiple segments, the dichotomous values are weighted by the proportion of the segment's sales to companywide sales and totaled.
ASEMP	Disclosure proxy for the relative accuracy of the number of employees compared to total assets The value ranges from 0 to 1.	Assign each segment 1 if the segment's total assets per employee at each industry and year is smaller than the third quartile and 0 otherwise. For firms with multiple segments, the dichotomous values are weighted by the proportion of the segment's sales to companywide sales and totaled.
REPFINENESS	Disclosure proxy for the overall fineness of reportable segment information The value ranges from 0 to 1.	Compare the number of segments with the number of two-digit industry codes. For firms with multiple segments, the ratios are weighted by the proportion of the segment's sales to companywide sales and totaled. For a detailed explanation, see Appendix B.
GEOFINENESS	Disclosure proxy for the overall fineness of entity- wide foreign sales information The value ranges from 0 to 1.	Calculate the score based on the region names and sales disclosed in "information of geographic areas." For a detailed explanation, see Appendix B.
Independent v	ariable	
a. proxies for prod	luct market competition	
SUB	Extent of product substitutability in the industry	Calculated by -1*[operating profit/sales], with segment-level information for each two-digit industry and year. For firms with multiple segments, the proportions are weighted by the proportion of the segment's sales to companywide sales and totaled.
MKTSIZE	Level of market size in the industry	Natural log of industry sales each year, with the industry sales calculated as the sum of segment sales for firms operating in the industry. For firms with multiple segments, the sizes are weighted by the proportion of the segment's sales to companywide sales and totaled.
ENTRY	Ease of entry into the industry	The industry level of ease of entry is calculated by -1*[natural log of a weighted average of the gross value of total assets for firms in the industry, weighted by each firm's market share in the industry]. The firm level of value is calculated by weighing the industry level of value by the proportion of the segment's sales to companywide sales and totaled.
<i>COMPEINDEX</i> b. Control variable	Aggregate competition index es	Mean of percentile rankings of SUB, MKTSIZE, and ENTRY
CONC	Four-firm concentration ratio in the industry (defined by the two-digit industry code)	The proportion of sales in the industry occupied by the four largest firms (by sales) in each industry and year. The industry sales are calculated with segment-level sales.
ASSEIS MTR	Asset size at the firm level	Natural log of Companywide total assets
WIID	Log market-to-book ratio at mini level	shares*market price at the end of the fiscal year)/(total assets – total liabilities)]

Appendix A. Definitions of variables used in the analysis

RD	Log research and development intensity at the firm level	Natural log of (R&D expenditures/sales); the ratio is set to 0 for missing values
EXTFINANCE	External finance at the firm level	Sum of (change in total debt and total equity finance). Equity finance refers to the change in the book value of equity divided by lagged total assets.
LEV	Leverage at the firm level	Total debt/total assets
INSTINV	Institutional investor ratio at the firm level	The ratio of the number of shares owned by financial institutions and financial product dealers divided by the number of shares issued at the end of the period (excluding treasury shares)
FORINV	Foreign investor ratio at the firm level	The ratio of the number of shares owned by foreign corporations and other foreign institutions divided by the number of shares issued at the end of the period (excluding treasury shares)
FORSALE	Foreign sales ratio at the firm level	The ratio of foreign sales divided by total sales

Appendix B. Method of constructing variables about overall segment information

A) *REPFINENESS*: The fineness of reportable segment disclosure (with segmentation usually defined by line of business)

Step1: count the number of distinct two-digit codes by segment

When Segment A has industry codes "11", "21", and "31", the number of codes is

three. When Segment B has industry codes "11", "11", and "21", the number of codes becomes two because one code (11) duplicates.

Step2: count the number of segments by a firm

The segments exclude "Total consolidated," "Adjustment," and "Total" because those segments do not have industry codes.

Step3: calculated the ratio of the number of segments and the number of industry codes

Using the values calculated in previous steps, the ratio (the number of segments / the number of industry codes) is computed. The maximum ratio is one because the number of segments never exceeds the number of industry codes.

The below two cases exemplify the calculation.

Case 1 Industry codes The number of industry codes

Segment A	11	1	The number of segments: 3
Segment B	11 12	2	The <i>REPFINENESS</i> score:
Segment C	34 37	2	3/5 = 0.6
Total		5	

Case 2	Industry codes	The number of industry	codes
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Segment A	11	1	The number of segments: 3
Segment B	11 11 15	2	The <i>REPFINENESS</i> score:
Segment C	34 36 37	3	3/6 = 0.5
Total		6	

B) GEOFINENESS: The fineness of sales by region

A fineness score is calculated as follows based on region names and sales disclosed in "information of geographic areas":

$$F = \sum_{i=1}^{n} (AREAREV_i / FORREV) * Weight_i$$

With: AREAREV = Sales for a geographic area 'i'

FORREV = total foreign sales

Weight =

0: for a geographic area described as "Foreign" or "Others" (*Nikkei region code* or code is 0999)

1: for a geographic area described as "multi-continents" (e.g., "Asia and Oceania," "Europe and America") (an area with multiple codes whose last two digits are 00)

2: for a geographic area described as "continents" (e.g., "Asia,"

"Europe,") (an area with a single code whose last two digits are 00)

3: for a geographic area described as "multi-countries" (e.g., "Southeast Asia," "Middle East," "Greater China") (an area with multiple codes whose last two digits are except 00)

4: for a geographic area described as a "country" or "jurisdiction" (e.g.,

"America," "China") (an area with a single code whose last two digits are except 00)

The above method refers to Leung and Verriest (2015) and Kobbi-Fakhfakh et al. (2020).

The F value calculated above is divided by four to scale from zero to one.

Appendix C. Accounting standards for segment-level information

The accounting standards that regulate segment information in Japanese firms are either ASBJ Statement No.17 (Japanese GAAP), IFRS 8 (IFRS), or SFAS No.131 (U.S. GAAP). The standards employ the *management approach* based on the business structures used for daily operation or performance evaluation. However, the standard allows management to exercise discretion in disclosing information in certain respects because some requirements depend on management's judgments. As a result, the fineness of the reportable segment disclosure (the primary segmentation) and regional disclosure can vary in each firm and year.

R&D expenditures and the number of employees are not subject to the mandatory disclosure in the segment information section. Rather, they appear in different sections of annual reports. R&D expenditures are reported in the section entitled "Research and Development

Activities." The disclosure guidance recommends companies report R&D expenditure by associating it with segments. Nevertheless, it also permits the expenditure to be disclosed without this association if the treatment is complex, provided that the company describes the fact and amount (FASF 2023, p.83).

In contrast, the number of employees is provided in the section entitled "Employees." The guidance also requires companies to report the number by allocating it to each segment (FASF 2023, p.32). However, if it is challenging to identify to which segment a particular employee belongs, the individual may be included in an "entity-wide (common)" group. In addition, the definition of employees and the scope of temporary employees are at the discretion of the companies (FASF 2023, p.33).

<Reference>

Financial Accounting Standards Foundation (FASF). (2023). *Instructions for Preparation of Annual Securities Report (for submission for the fiscal year ending March 31, 2024).* FASF. [in Japanese]