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Title: Causal ambiguity: Shape-flip between product market competition at industry level and voluntary disclosure

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Abstract

This paper analyses the moderating effect of causal ambiguity on the relation between product market competition (i.e. product substitution) and firms' voluntary disclosure behaviour. Our empirical results show a "shape-flipping function". That is, we observe an inverse U-shaped relation between competition and disclosure when causal ambiguity is low. Such a relation gradually evolves towards a U shape as the level of causal ambiguity increases. Our theoretical explanation is that causal ambiguity relaxes or inhibits the intensity of the proprietary and agency costs of voluntary disclosure (underlying restrictions of competition), and simultaneously strengthens the subjacent incentives of competition to reveal information. We obtain empirical evidence of this global perspective based on logistic estimations of a sample of US manufacturing firms from 2002 to 2015. Our models use earnings per share (EPS) forecast as a proxy of voluntarily disclosed information, inverse margin rate as a proxy of product market competition at industry level, and several proxies of causal ambiguity (i.e. firm complexity and firm predictability).

Keywords: causal ambiguity, competition, voluntary disclosure.

1. Introduction

The literature exploring the relation between product market competition and voluntary disclosure is far from conclusive. From a theoretical perspective, how product market competition influences individual firms' voluntary disclosure decisions is not clear. On the one hand, agency costs theory (Berger and Hann 2007; Bens et al. 2011) and proprietary costs theory (Verrecchia 1983, 1990; Clinch and Verrecchia 1997; Bamber and Cheon 1998; Botosan and Stanford 2005; Berger and Hann 2007; Li 2010; Ali et al. 2014; Huang et al. 2017) propose that product market competition imposes restrictions that discourage the voluntary disclosure of information. In contrast, the signalling effect (Grossman 1981; Milgrom 1981), the deterrence hypothesis (Darrough and Stoughton 1990; Clinch and Verrecchia 1997; Wagenhofer 1990; Li 2010) and the accountability impact (Muiño and Núñez-Nickel 2016),[1] posit that product market competition fosters firms' incentives to disclose information. To the best of our best knowledge, no prior literature has provided a general framework integrating the effect of all these incentives and restrictions on voluntary disclosure decisions (Beyer et al. 2010).[2]

Likewise, at the empirical level, previous literature uses different proxies for both "competition" and "voluntary disclosure", which complicates the interpretation and comparison of results among studies. For instance, past work approximates market competition using either the potential entrants or existing rivals (Li 2010), the speed of profit adjustment

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Notes

[1] See Hirst et al. (2008), Beyer et al. (2010), Berger (2011) and Lang and Sul (2014) for a detailed literature review on voluntary disclosure.

[2] In an attempt to reconcile the seemingly contrary perspectives, a number of studies explore the relative strength of these competition-driven incentives and restrictions. For example, Verrecchia (1983) shows that the positive signalling effect claimed by Grossman (1981) and Milgrom (1981) might be outweighed by the proprietary costs of disclosing strategic information to existing competitors. Other recent studies have addressed the joint effect of the competition-driven restrictions (Berger and Hann 2007; Bens et al. 2011) and incentives (Muiño and Núñez-Nickel 2016) to disclose information.

(Harris 1998), external shocks from the reduction of import tariff ratios (Huang et al. 2017), or industry concentration (e.g. Bamber and Cheon 1998; Ali et al. 2014; Lang and Sul 2014). Adding to this heterogeneity, some other studies analyse competition by differentiating firm-level and industry-level measures (Muiño and Núñez-Nickel 2016). In the same vein, prior work measures voluntary disclosure based on the reporting of segment information (Botosan and Harris 2000; Botosan and Stanford 2005; Berger and Hann 2007; Bens et al. 2011), the issuance of earnings forecast (Bamber and Cheon 1998; Ali et al. 2014; Guay et al. 2016; Huang et al. 2017; Monk 2017), or the disclosure of information on share repurchases (Brockman et al. 2008). Given this variety of empirical measures, it is hard to say whether the mixed results in the empirical literature are a consequence of the different underlying effects mentioned above at the theoretical level, or the measurement biases due to using different proxies for the same concept. Therefore, although valuable, prior empirical literature does not help to reconcile the seemingly contrary predictions of the different theories exploring the effect of market competition on voluntary disclosure (Dedman and Lennox 2009, p. 211).

This study presents a framework that compiles the apparent inconsistent predictions of prior theoretical and empirical research. Based on single measures of market competition and voluntary disclosure, we propose a comprehensive framework that explains both the restrictions and the incentives of disclosure decisions under the influences of market competition. To achieve this target, we develop a model with which we study the effect of industry-level product market competition on firms' voluntary disclosure of quarterly earnings forecasts by considering individual firms' causal ambiguity level (Barney 1991; Mosakowski 1997; Luft et al. 2016). Causal ambiguity refers to the uncertainty or lack of conciseness and/or concretion about the relations between the underlying processes of the firm (i.e. inputs) and the results that they cause (i.e. outputs). In particular, our theoretical framework posits that causal ambiguity moderates the relative effect that competition-driven restrictions and incentives

exert on individual firms' voluntary disclosure. Concretely, we claim that higher levels of causal ambiguity tend to simultaneously weaken restrictions and increase incentives to voluntarily disclose information. Causal ambiguity prevents rivals or monitors from using the disclosed information effectively, because they cannot accurately analyse and/or interpret such information due to the uncertainty in the causal effect of underlying processes and potential outcomes. Therefore, causal ambiguity reduces firms' perceived proprietary and agency costs of disclosure. At the same time, causal ambiguity intensifies the incentives to reveal information because when a firm's processes are ambiguous, managers may need to disclose more information to clearly communicate the outcomes or performance of the firm (Guay et al. 2016).

This theoretical framework (i.e. weaker restriction effects and stronger incentive effects with the increase in causal ambiguity) allows us to model the relation between industry-level product market competition and voluntary disclosure as a shape-flipping function (Haans et al. 2016). We argue that the effect of market competition on the voluntary disclosure actions of firms with low causal ambiguity is mostly determined by restrictions (i.e. agency and proprietary costs). Hence, for firms with low levels of causal ambiguity, we expect the relation between competition and disclosure to have an inverse U shape. However, as the level of firms' causal ambiguity increases, incentives become relatively more important than restrictions. Therefore, we expect this relation to gradually turn into a U shape.

We test our hypotheses with logit models, using a sample of US manufacturing firms between 2002 and 2015. As expected, our empirical results show that causal ambiguity (measured by firm complexity and predictability) significantly moderates the relation between product market competition at industry level (measured by inverse margin rate) and voluntary disclosure (measured by quarterly EPS forecasts).

Our study is related to the empirical studies analysing the relation between competition and voluntary disclosure (Ali et al. 2009; Ali et al. 2014; Bamber and Cheon 1998; Botosan and Harris 2000; Botosan and Stanford 2005; Dedman and Lennox 2009; Harris 1998; Huang et al. 2017; Li 2010; Verrecchia and Weber 2006, among others). However, our theoretical framework is mostly based on the theoretical contributions of Berger and Hann (2007), Bens et al. (2011), and Muiño and Núñez-Nickel (2016). The two first studies (Berger and Hann 2007; Bens et al. 2011) explain the joint effect of market competition restrictions, and the third one (Muiño and Núñez-Nickel 2016) develops non-linear models to explain the influence of incentives on voluntarily disclosure. Resting on this previous literature, our study provides a new global perspective that combines restrictions and incentives together in a single framework. Moreover, we identify firms' causal ambiguity as a factor that moderates the influence of industry-level competition on voluntary disclosure. Specifically, we posit that this factor regulates the relative weight of competition-driven restrictions and incentives to disclose. Altogether, our framework provides insights about which incentives and restrictions may dominate at different competition levels. When market competition is low, managers are more worried by the shareholders than by rivals. Therefore, the balance between the agency problem (restriction) and the accountability (incentive) is dominant than other effects because voluntary disclosure is marked by disputes between principals and agents. However, as competition increases, the agency problem loses relevance and it is dominated by the strategic implications of disclosing information. In other words, as competition increases towards perfection, rivals become the main problem and managers face a trade-off between revealing their few strategic differences to the incumbent competitors (restriction by proprietary costs) and informing customers about their performance or warning potential rivals about the low profit margins (incentives by signalling and/or deterrence). Our results indicate that such a decision is influenced by the degree of causal ambiguity of the company.

Finally, our findings also contribute to the literature on earnings guidance. Prior work documents the direct influence of some determinants of causal ambiguity (i.e. complexity and predictability) on earnings guidance (Hutton 2005; Guay et al. 2016; Monk 2017). Our findings expand prior work by showing that causal ambiguity (i.e. resulting from firms' complexity and predictability) can also act as a moderator of the influence that product market competition exerts on earnings guidance.

The rest of the paper is organised as follows. The next section develops the theoretical background and hypotheses. We first analyse how competition affects restrictions on voluntary disclosure. We then analyse the effect of market competition on firms' incentives to disclose. Finally, we introduce the concept of causal ambiguity and analyse how this moderator influences restrictions and incentives to disclose. Sections 3 and 4 present sample selection and variable definitions. We show the main empirical results in section 5, and the robustness analysis in section 6. Finally, section 7 presents our conclusions and discussion.

2. Theoretical Background

2.1. Voluntary disclosure restrictions and market-competition

Prior literature on voluntary disclosure identifies proprietary and agency costs as two important restrictions to revealing information (Verrecchia 1983; Berger and Hann 2007, Bens et al. 2011). The notion of proprietary costs refers to the potential costs that a firm may incur as a result of disclosing proprietary information to its rivals in the competitive product market (Verrecchia 1983). Agency costs refer to managers' incentives to conceal agency conflicts by hiding information about their managerial mistakes (e.g. Berger and Hann 2007; Bens et al. 2011). Both proprietary and agency costs are likely to restrict firms' intentions to disclose strategic information. Firms facing higher proprietary costs prefer to withhold information to preserve their competitive position in the market. Likewise, managers of companies dealing

with higher agency costs are also more likely to keep principals in the dark by withholding information about how the company is managed. Given that the two disclosure costs discourage firms from disclosing information, external principals are unlikely to identify whether firms withhold information to safeguard their strategic advantages or to hide managerial entrenchment behaviour (Beyer et al. 2010; Berger 2011).

Prior literature suggests that these two restrictions vary with the level of product market competition. According to Verrecchia (1983) and Ali et al. (2014), the proprietary costs of disclosure increase with product market competition. Market competition promotes similarity among firms' processes and more substitutability among products (Raith 2003). Therefore, industries with a higher product market competition are likely to have more elastic demands. Assuming an endogenous market structure (e.g. firms can enter or exit the market freely), higher demand elasticity implies that firms with decreasing marginal costs (and in turn in prices) can increase their market share (in terms of output) by driving competitors out of the market (Raith 2003).[3] Therefore, as competition increases and firms become more similar (e.g. higher product substitutability), firms are less willing to compromise their competitive position by revealing information and allowing competitors to identify (and probably eliminate) their strategic advantages. In summary, product market competition increases firms' proprietary costs, and hence, it restricts voluntary disclosure (Verrecchia 1983).[4] In contrast, we expect agency costs to decrease with market competition. Since corporate governance mechanisms mitigate agency problems to some extent (Bushman et al. 2004), and market competition is a

[3] Market size and entry costs also influence market competition at industry-level (Raith 2003). However, we consider external impacts on the normal evolution of the market. In any case, we control for these variables in the empirical tests.

[4] According to the theoretical arguments of Muiño and Núñez-Nickel (2016), for competition at firm-level (i.e. firm competitiveness in the industry), the direction of its influence on disclosure decisions can be opposite to that of market competition. Hence, for more competitive firms, there are more profits to hide, and therefore, more proprietary costs. The consequence of this reasoning is a negative correlation between competition (at firm-level) and voluntary disclosure (Berger 2011).

substitute of corporate controls (Giroud and Mueller 2011; Chhaochharia et al. 2017), we argue that an increase in product market competition is likely to reduce agency costs and lead to a higher probability of voluntary disclosure.

Figure 1 summarises how industry-level competition influences voluntary disclosure through the joint effects of proprietary and agency costs. As competition at industry level increases, agency costs decrease and the probability of voluntary disclosure increases. However, at the same time, the higher proprietary costs related with the higher competition diminish firms' propensity to disclose. Since both proprietary and agency costs are restrictions to disclosure, the probability of voluntary disclosure as a result of their joint effects should be lower than the probability determined individually by each one of them. Hence, the joint probability function of disclosure under both types of restrictions is below the two individual disclosure probability functions under each restriction that compose it. The joint effects generate an inverse U-shaped relation between industry-level competition and voluntary disclosure in which the maximum probability of disclosure is found near the intersection of the two restriction functions. Hypothesis 1 summarises the global restriction effects of market competition on voluntary disclosure behaviour.

FIGURE 1 about here

Hypothesis 1: *The association between industry level competition and disclosure restrictions (proprietary and agency costs) is defined by an inverse-U shape.*

2.2. Voluntary disclosure incentives and product market competition

The extant literature on voluntary disclosure also indicates that firms have three different incentives to voluntarily reveal their strategic information. First, firms have incentives to reveal information on their quality so as to differentiate themselves from their rivals (Grossman 1981; Milgrom 1981). This factor is commonly known as the "signalling effect".

Second, firms have incentives to disclose strategic information to deter the entrance of new competitors. This incentive is referred to as the "Deterrence hypothesis" (Darrough and Stoughton 1990). The third incentive is the "accountability effect". As a consequence of the possible existence of agency costs, managers (agents) need to be accountable to the principals (Muiño and Núñez-Nickel 2016). In other words, managers need to disclose information in order to meet the information requirements from the principals.

The three different motivations to disclose information are contingent on the level of product market competition. In more competitive industries, products tend to be more similar and substitutable (Raith 2003). Therefore, firms are more likely to have incentives to disclose information to differentiate themselves. In other words, the incentives to disclose information due to the "signalling effect" intensify as market competition increases. Likewise, as competition increases and the industry profits converge to zero, an excess of production means losses for all the firms in the same industry. As a result, firms have incentives to disclose information about market demand to discourage overproduction (Clinch and Verrecchia 1997) or to deter potential rivals from entering into the market (Darrough and Stoughton 1990). Similar to the "signalling effect", product market competition strengthens the incentives to disclose information related to the "Deterrence hypothesis".[5] On the contrary, product market competition is likely to weaken the incentives to disclose due to the "accountability effect". If competition is a substitute of other corporate controls (Giroud and Mueller 2011; Chhaochharia et al. 2017) more competition can reduce the informational demands from principals. Therefore, contrary to the other two incentives, market competition weakens the "accountability effect" and reduces firms' incentives to voluntarily reveal information.

[5] Darrough and Stoughton (1990) is the first paper that studies the deterrence hypothesis in relation to new entrants. Clinch and Verrecchia (1997) extend the same concept to the extant rivals through overproduction.

Given that product market competition influences the three effects mentioned above, the overall effect of market competition on voluntary disclosure can be represented as a U-shaped relation (Muiño and Núñez-Nickel 2016).[6] Figure 2 summarises the incentive effects.

FIGURE 2 about here

2.3. Causal ambiguity

Causal ambiguity[7] is the uncertainty (or the lack of conciseness and/or concretion) about the relation among the underlying profit-generating processes of the firm and the results that they cause (e.g. Barney 1991, Mosakowski 1997, Luft et al. 2016). Although this uncertainty may result from the industry or the overall business environment, it can also be associated with the particular degree of complexity of individual firms' processes (Hutton 2005). If the underlying process of an individual firm is ambiguous (uncertain, imprecise or complex), information users would need more quantity and/or quality of information to understand, interpret and predict the results of the firm. In other words, information of firms

[6] The concept of disclosure incentives in Muiño and Núñez-Nickel (2016) is developed based only on deterrence and agency incentives. For the sake of generality, we also include the signalling effect in the theoretical framework of the current study. We can think of signalling effect and deterrence hypothesis as one increasing incentive which has more weight compared to the accountability effect. We do not develop a new hypothesis for section 2.2 because the framework comes from Muiño and Núñez-Nickel (2016). However, we include this section as part of our theoretical background because it completes our discussion about both restrictions and incentives of voluntary disclosure. It also facilitates the theoretical development in section 2.3. regarding the moderating effect of causal ambiguity on the two types of underlying effects (i.e. restrictions and incentives) on disclosure.

[7] We use the concept of "Causal Ambiguity" to capture firm-level uncertainty following previous literature such as Barney (1991), Mosakowski (1997), Luft et al. (2016), among others. Previous literature also uses different notions referring to similar (but not exactly the same) concepts related to uncertainty. For instance, Zhang (2006) uses "Information uncertainty", and he recognises that "by information uncertainty, he means ambiguity" (page 105). Francis et al. (2005) refers to this concept as information precision (the opposite term of ambiguity), but in a continuation study, Francis et al (2007), the authors denote it again by information uncertainty (despite using the same construct to measure it). In general, risk and ambiguity are the two main concepts of uncertainty (Zhang 2006). The former describes uncertainty over payoffs while the latter refers to uncertainty about the probability of payoffs (Epstein and Schneider 2008; Hussinger and Pacher 2015; Williams 2015). Causal ambiguity is very similar to information ambiguity, but it emphasises uncertainty over the distributions of firms' inputs-outputs structure (Luft et al. 2016; Mosakowski 1997), rather than uncertainty over the distributions of payoffs/outputs. Other studies use the main determinants of uncertainty such as operational complexity as in Hutton (2005) and Guay et al. (2016). Finally, causal ambiguity is also different from the information asymmetry concept since the latter usually describes the different information that a manager (agent) has in relation to the principal. Causal ambiguity, in contrast, is at firm level and it affects managers and stakeholders at the same level (Luft et al. 2016).

with more complex production systems (or less predictable systems) can be harder to process, and therefore information users should have more problems estimating the firm's results.

We posit that if the underlying profit-generating process is ambiguous, under common-knowledge conditions, managers who want to provide principals or rivals with a clear picture of the company may need to disclose more information (Guay et al. 2016). Therefore, we expect firms' incentives to disclose to be higher as the level of causal ambiguity increases. Conversely, when causal ambiguity increases, restrictions to disclosing information are weakened because information users (principals or rivals in our case) have more problems with understanding, interpreting and predicting the firm's behaviour. Thus, it is less costly (in terms of proprietary and agency costs) for managers to disclose more information.

These arguments suggest that causal ambiguity simultaneously fosters the incentives and defuses the restrictions on voluntary disclosure. Hence, as causal ambiguity increases, we expect the influence of incentives to gradually offset the effect of restrictions. Based on this reasoning, we propose that as causal ambiguity increases, the inverse U-shaped effect of product market competition on voluntary disclosure generated by the preponderance of restrictions gradually turns into a U-shaped effect. Figure 3 shows such intuition and hypothesis 2 summarises the effect of causal ambiguity:

> ***Hypothesis 2:*** *The relation between competition at industry level and voluntary disclosure is defined by a shape-flipping function when we include the moderate effect of causal ambiguity.*

FIGURE 3 about here

3. Data and sample selection

To test our theoretical predictions, we explore firms' voluntary disclosure decisions in terms of quarterly management earnings forecasts. We choose managers' earnings forecasts as a proxy of disclosure for a number of reasons. First, earnings forecasts reveal not only direct

valuable information on future performance, but also indirect information on market demand and operating costs (Huang et al. 2017) that is relevant for different market agents such as stockholders and competitors. Hence, firms disclosing these forecasts may face the competition-driven restrictions and incentives mentioned in our theoretical framework. For instance, firms providing forecasts have proprietary costs because competitors can take strategic decisions to penalise the disclosing firm (Bamber and Cheon 1998). At the same time, by disclosing this performance indicator, managers fulfil their accountability and signalling duties but they also suffer from agency costs because they are informing principals (i.e., stockholders) about their effort and performance in the company. Finally, as a measure of success or failure of the firm performance, the information of earnings forecasts can encourage or discourage new entrants (deterrence hypothesis). Second, prior literature indicates that these forecasts are one of the most relevant voluntary disclosure choices that firms make (Hirst et al. 2008; Huang et al. 2017; Lu and Tucker 2012). Third, managers have considerable discretion on whether and how to provide earnings forecasts, nevertheless these forecasts are relatively more homogeneous across all firms than other voluntarily disclosed information (Huang et al. 2017). In relation to the time period of the earnings forecasts, we choose quarterly forecasts for three reasons. First, there are more frequent communications among managers and other stakeholders through quarterly forecasts than annual ones (Anilowski et al. 2007). Second, quarterly forecasts are more informative than other types of forecasts of firm-level returns because they essentially provide more fine-grained information than annual forecasts (Chen et al 2011). Third, prior literature exploring voluntary disclosure solely from the perspective of proprietary costs uses annual forecasts because the influence of such costs is probably more significant for annual forecasts than for the quarterly ones (Ali et al. 2014; Li 2010). However, our theoretical framework incorporates not only proprietary costs but also four other incentives and restrictions. Therefore, quarterly forecasts are more suitable for testing our hypotheses.

To construct our sample, we start with an initial dataset containing the quarterly financial statements information of all US-based manufacturing firms (NAICS 3111-3399) available in Compustat North America from 2002–2015.[8] Next, we merge this data with information on firms' quarterly forecasts of earnings per share (EPS) from the Institutional Brokers Estimate Systems (I/B/E/S) Guidance File. For merging purposes, we assume that those Compustat firms not appearing in the I/B/E/S Guidance database in a given quarter are non-disclosers (i.e. they did not provide EPS forecasts to the market in that quarter). Given that this study focusses on EPS forecasts issued in the post Regulation Fair Disclosure (Reg FD) period (i.e. after August 2000), the potential bias introduced in our sample due to this assumption is likely to be relatively low (e.g. Chuk et al. 2013).[9] Then, we incorporate information about analyst coverage (i.e. number of analysts providing earnings forecasts) and institutional ownership in our dataset. The information is from the I/B/E/S Adjusted Summary File, and Thomson Reuters CDA/Spectrum Institutional (13F) Holdings database, respectively. Similar to managers' EPS forecasts, if a firm in our sample does not appear in the I/B/E/S database in a given quarter, we assume that the number of analysts following that specific firm in that specific quarter is zero (e.g. Chang, Dasgupta and Hilary 2006; Hameed, Morck, Shen and Yeung 2015). Likewise, if a company in our dataset does not appear in Thomson Reuters CDA/Spectrum Institutional (13F) Holdings database in a given quarter, we consider the institutional ownership of that firm to be zero (e.g. Bushee and Miller 2012; Ferreira and Matos 2008). Finally, we add information about firms' board structures, a proxy for corporate

[8] We identify these firms by their country of incorporation (FIC code) as reported in Compustat (e.g. Francis 2010; Kim, Li and Li 2012).

[9] Prior research suggests that I/B/E/S database covers EPS forecasts in a more complete and consistent way than it does with any other kinds of forecasts. Specifically, Chuk, Matsumoto and Miller (2013) indicate that although the I/B/E/S Guidance File has a bias towards the coverage of certain types of firms (e.g. larger firms, firms followed by more analysts, firms with higher institutional ownership, etc.), this bias is much lower for the forecasts involving earnings information. In subsection 6.1, some robustness tests suggest that our results are robust to the potential coverage biases of certain types of firms mentioned by prior literature (e.g., Chuk et al. 2013; Heflin et al. 2016).

governance from Boardex, as well as information on stock market returns from CRSP. Our sample is therefore limited to firms for which the previously mentioned information (i.e. corporate governance and stock market information) is available.[10] Our final sample includes 55,910 observations corresponding to 1,585 distinct firms in 81 different four-digit NAICS industries during the fiscal years 2002–2015.[11]

4. Variables

4. 1. Dependent variable

We define our dependent variable as "*Voluntary disclosure*". For each firm *i* at each quarter *t*, we calculate a dummy variable that takes a value of one if a firm voluntarily discloses at least one earning per share (EPS) forecast of that fiscal quarter, and zero otherwise. We identify a quarter as the interval window between "-100" and "0" days, where 0 is the fiscal quarter end. We calculate this variable using information from the I/B/E/S guidance database.

4.2 Main Independent variable

Our main independent variable is "*Competition*". Following our theoretical arguments, we measure market competition at industry level using the degree of product substitutability.[12] Specifically, we measure the intensity of the competition in four-digit NAICS industries with the inverse of the price-cost margin of every industry. When the product market tends towards

[10] The fact that our sample contains firms for which corporate governance and stock market returns are available (i.e. mostly larger firms followed by more analysts) also helps to reduce the potential sample bias mentioned by Chuk et al. (2013).

[11] Prior literature suggests that Compustat-based measures of product market-competition might not be good proxies of the competitive environment (because Compustat excludes private firms) and might lead researchers to draw incorrect conclusions (e.g. Ali et al. 2014; Keil 2017). In subsection 6.3 we show a set of models in which market-level variables related to competition are calculated using data from the US Census of Manufacturers.

[12] Theoretical developments of other types of competition, such as the competition coming from market size or new entrants (Raith 2003), are beyond the scope of this paper. As is aforementioned, competition at firm-level (Muiño and Núñez-Nickel 2016) or the degree of industry concentration (Ali et al. 2014) can lead us to different theoretical relations. In order to account for the effect of other types of competition (i.e. market size, new entrants, or concentration) on firms' voluntary disclosure decisions, we include proxies for those types of competition as control variables in our empirical models (see detailed discussions in section 4.3).

perfect competition (maximum level of competition), the selling price becomes similar to the marginal cost, which leads to zero profits. Therefore, the price-cost margin is commonly used to analyse the substitutability degree of products in an industry (e.g. Karuna 2013; Muiño and Nuñez-Nickel 2016). We calculate the inverse of this ratio to capture its positive correlation with the competition. That is, higher values of this ratio imply more competition intensity at industry level:

$$Competition = C_{jt}/S_{jt},$$

where C_{jt} is the total cost of goods sold for industry *j* at quarter *t*, and S_{jt} is the total sales revenue of the same industry and quarter. We use accounting data from Compustat to calculate this industry-level variable.

4.3 Variables moderating the effect of Competition on Voluntary Disclosure

To test Hypothesis 2, we include a proxy for firm-level causal ambiguity. Based on prior literature, we approximate firm-level causal ambiguity from two perspectives. First, we approximate it with firm complexity as a complex firm is an appropriate context for causal ambiguity (Mosakowski 1997). We measure firm complexity using variables "*Complexity-Intangibles*" and "*Complexity-Segments*". The former is the percentage of firm *i*'s intangible assets out of total assets, and the latter is the number of firm *i*'s business segments in period *t* (Hutton 2005). Second, we approximate firms' causal ambiguity based on the degree to which their revenues are predictable. We define "*Predictability-Revenues*" for firm *i* at time *t*, as the natural logarithm of one divided by the standard deviation of firm *i*'s revenues during the last five years (Hutton 2005).[13] Therefore, higher values of "*Predictability*" correspond to firms with more predictable revenues. Given that these three variables are significantly correlated (in all cases pairwise correlation is significant at a 1%-level) and approximate the same theoretical

[13] We compute this variable for all cases in which we have a minimum of 20 quarters of information.

concept (i.e. causal ambiguity), we use a factor analysis to reduce them to a single proxy for causal ambiguity (e.g. Matsumoto 2002).[14] We name this variable (i.e. the extracted factor) simply as "*Causal Ambiguity*". Larger values of this variable correspond to firms with more complex operations and/or less predictable revenues. In other words, this variable increases with the degree of firms' causal ambiguity. We interact this variable with "*Competition*" to test the moderation effect of firm-level causal ambiguity on the relation between "*Competition*" and "*Voluntary Disclosure*" (H2).

Although there is no hypothesis development about other potential moderator variables, we benchmark our empirical models against alternative models showing the potential moderating effect of other two market-level variables: "*Concentration*" and "*Entry Barriers"*. "*Concentration*" accounts for industry concentration. We approximate the industry concentration of four-digit NAICS industry-quarter by the Herfindahl-Hirschman index calculated for the firms of Compustat. For each four-digit NAICS industry, we calculate this index for each quarter by adding the squares of the individual company market shares of the 50 largest firms in the industry or that of all the firms in the industry, whichever is lower. The second alternative moderator variable is "*Entry barriers*", which captures the degree of competition from potential rivals (i.e. entry barriers set up clear restrictions to the free competition in any industry). For each four-digit NAICS industry-quarter, we calculate this variable as the total capital expenditures of the industry in millions of dollars divided by the number of firms in the industry (e.g. Muiño and Núñez-Nickel 2016). This variable proxy the investments that new entrants would need to make in order to compete with incumbent firms

[14] Following Matsumoto (2002), we use the principal components factor method of factor analysis to reduce the three proxies of causal ambiguity into a single proxy. The results of the factor analysis indicate that there is one factor with an eigenvalue greater than one, and thus, we summarise these three variables into a single factor. Factor loadings are 0.61, 0.77, and -0.81 for *Complexity-Intangibles*, Complexity-Segments and *Predictability*-Revenues, correspondingly. The extracted factor captures around 60% of the common variance of the variables. In subsection 6.2, we show that the results of our main models using each of these three proxies separately are consistent with the results of the single proxy using factors analysis.

(Li 2010). Although these two variables might be used as proxy for competition (e.g. Ali et al. 2014, Leung and Verriest 2015), we use them as moderators to analyse the degree (if any) to which the proposed curvilinear effect of competition on voluntary disclosure is contingent on market features such as the level of concentration or entry barriers. Likewise, these alternative moderators allow us to benchmark the significance of the proposed moderation effect of firm-level causal ambiguity against the potential moderating effect of other market-level environmental influences.

4.3 Control variables

At the market-level, we control for some variables that can influence firms' voluntary disclosure decisions. For this purpose, the variable "*Herding*" controls for firms' incentives to imitate the voluntary disclosure behaviour in the industry (Botosan and Harris 2000; Aerts et al. 2006; Tse and Tucker 2010). "*Herding*" for firm *i* is defined as the percentage of firms (other than *i*) belonging to the same four-digit NAICS industry that provided at least one quarterly EPS forecast in the previous quarter. Likewise, to control for the size of the market in which firms perform their activities, we include the variable "*Market Size*". It is calculated as the natural logarithm of the total sales of the industry in millions of dollars for a given industry. Lastly, firms in industries with higher litigation risks are more likely to disclose earnings guidance to mitigate this risk (e.g. Li 2010; Ali et al. 2014). We control for this effect with the variable "*Litigation Risk*", which takes a value of one if a firm operates in an industry facing high litigation risk, and zero otherwise.[15]

Next, we control for investors and analysts' informational needs. We proxy these notions with the variables "*Institutional ownership*" and "*Analysts Coverage*". We define "*Institutional ownership*" as the percentage of the firm's shares owned by institutional

[15] Such industry classification is proposed by Francis, Philbrick and Schipper (1994), which is also the common approach adopted by more recent literature such as Li (2010).

investors. Institutional investors have different behaviour on the investments, and therefore, they can have distinct exigencies of firm's disclosures (Bamber and Cheon 1998; Bushee et al. 2003; Healy et al. 1999). Likewise, the number of analysts that follow a firm can influence the disclosures that the firm reveal (Ajinkya et al. 2005; Anilowski et al. 2007; Healy et al. 1999). We define and calculate "*Analysts coverage*" as the number of analysts that follow firm *i* in fiscal quarter *t*.

At the firm-level, we include variables accounting for firms' financial dimensions that can determine the way in which firms compete in their relevant markets. For this purpose, we include variables capturing firms' competitive position, size, leverage, growth and performance. The variable "*Competitive Position*" controls for the relative strength of individual firms' competitive position in the market (Muiño and Nuñez-Nickel 2016). This variable is computed as the inverse of firms' price-cost margin (i.e. cost of goods sold/revenues). We standardise this variable for each industry-year-quarter (i.e. we subtract the industry-year-quarter mean and divide the difference by the industry-year-quarter standard deviation). "*Firm size*" is defined as the natural logarithm of the firms' market capitalisation at the end of the current quarter in millions of dollars. "*Leverage*" accounts for firms' debt-equity ratio (i.e. total liabilities/Stockholders' Equity). "*Book to Market*" controls for firms' Book to Market ratio (i.e. firm market capitalisation plus long-term debt divided by firm total assets). We use a number of control variables aiming to capture different dimensions of firms' performance. "*Performance*" accounts for firms' return on assets (i.e. income before extraordinary items divided by total assets). As an additional performance measure, we include the variable "*Loss*", which is a dummy variable taking a value of one if the firm results in the current quarter are positive, and zero otherwise (e.g. Huang et al. 2017). Similarly, firms reporting good news may have more incentives to disclose than firms disclosing bad news (e.g. Kothari et al. 2009). The variables "*Adj. Market Returns*" and "*EPS increase*" account for this

effect. We define "*Adj. Market Returns*" as the quarterly buy-and-hold stock return minus the CRSP value-weighted stock return in the current quarter. "*EPS increase*" is a dummy variable set to 1 if the EPS of the current quarter is larger than the EPS in the prior quarter, and 0 otherwise (e.g. Huang et al. 2017).

Our models also consider potential differences in disclosure behaviour arising from the heterogeneity among firms' degree of corporate governance, external audit quality, and firms' prior disclosure habits. Stronger corporate governance is likely to be related with higher incentives to disclose (e.g. Ajinkya et al. 2005; Karamanou and Vafeas 2005; Cerbioni and Parbonetti 2007). To account for this effect, we include the variables "*Duality*" and "*Independent*". The former takes the value of one if the CEO of the firm is also the chairman of the board of directors. The latter is the percentage of independent directors on the firm's board. Likewise, firms with a higher audit quality are prone to disclosing more information (see Huang et al. 2017). We measure the firms' audit quality with the variable "*Audit Quality*", which takes the value of one if the firm is audited by a Big-4 auditor, and zero otherwise. In addition, our models control for firms' disclosure behaviour in the previous period (period *t-1*) by including the variable "*Stickiness*". This measure accounts for the possibility that a firm will repeat its past behaviour instead of imitating the behaviour of other agents (disclosure as a "sticky" behaviour. See Botosan and Harris 2000; Tucker 2015). We calculate this variable considering the disclosure behaviour of the individual firms in quarters *t-1* and *t-2*. To calculate this variable, we assign a value of one if the firm disclosed information in *t-1* and *t-2*, a value of 0.5 if the firm disclosed information in one of the periods, and zero if the firm did not disclose any information at all during these two prior periods. Higher values of "*Stickiness*" correspond to firms for which disclosing information is more likely to be a sticky practice.

Finally, to control for temporal factors exerting a common effect on the behaviour of all firms in the sample, we include year and quarter dummy variables. These variables take a

value of one if the data have been measured in the same year or quarter, and zero otherwise. Table 1 displays and summarises the definitions of all the variables that we include in the empirical tests.

TABLE 1 about here

5. Results

5.1. Descriptive statistics

Table 2 displays the descriptive statistics of all variables that we use in the empirical models. All variables are winsorized at the 1% and 99%-level to avoid the influence of outliers. The mean (median) of "*Voluntary disclosure*" is 0.18, pointing out that approximately 18% of firms in the sample reveal their private information on EPS. This information is consistent with the variable "*Stickiness*" (i.e. if a firm discloses EPS information in the previous quarter) with a mean (median) of 0.17. Interestingly, despite this general lack of disclosure by firms, there are a considerable number of analysts ("*Analysts coverage*") covering these firms. With a range from 0 to 25 analysts, only the first quartile of this variable does not have coverage. In relation to the "*Competition*" (i.e. our main exogenous variable), with a range from 0.24 to 0.87, we can see how the evolution towards the perfect competition is gradual, although the sample does not have extreme cases of industries where "*Competition*" (inverse of price-cost ratio at industry level) is equal to one. Although all industries appear with benefits, the range of results covers the entire spectrum at firm-level. Regarding the remaining variables, they guarantee the sufficient variability to obtain results that allow us to generalise our conclusions.

TABLE 2 about here

Table 3 presents the correlation matrix of all variables included in our tests. The Pearson (Spearman) correlation coefficients are displayed below (above) the diagonal. Table 3 indicates that our endogenous variable, "*Voluntary disclosure*" is significantly related to the rest of the

variables. However, the high and significant correlation coefficient between "*Stickiness*" and our endogenous variable (0.76-Pearson/0.76-Spearman) is noteworthy. This result joins previous findings (Chen et al. 2002) in suggesting that voluntary disclosure is a sticky practice. The table also depicts a high and significant correlation among our three individual proxies of causal ambiguity (i.e. firm complexity (i.e. "*Complexity-Intangibles*", "*Complexity-Segments*", and "*Predictability-Revenues)*" and the variable "*Causal Ambiguity*". These correlations arise naturally because "*Causal Ambiguity*" is calculated based on the individual proxies using factor analysis.

Finally, we consider it important to comment on some high correlations between some control variables and our main independent variables. First, "*Litigation Risk*" and "*Competition*" are highly and negatively correlated. Hence, in our sample, industries with higher litigation risk are, in general, industries with low competition intensity. Second, "*Firm size*" has a positive correlation with "*Causal Ambiguity*". This correlation is somewhat expected since larger firms are more likely to have more business segments and intangible assets. Likewise, larger firms are likely to have more operations as well as greater revenue figures that are hard to predict. Therefore, the standard deviation of revenues calculated in US dollars is also likely to increase with firm size. This size-effect is consistent with the findings of Hutton (2005).[16] Third, there is a negative correlation between "*Causal Ambiguity*" and "*Analyst Coverage*". These results are consistent with the idea that "*Firm size*" correlates positively with "*Institutional Ownership*" and "*Analysts Coverage*". Therefore, analysts tend to follow larger firms, which are also likely to have more causal ambiguity. Finally, for readability purposes, we do not offer insights on the potential strong correlation among our

[16] As we show in the next section, the VIF of "*Causal Ambiguity"* and "*Firm Size*" in the empirical models is not a major concern. Concretely, VIF coefficients are below 10 (Gujarati 2003) This suggests that the high correlation between these variables does not represent a major issue in our empirical tests. In addition, consistent with the approach suggested by Hutton (2005), we confirm that our results hold even when we exclude "*Firm Size*" from the models.

control variables. However, as we show in the next section, the VIF analysis indicates that none of them represent a major multicollinearity problem for our empirical results.

TABLE 3 about here

5.2. Regression results

Our first hypothesis proposes a negative quadratic relationship (i.e. inverted-U shape) between firms' voluntary disclosure and market competition. Therefore, our empirical models explain "*Voluntary Disclosure"* as a quadratic function of "*Competition"*. Hypothesis 2 proposes a shape-flipping function. Haans et al. (2016)[17] use this term to refer to functions describing an inverse U-shaped relationship between two variables ("*Voluntary disclosure"* and "*Competition"* in our case) that gradually turns (or flips) into a U shape as a result of the influence of a moderator ("*Causal Ambiguity*" in our case). To test this proposition, we multiply the above-mentioned effect of "Competition" (i.e. quadratic function) by the variable "*Causal Ambiguity*" (i.e. moderator variable). Given the binary nature of our endogenous variable ("*Voluntary disclosure*"), we test our hypotheses using a panel logit model with year and quarter fixed effects and firm-clustered errors (Guay et al. 2016; Huang et al. 2017; Monk 2017; Muiño and Núñez-Nickel 2016). Equation (1) shows the complete econometric model that we use to test our hypotheses.

$$\Pr\left(Voluntary\ disclosure_{it}\right) = = \frac{1}{1+\exp\left[-\begin{pmatrix} \beta_0 + \beta_1 Competition_{it} + \beta_2 Competition_{it}^2 \\ +\beta_3\ Causal\ Ambiguity \\ +\ \beta_4 Competition_{it}\ x\ Causal\ Ambiguity \\ +\ \beta_5 Competition_{it}^2\ x\ Causal\ Ambiguity \\ +\ \Sigma Control\ Variables_{it} + \Sigma Year + \Sigma Quarter \end{pmatrix}\right]} \quad (1)$$

[17] We have not found this methodology applied in accounting research. However, prior literature on strategic management has developed a specific theoretical framework to analyse the potential causes and implications of shape-flipping curves (Haans et al. 2016). Uotila et al. (2009) is an example of how this framework has been applied in empirical research.

Where Pr(*Voluntary disclosure*) is the probability of disclosing EPS forecasts in the current quarter, "*Competition*" and "*Causal Ambiguity*" are our main independent and moderator variables, respectively. *ΣControl Variables* is the sum of all control variables multiplied by their coefficients and *ΣYear* and *ΣQuarter* represent the year and quarter fixed-effects. All variables are specified in section 4 and summarised in Table 1. We test H1 with the coefficients of the linear and quadratic terms of "*Competition*" (*Competition*^{2}). We expect β_1 to be positive, and β_2 to be negative. In other words, we foresee the initial positive tendency between "*Voluntary disclosure*" and "*Competition*" as gradually decreasing until the slope becomes negative as the market evolves towards perfect competition. We anticipate finding a significant inverse U-shaped relation between "*Voluntary Disclosure"* and "*Competition*". In H2 we propose a shape-flipping function. Empirically, we find support for this proposition if β_5 is positive (i.e. the function flattens as "*Causal Ambiguity*" increases) and the flip occurs within the range of our data. Specifically, the level of the moderator variable for which a flip-shape occurs can be calculated as $-\beta_2 / \beta_5$ (Haans et al. 2016). Therefore, we expect $-\beta_2 / \beta_5$ to be within the range of "*Causal Ambiguity*" (i.e. [-2.20, 2.35]).

Table 4 shows the main results, together with the corresponding VIF analysis. All models report coefficients, z-statistics and the degree of significance by asterisks. Model 1 tests the quadratic effect of "*Competition*" on "*Voluntary Disclosure*" (H1). Results indicate that "*Competition*" exerts a non-linear effect on "*Voluntary Disclosure*". More specifically, we find that the signs of the linear and quadratic coefficients of "*Competition*" are significant (p-value<.01) and with the expected signs ($\beta_1 > 0$ and β_2<0). Therefore, consistent with H1, we find an inverse U-shaped relationship when we do not consider the moderator effect. Model 2 tests the moderate effect of causal ambiguity (H2). Results indicate that "*Causal Ambiguity*" moderates the relationship between "*Competition*" and "*Voluntary Disclosure*". Concretely, we find that β_5 is positive and statistically significant (p-value<.01), which suggests that the

above-mentioned inverted-U shape flattens as "*Causal Ambiguity*" increases. According to Model 2, a shape-flip would occur when "*Causal Ambiguity*" is larger than $-\beta_2 / \beta_5$=1.87. Given that this critical value is within the range of "*Causal Ambiguity*" in our sample, we consider that this evidence supports H2. Models 3 and 4 test how our moderation model performs when other moderators are considered. Model 3 shows the moderating effects of "*Causal Ambiguity*" and "*Concentration*" simultaneously. We find that "*Concentration*" does not moderate the non-linear effect of "*Competition*" on "*Voluntary Disclosure*". Likewise, even if we control for this alternative moderation effect, the influence of "*Causal Ambiguity*" remains significant. Model 4 integrates the moderation effect of "*Entry Barriers*" as well. Findings suggest that "*Entry Barriers*" does not moderate the effect of "*Competition*" on "*Voluntary Disclosure*", either. The effect of "*Causal Ambiguity*" still remains.

TABLE 4 about here

Figure 4 displays the results of Model 2 of Table 4. The disclosure probability functions initially have an inverse-U shape, indicating that as the level of market competition increases, the positive relation between the probability of voluntary disclosure and competition observed in less competitive markets tend to disappear and finally becomes negative (H1). Nevertheless, consistent with H2, for high values of firm-level causal ambiguity, we observe a flip in the curvature of the function that turns into a U-shaped function, as found by prior research (e.g. Muiño and Núñez-Nickel 2016).

FIGURE 4 about here

Regarding the control variables, we find that the variables "*Herding*", "*Institutional Ownership*", "*Firms Size*", *"Loss"*, "*Audit Quality*", and "*Stickiness*" exert significant ($p<0.01$) and positive effects on firms' voluntary disclosure decisions. We would also like to emphasise that the direct of "*Causal Ambiguity*" is significant and positive ($p<0.01$). These results confirm previous findings (Hutton 2005; Guay et al. 2016), and they imply that causal ambiguity has

other effects independent from the level of competition. In contrast, "*Competitive Position*", "*Book to Market*", and "*Loss*" have significant and negative effects on "*Voluntary Disclosure*". These results are consistent with prior research suggesting that firms are more likely to disclose information when they are larger (e.g. Li 2010), when they have better performance (e.g. Yang 2012), when voluntary disclosure is a common practice in the industry (e.g. Tse and Tucker 2010), when they have recently disclosed information (e.g. Tucker 2015), and when they were monitored by larger institutional shareholders (e.g. Ali et al. 2014). Finally, the Variance Inflation Factor (VIF) analysis indicates that all VIF coefficients are below the limit value of 10 (Gujarati 2003); therefore, we conclude that multicollinearity does not drive the overall predictions presented in Table 4.

6. Robustness tests and additional analysis

6.1. Coverage biases

As we explain in section 3 (i.e. Data and sample selection), we assume that those Compustat firms not found in I/B/E/S are non-disclosures. Chuk et al. (2013) mention that I/B/E/S Guidance suffers from biases when covering certain types of firms. In particular, the authors indicate that this database has a systematically higher coverage of larger firms, firms with higher institutional ownership, firms followed by more analysts and firms with better performance. To check the potential effect of this coverage bias on our results, we conduct the robustness tests previously proposed and used by Billings et al. (2015) and Heflin et al. (2016). The first four models of Table 5 present a subsample analysis recommended by Billings et al. (2015). Specifically, models 1 to 4 show the results of our main models using the following subsamples: only the observations that overcome the median of "*Institutional ownership*" (Model 1), only observations that overcome the median of "*Analysts coverage*" (Model 2), only observations that overcome the median of "*Performance*" (Model 3), and only observations that overcome the median of "*Firm size*" (Model 4). In addition, Model 5 presents the

subsample analysis suggested by Heflin et al. (2016). In this model, we test our main model using a subsample with the following rules: (1) "*Institutional ownership*" higher than 0.05, (2) "*Analysts coverage*" higher than 2, and (3) firms with positive results in at least two of the last eight quarters. Results of all these models indicate that the non-linear relation between "*Competition*" and "*Voluntary Disclosure*" is moderated by causal ambiguity. Overall, these robustness tests corroborate both the sign and the significance of the different coefficients. Hence, even if a coverage bias is likely to exist, our results are reasonably robust to that bias.

In the same vein, according to section 3 (Data and sample selection), all of our analyses follow an assumption: when a firm does not appear in I/B/E/S or CDA/Spectrum databases in relation to the number of analysts or the percentage of institutional investors respectively, we assign a value of zero to these observations. Alternatively, we can consider that the lack of information does not mean that any analyst does not follow a given firm in a given quarter or the firm does not have any institutional ownership, but that this information is simply not available. To test whether our assumption has a significant effect on our results, we run a set of models assuming missing values for "*Analysts Coverage*" and "*Institutional Ownership*" whenever information for any given firm in any given quarter is not available in I/B/E/S or CDA/Spectrum databases. Regression results are presented in Model 6 of Table 5. Results indicate that the signs and significance of the coefficients of "*Competition*" and "*Competition*^{2}", as well as the moderating effect of causal ambiguity are similar despite the loss of observations (i.e. from 55,770 to 34,780). In other words, the result of our analysis holds even if the number of observations is reduced due to more restrictions.

TABLES 5 about here

6.2. Analysis using individual proxies of causal ambiguity

In our main analysis we use a single proxy for causal ambiguity that summarises three proxies: *Complexity-Intangibles*, *Complexity-Segments* and *Predictability*. In this subsection, we show the individual effect of each of these three proxies of causal ambiguity. Table 6 indicates that the results of the three proxies of causal ambiguity are consistent with our main results.[18] Specifically, each of the three variables significantly moderates the relation between "Competition" and "Voluntary Disclosure".

TABLE 6 about here

6.3 Analysis using market variables with data from the Census of US Manufacturers

As Compustat only includes public firms, we can introduce some biases in the empirical results by using an industry-level competition measurement calculated exclusively with the financial information of public firms (Ali et al. 2014; Keil 2017). To corroborate our findings, we run our main models, but with the industry-level variables calculated with information on competition from the US Census of Manufacturers (hereafter USCM) (e.g. Ali et al., 2014; Muiño and Nuñez-Nickel 2016). Because the data of USCM are published every five years, industry-level information is available only for the years 2002, 2007 and 2012. Thus, to conduct this additional analysis, we use an approach similar to Ali et al. (2014). We assume that the market information provided by each report remains valid for all consecutive quarters until a new report is issued. In other words, the values provided by the 2002, 2007 and 2012 reports are used in all quarters of the periods 2002–2006, 2007–2011 and 2012–2015,

[18] As it can be seen in models 1-6 of Table 6, the signs of the coefficients of "*Causal Ambiguity*", proximated by "Complexity-Intangibles" and "Complexity-Segments", and those of their interaction terms with "*Competition*", "*Competition*^{2}" are the same as the signs of the coefficients presented in our main analysis. This result is expected because both "Complexity-Intangibles" and "Complexity-Segments" are positively associated with "Causal Ambiguity". In other words, higher values of "Complexity-Intangibles" and "Complexity-Segments" correspond to higher values of "Causal Ambiguity". Differently, in models 7-9 of Table 6, the signs of the coefficient of "*Causal Ambiguity*", as well as the coefficients of the interaction terms of "*Causal Ambiguity*" with "*Competition*" and "*Competition*^{2}" are opposite to the signs in our main analysis. These results are consistent with our main analysis because "*Predictability-Revenues*" is negatively correlated with "*Causal Ambiguity*". In other words, more predictable revenues correspond to lower values of "Causal Ambiguity".

respectively. Table 7 shows the results of this additional analysis that are consistent with the findings of our main analysis.

TABLE 7 about here

6.4 Analysis using Predictability of other items in the Income Statement

As mentioned in subsection 4.3, one of the components of our measure of firms' causal ambiguity (i.e. "*Causal Ambiguity*") is the predictability of revenues (i.e. Predictability-Revenues"). In subsection 6.2, we show that Predictability-Revenues significantly moderates the relation between "*Competition*" and "*Voluntary Disclosure*". We use the predictability of revenues following prior research (i.e. Hutton 2005). Intuitively, the dispersion of the revenues indicates the extent to which a firm's economic activities can be predicted. Nevertheless, it is interesting to test whether the predictability of other items of the income statement exert a similar moderation effect. Thus, we calculate the predictability of firms' cost of goods sold ("*Predictability-COGS*"), selling, general and administrative expenses ("*Predictability-SG&A*"), and earnings ("*Predictability-Earnings*"). This additional analysis is shown in Table 8. Results indicate that only "*Predictability–COGS*" exerts the same moderation effect but with a lower level of significance than *"Predictability Revenues"*. This is somewhat reasonable because the cost of goods sold is likely to follow a similar path to the revenues. We suspect the real influential factor of the two variables is the predictability of the sales volume (i.e. number of units sold out). In other words, the sales volume is a common component that influences both revenues and COGS (through variable costs). However, COGS is the sum of variables costs that changes proportionally with the sales volume, and fixed costs that remain constant, related to the changes in sales volume. Therefore, it seems reasonable to think that, despite both variables having the same sign, *"Predictability COGS"* has a lower level of significance than *"Predictability Revenues"* because of the perturbation from fixed costs. Nevertheless, the direction of this result is consistent with the moderation effect proposed in our main analysis.

TABLE 8 about here

6.5. Addressing Potential Endogeneity

Although prior evidence suggests a low endogeneity among voluntary disclosure and market competition (measured by market concentration), we formally tested the existence of endogeneity using a Durbin-Wu-Hausman test (e.g. Greene 2003, p. 83; Lapointe-Antunes et al. 2006). We conduct this test in two steps. First, we run a first model (i.e. first-step model) in which our measure of market competition (i.e. "Competition") is regressed against market-level determinants of competition. Concretely, we use "*Concentration*", "*Entry Barriers*" and "*Market Size*" as explanatory variables because these factors are likely to shape the competition in the market (e.g. Karuna 2010). In a second step, we add the residuals of the first-step model as an independent variable in our empirical models explaining firms' voluntary disclosure decisions (i.e. second-step models). A significant coefficient of this new variable would indicate the presence of endogeneity (i.e. there are factors not included in our models that simultaneously affect the level of competition in the product market and individual firms' voluntary disclosure actions). Our results indicate that the coefficient of this new variable is not statistically significant. Hence, based on these findings, we conclude that endogeneity is unlikely to play a significant role in our empirical tests.[19]

7. Discussion and conclusion

The main contribution of this paper is to identify firms' causal ambiguity as a moderator of the relation between product market competition at the industry level and the voluntary disclosure of information. Such an effect starts and supports a series of interesting, and new theoretical concepts in this research line. First, the inclusion of causal ambiguity in the theoretical arguments allows us to develop a holistic model that includes all previous underlying influences (i.e. incentives and restrictions) on the disclosure of information.

[19] Results of this analysis are available from the authors upon request.

Second, the most evidential conclusion of this model is that causal ambiguity is the gauge that regulates the strengths between the incentives and restrictions of voluntary disclosure. Ambiguity simultaneously increases incentives and decreases restrictions. Third, the analysis not only ends with a conclusion at the global level on incentives and restrictions, but also specifies which incentives and restrictions are protagonists at different competition levels. For instance, when the competition intensity is low, the agency problem dominates in the relation between competition and voluntary disclosure. That is, voluntary disclosure is marked by disputes between principals (incentive by accountability factor to the principals) and agents (restriction by agency costs). Other incentives and restrictions exist, but they are less relevant in low competition markets. By contrast, when market competition approaches perfect competition, the threat for managers comes from rivals not from shareholders, therefore, the agency problem loses its dominant effect, and the strategic information becomes more and more important. Thus, managers need to consider the trade-offs between revealing their few strategic differences to the incumbent competitors (restriction by proprietary costs) and informing customers about their performance or warning potential rivals about the low profit margins to avoid the overproduction in the industry (incentives by signalling and/or deterrence). Such a decision is also influenced by the degree of causal ambiguity. Causal ambiguity reduces external agents' capacity to correctly interpret the disclosed information. As causal ambiguity increases, reduces the restrictions (e.g., proprietary costs) and, simultaneously, increments the incentives to disclose (e.g., managers need to disclosure more to inform their clients). By changing the relative importance between restrictions and incentives to disclose, causal ambiguity moderates the overall effect that market level competition exerts on firms' voluntary disclosure decisions.

In relation to recent studies on the same topic, our findings also show how they are linked to previous results developed by the literature. Both theoretical and empirical

controversies due to the disparity of results are reasonable. With our empirical results, we show how the relation between competition at industry level and voluntary disclosure changes by including the moderating effect of causal ambiguity.

We cannot finalise the conclusions without mentioning two aspects that are considered as future lines of investigation. The first one is with respect to the difference between causal ambiguity and information ambiguity. In this paper, the proxies of causal ambiguity are at firm-level (i.e. the firm complexity and revenue predictability of each firm). However, there are different types of information, and each one has its own level of ambiguity that could be added to the level of causal ambiguity that exists in the firm characteristic/structure. For instance, if we compare the results of our H1 with the findings of Muiño and Núñez-Nickel's H2 (2016) without including the moderator effect of the causal ambiguity, we find that they are diametrically opposite (i.e. Muiño and Núñez-Nickel 2016) obtains a U shape, whereas we obtain an inverse-U shape)[20]. We think that the type of information is the cause of this difference. We use EPS as information disclosure to test our model, and Muiño and Núñez-Nickel (2016) use the level of disaggregation in segment reporting. We believe that information about EPS has less informative ambiguity than the disaggregation in segment reporting, and therefore the influence of incentives for the latter is stronger than in our settings. The second aspect is related to the competition measure. We are interested in showing the effect of competition on both restrictions and incentives to voluntary disclosure using a single competition measure at industry-level, including the moderating effect of the causal ambiguity. However, there are other dimensions of competition that we do not

[20] When two non-linear models are estimated, one with an exogenous variable and the other with the inverse of this same exogenous variable, the models can be symmetric with respect to the Y-axis. Hence, estimate a model with a variable or its inverse does not necessarily affect the degree of convexity or concavity of the model. Therefore, despite using the inverse of the variable used by Muiño and Núñez-Nickel (2016), we could have found similar results as those in Muiño and Núñez-Nickel (2016). However, this is not true according to our empirical results. Muiño and Núñez-Nickel (2016)obtain a convex relationship between market competition and voluntary disclosure, and we have a concave relationship.

explore in this paper, but it can have interesting associations in relation to the causal ambiguity. In particular, the competitive position of the firm inside the market. We cannot avoid thinking of causal ambiguity as a source of strategic advantages interlinked with the firm's power competition.

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Table 1. Variable definitions

Variable	Definition
Voluntary disclosure	1 if firm *i* provides guidance on the EPS of the current quarter and 0 otherwise.
Competition	Inverse of price-cost margin (i.e. total operating costs divided by total value of shipments for the same industry). Calculated for each four-digit NAICS4 industry *j*, in quarter *t*.
Complexity-Intangibles	Percentage of firm *i*'s assets that are intangible in quarter *t.*
Complexity-Segments	Number of firm *i*'s business segments in quarter *t*
Predictability	1 divided by the standard deviation of firm i's revenues during the last 5 years (presented in natural logarithm). Calculated for each firm *i*, in quarter *t*.
Causal Ambiguity	First factor of a factor analysis conducted with *Complexity-Intangibles*, *Complexity-Segments*, and *Predictability*. Calculated for each firm *i*, in quarter *t.*
Concentration	Herfindahl-Hirschman Index calculated for the largest 50 firms in the industry. Calculated for each four-digit NAICS4 industry *j*, in quarter *t*.
Entry barriers	Total capital expenditures in the industry divided by the number of firms in the same industry (in USD millions). Calculated for each four-digit NAICS4 industry *j*, in quarter *t*.
Herding	Percentage of firms in the industry that provided at EPS guidance in the previous quarter. Calculated for each four-digit NAICS4 industry *j*, in quarter *t*.
Market Size	Natural logarithm of total sales of the industry (in USD Millions). Calculated for each four-digit NAICS4 industry *j*, in quarter *t*.
Litigation Risk	1 if a firm *i* operates in an industry facing high litigation risk in quarter *t*, and 0 otherwise.
Institutional ownership	Percentage of firm *i*'s stock owned by institutional investors in quarter *t*.
Analysts Coverage	Number of analysts following firm *i* in quarter *t*.
Firm Size	Natural logarithm of firm *i*'s market capitalisation (in million USD) in quarter *t*.
Leverage	Firm *i*'s Debt-equity ratio (i.e. total liabilities divided by Stockholders' equity) in quarter *t*.
Book to market	Firm *i*'s Book to market ratio (i.e. firms market capitalisation plus long-term debt divided by firm total asset) in quarter *t*.
Performance	Firm *i*'s ROA ratio (i.e. income before extraordinary items divided by total assets) in quarter *t*.
Loss	1 if firm *i*'s results in quarter *t* are positive, and 0 otherwise.
Adj. Market Returns	Firm *i*'s quarterly buy-and-hold stock return minus the CRSP value-weighted stock return in quarter *t.*
EPS increase	1 if firm *i*'s EPS of quarter *t* are larger than the EPS in the prior quarter, and 0 otherwise.
Duality	1 if the CEO of firm *i* is also the chairman of the board of directors in quarter *t*.
Independent	Percentage of independent directors on firm *i*'s board in quarter *t*.
Audit Quality	1 if firm *i* is audited by a Big-4 auditor in quarter *t*, and 0 otherwise.
Stickiness	1 if firm *i* disclosed information in the two previous quarters, 0.5 if the firms disclosed information in at least one of those periods, and 0 otherwise.

Notes: All continuous variables winsorized at 1% and 99% level.

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Q1	Median	Q3	Max	N
Voluntary Disclosure	0.18	0.38	0.00	0	0	0	1	55,770
Competition	0.58	0.17	0.24	0.49	0.59	0.70	0.87	55,770
Causal Ambiguity	0.01	0.98	-2.20	-0.74	-0.13	0.67	2.35	55,770
Complexity-Intangibles	0.17	0.18	0	0.02	0.11	0.27	0.72	55,770
Complexity-Segments	1.99	1.33	1	1	1	3	6	55,770
Predictability-Revenues	-3.11	1.81	-7.14	-4.36	-3.1	-1.91	2.88	55,770
Concentration	0.18	0.12	0.05	0.08	0.14	0.24	0.48	55,770
Entry Barriers	44.87	64.66	1.64	11.12	22.68	49.05	441.32	55,770
Herding	0.1	0.08	0.00	0.02	0.09	0.15	0.30	55,770
Market Size	9.72	1.37	5.43	8.77	10.04	10.78	11.82	55,770
Litigation Risk	0.35	0.48	0.00	0	0	1	1	55,770
Institutional Ownership	0.59	0.31	0.00	0.36	0.67	0.84	1.00	55,770
Analysts Coverage	6.71	6.37	0.00	2	5	10	25	55,770
Competitive Position	-0.07	0.79	-1.95	-0.38	-0.16	0.04	6.06	55,770
Firm Size	6.48	1.90	0.02	5.20	6.42	7.71	10.95	55,770
Leverage	1.35	2.60	0.03	0.31	0.72	1.39	27.12	55,770
Book to Market	1.78	1.51	0.17	0.91	1.33	2.10	20.09	55,770
Performance	0	0.06	-0.69	-0.01	0.01	0.02	0.11	55,770
Loss	0.3	0.46	0.00	0	0	1	1	55,770
Adj. Market Returns	0.02	0.23	-0.59	-0.11	0.00	0.12	1.17	55,770
EPS increase	0.54	0.50	0.00	0	1	1	1	55,770
Duality	0.53	0.50	0.00	0	1	1	1	55,770
Independent	0.73	0.16	0.00	0.67	0.78	0.86	0.92	55,770
Audit Quality	0.81	0.39	0.00	1	1	1	1	55,770
Stickiness	0.17	0.35	0.00	0	0	0	1	55,770

Notes: This table shows descriptive statistics for the sample of 55,770 firm-quarter across fiscal years 2002-2015. Variable definitions: *Voluntary disclosure* takes a value of 1 if the firm provides guidance about the EPS of the current period and 0 otherwise. *Competition* is the 4-digit NAICS inverse of price-cost margin in every period (i.e. Total operating costs divided by total value of shipments for the same industry.) *Complexity-Intangibles* is the percentage of firm i's assets that are intangible in period t. *Complexity-Segments* is the number of firm i's business segments in period t. *Predictability* is calculated as the natural logarithm of 1 divided by the standard deviation of firm i's revenues during the last 5 years. *Causal Ambiguity* is estimated with the first factor of a factor analysis conducted with the variables *Complexity-Intangibles*, *Complexity-Segments*, and *Predictability*. *Concentration* is the Herfindahl-Hirschman Index calculated for the largest 50 firms in the industry. *Entry Barriers* accounts for the total capital expenditures in each 4-digit NAICS industry divided by the number of firms in the same industry (in USD millions $). *Herding* is the percentage of firms in industry j that provided at EPS guidance in the previous quarter. *Market Size* is the natural logarithm of total sales of a given 4-digit NAICS industry (in USD millions). *Litigation Risk* takes a value of 1 if a firm operates in an industry facing high litigation risk, and 0 otherwise. *Institutional ownership* represents the percentage of firm's stock owned by institutional investors. *Analysts Coverage* account for the number of analysts following the firm. *Firm Size* is the natural logarithm of firm market capitalisation (in million USD). *Leverage* is the firms' debt-equity ratio (i.e. total liabilities divided by Stockholders' equity). *Book to market* accounts for firms' book to market ratio (i.e. firms market capitalisation plus long-term debt divided by firm total asset). *Performance* is the firms' ROA ratio (i.e. income before extraordinary items divided by total assets). *Loss* takes a value of 1 if firm results in the current quarter are positive, and 0 otherwise. *Adj. Market Returns* account for firms' quarterly buy-and-hold stock return minus the CRSP value-weighted stock return in the current quarter. *EPS increase* takes a value of 1 if EPS of current quarter are larger than the EPS in the prior quarter, and 0 otherwise. *Duality* takes a value of 1 if the CEO of the firm is also the chairman of the board of directors. *Independent* represents the percentage of independent directors on the firms' board. *Audit Quality* takes the value of 1 if the firm is audited by a Big-4 auditor, and 0 otherwise. *Stickiness* takes a value of 1 if the firm disclosed information in the two previous periods, 0.5 if the firms disclosed information in at least one of those periods, and 0 otherwise.

Table 3. Correlation Matrix

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	*Voluntary Disclosure*	1.00	-0.03	0.16	0.12	0.04	-0.18	-0.06	0.05	0.19	0.04	0.03	0.18	0.27	-0.03	0.23	-0.02	0.07	0.12	-0.12	0.01	0.01	0.01	0.09	0.12	0.76
2	*Competition*	0.00	1.00	0.27	0.01	0.30	-0.28	0.40	0.10	-0.07	-0.50	-0.50	0.06	-0.07	0.16	0.05	0.28	-0.35	0.10	-0.18	0.03	0.00	0.11	0.03	0.05	-0.03
3	*Causal Ambiguity*	0.15	0.27	1.00	0.66	0.74	-0.82	0.20	0.18	-0.01	-0.17	-0.30	0.34	0.52	-0.05	0.69	0.45	-0.14	0.27	-0.33	0.06	0.01	0.18	0.27	0.31	0.18
4	*Complexity-Intangibles*	0.11	-0.02	0.61	1.00	0.28	-0.34	0.03	0.04	0.05	-0.06	-0.15	0.22	0.28	-0.13	0.36	0.23	-0.04	0.12	-0.20	0.03	0.01	0.07	0.18	0.13	0.14
5	*Complexity-Segments*	0.05	0.26	0.78	0.21	1.00	-0.43	0.20	0.10	-0.05	-0.19	-0.29	0.14	0.18	0.03	0.35	0.30	-0.16	0.16	-0.23	0.04	0.01	0.17	0.15	0.16	0.06
6	*Predictability-Revenues*	-0.18	-0.30	-0.81	-0.28	-0.45	1.00	-0.21	-0.25	0.00	0.14	0.24	-0.38	-0.65	0.01	-0.81	-0.47	0.11	-0.30	0.32	-0.05	-0.01	-0.17	-0.29	-0.37	-0.20
7	*Concentration*	-0.04	0.32	0.17	0.01	0.15	-0.19	1.00	0.08	-0.22	-0.51	-0.24	-0.01	-0.05	0.03	0.04	0.25	-0.21	0.08	-0.12	0.02	-0.01	0.11	0.03	-0.01	-0.06
8	*Entry Barriers*	0.00	0.23	0.22	0.00	0.17	-0.28	0.18	1.00	0.21	0.30	0.00	0.07	0.17	0.03	0.22	0.16	-0.07	0.08	-0.07	-0.02	-0.02	0.02	0.12	0.08	0.06
9	*Herding*	0.19	0.04	-0.01	0.01	-0.05	-0.03	-0.12	0.09	1.00	0.18	0.08	0.07	0.07	0.12	0.00	-0.14	-0.04	0.01	-0.02	-0.03	0.01	-0.08	0.06	-0.04	0.21
10	*Market Size*	0.06	-0.46	-0.10	0.00	-0.12	0.08	-0.55	0.25	0.21	1.00	0.55	0.00	0.16	-0.08	0.06	-0.17	0.24	-0.11	0.16	-0.03	0.01	-0.08	0.07	0.02	0.04
11	*Litigation Risk*	0.03	-0.52	-0.29	-0.13	-0.27	0.23	-0.24	-0.12	0.09	0.47	1.00	-0.07	0.05	-0.10	-0.10	-0.25	0.19	-0.21	0.26	-0.05	0.00	-0.08	-0.03	-0.03	0.03
12	*Institutional Ownership*	0.17	0.08	0.33	0.18	0.16	-0.39	0.02	0.07	0.07	0.00	-0.08	1.00	0.46	-0.09	0.47	0.08	0.10	0.19	-0.21	0.05	0.01	0.02	0.32	0.27	0.20
13	*Analysts Coverage*	0.24	-0.07	0.50	0.23	0.21	-0.64	-0.03	0.16	0.09	0.20	0.08	0.35	1.00	-0.16	0.81	0.17	0.28	0.23	-0.19	0.01	0.02	0.09	0.34	0.37	0.29
14	*Competitive Position*	-0.07	0.00	-0.13	-0.14	-0.04	0.12	0.01	0.00	-0.01	0.01	0.02	-0.10	-0.14	1.00	-0.20	0.08	-0.32	-0.22	0.14	-0.04	-0.04	-0.01	-0.06	-0.05	-0.03
15	*Firm Size*	0.22	0.03	0.70	0.31	0.38	-0.80	0.03	0.21	0.00	0.11	-0.08	0.45	0.78	-0.19	1.00	0.26	0.33	0.41	-0.38	0.11	0.02	0.15	0.35	0.41	0.25
16	*Leverage*	-0.04	0.12	0.18	0.06	0.13	-0.19	0.10	0.07	-0.07	-0.07	-0.10	0.01	0.05	0.04	0.07	1.00	-0.27	-0.04	-0.05	0.03	0.01	0.09	0.17	0.18	-0.01
17	*Book to Market*	0.00	-0.34	-0.21	-0.12	-0.16	0.17	-0.16	-0.09	-0.09	0.20	0.19	0.02	0.16	-0.09	0.20	-0.09	1.00	0.29	-0.10	0.13	0.02	-0.04	0.07	0.05	0.06
18	*Performance*	0.10	0.20	0.29	0.11	0.16	-0.34	0.13	0.07	0.05	-0.15	-0.23	0.21	0.17	-0.26	0.32	-0.06	-0.08	1.00	-0.79	0.14	0.25	0.12	0.10	0.07	0.12
19	*Loss*	-0.12	-0.20	-0.33	-0.16	-0.21	0.33	-0.12	-0.09	-0.02	0.14	0.26	-0.21	-0.19	0.20	-0.37	0.06	0.02	-0.60	1.00	-0.13	-0.19	-0.13	-0.10	-0.09	-0.13
20	*Adj. Market Returns*	-0.01	0.01	0.00	-0.01	0.01	-0.01	0.00	-0.02	-0.02	-0.02	-0.02	0.01	-0.03	-0.03	0.04	0.01	0.13	0.09	-0.08	1.00	0.04	0.01	0.01	0.02	0.01
21	*EPS increase*	0.01	0.00	0.01	0.00	0.01	-0.01	-0.01	-0.03	0.01	0.01	0.00	0.01	0.02	-0.04	0.02	0.00	0.01	0.18	-0.19	0.03	1.00	0.01	0.00	0.01	0.02
22	*Duality*	0.01	0.10	0.18	0.06	0.16	-0.17	0.10	0.07	-0.09	-0.06	-0.08	0.02	0.10	-0.02	0.15	0.05	-0.05	0.10	-0.13	0.00	0.01	1.00	0.02	0.07	0.01
23	*Independent*	0.10	0.01	0.24	0.15	0.14	-0.24	0.02	0.10	0.09	0.08	-0.03	0.31	0.28	-0.04	0.31	0.04	0.03	0.08	-0.09	-0.01	0.00	0.03	1.00	0.17	0.11
24	*Audit Quality*	0.12	0.04	0.30	0.11	0.16	-0.37	-0.03	0.07	-0.04	0.04	-0.03	0.28	0.31	-0.05	0.41	0.08	-0.01	0.06	-0.09	0.00	0.01	0.07	0.15	1.00	0.13
25	*Stickiness*	0.76	0.00	0.17	0.12	0.05	-0.19	-0.04	0.02	0.22	0.07	0.03	0.19	0.25	-0.07	0.23	-0.04	-0.01	0.10	-0.13	-0.01	0.01	0.00	0.11	0.12	1.00

Notes: The table shows Pearson (below the diagonal) and Spearman (above the diagonal) correlation coefficients. Variable definitions: *Voluntary disclosure* takes a value of 1 if the firm provides guidance about the EPS of the current period and 0 otherwise. *Competition* is the 4-digit NAICS inverse of price-cost margin in every period (i.e. total operating costs divided by total value of shipments for the same industry.) *Complexity-Intangibles* is the percentage of firm i's assets that are intangible in period t. *Complexity-Segments* is the number of firm i's business segments in period t. *Predictability* is calculated as the natural logarithm of 1 divided by the standard deviation of firm i's revenues during the last 5 years. *Causal Ambiguity* is estimated with the first factor of a factor analysis conducted with the variables *Complexity-Intangibles*, *Complexity-Segments*, and *Predictability*. *Concentration* is the Herfindahl-Hirschman Index calculated for the largest 50 firms in the industry. *Entry Barriers* accounts for the total capital expenditures in each 4-digit NAICS industry divided by the number of firms in the same industry (in USD millions $). *Herding* is the percentage of firms in industry j that provided at EPS guidance in the previous quarter. *Market Size* is the natural logarithm of total sales of a given 4-digit NAICS

industry (in USD millions). *Litigation Risk* takes a value of 1 if a firm operates in an industry facing high litigation risk, and 0 otherwise. *Institutional ownership* represents the percentage of firm's stock owned by institutional investors. *Analysts Coverage* account for the number of analysts following the firm. *Firm Size* is the natural logarithm of firm market capitalisation (in USD millions). *Leverage* is the firms' debt-equity ratio (i.e. total liabilities divided by Stockholders' equity). *Book to market* accounts for firms' book to market ratio (i.e. firms market capitalisation plus long-term debt divided by firm total asset). *Performance* is the firms' ROA ratio (i.e., income before extraordinary items divided by total assets). *Loss* takes a value of 1 if firm results in the current quarter are positive, and 0 otherwise. *Adj. Market Returns* account for firms' quarterly buy-and-hold stock return minus the CRSP value-weighted stock return in the current quarter. *EPS increase* takes a value of 1 if EPS of current quarter are larger than the EPS in the prior quarter, and 0 otherwise. *Duality* takes a value of 1 if the CEO of the firm is also the chairman of the board of directors. *Independent* represents the percentage of independent directors on the firms' board. *Audit Quality* takes the value of 1 if the firm is audited by a Big-4 auditor, and 0 otherwise. *Stickiness* takes a value of 1 if the firm disclosed information in the two previous periods, 0.5 if the firms disclosed information in at least one of those periods, and 0 otherwise. r>|0.01|significant at 5% level; r>|.013| significant at 1% level.

Table 4. Main Analysis

			Dependent Variable: Voluntary Disclosure			
Independent Variables	Predicted Sign	VIF	Model 1	Model 2	Model 3	Model 4
Competition	H1: +	1.93	7.588***	9.202***	11.837***	8.323***
			(5.374)	(6.214)	(4.880)	(4.841)
Competition²	H1: -		-6.677***	-8.370***	-10.748***	-7.802***
			(-5.420)	(-6.306)	(-4.966)	(-5.209)
Causal Ambiguity		2.88	0.021	1.191***	1.111***	1.219***
			(0.510)	(3.861)	(3.616)	(3.849)
Competition x Causal Ambiguity				-4.780***	-4.497***	-4.847***
				(-4.262)	(-4.012)	(-4.171)
Competition² x Causal Ambiguity	H2: +			4.476***	4.223***	4.513***
				(4.433)	(4.188)	(4.282)
Concentration		1.84	-0.215	-0.176	4.859	-0.114
			(-0.727)	(-0.602)	(1.093)	(-0.380)
Competition x Concentration					-18.373	
					(-1.259)	
Competition² x Concentration					15.969	
					(1.364)	
Entry Barriers		1.99	-0.001**	-0.002**	-0.002***	-0.016
			(-2.235)	(-2.545)	(-2.749)	(-1.612)
Competition x Entry Barriers						0.043
						(1.331)
Competition² x Entry Barriers						-0.031
						(-1.233)
Herding		1.23	1.667***	1.528***	1.452***	1.599***
			(4.415)	(4.183)	(3.977)	(4.380)
Market Size		2.88	0.043	0.042	0.045	0.044
			(1.252)	(1.229)	(1.310)	(1.308)
Litigation Risk		1.73	0.096	0.083	0.094	0.085
			(1.292)	(1.137)	(1.254)	(1.154)
Institutional Ownership		1.38	0.528***	0.556***	0.550***	0.549***
			(4.815)	(5.087)	(5.026)	(5.040)
Analysts Coverage		2.97	0.014**	0.013**	0.013**	0.013**
			(2.547)	(2.389)	(2.289)	(2.312)
Competitive Position		1.1	-0.109***	-0.108**	-0.110***	-0.109**
			(-2.621)	(-2.564)	(-2.607)	(-2.570)
Firm Size		5.87	0.103***	0.105***	0.110***	0.106***
			(3.261)	(3.374)	(3.600)	(3.426)
Leverage		1.08	-0.019	-0.020	-0.020	-0.019
			(-1.435)	(-1.579)	(-1.599)	(-1.559)
Book to Market		1.58	-0.031	-0.030	-0.033	-0.029
			(-1.471)	(-1.385)	(-1.526)	(-1.367)
Performance		1.72	0.731	0.591	0.586	0.594
			(1.423)	(1.140)	(1.127)	(1.143)
Loss		1.75	-0.175***	-0.180***	-0.180***	-0.178***
			(-2.648)	(-2.716)	(-2.714)	(-2.705)
Adj. Market Returns		1.06	-0.005	-0.004	-0.006	-0.003
			(-0.051)	(-0.042)	(-0.064)	(-0.038)
EPS increase		1.08	-0.059	-0.059	-0.059	-0.060
			(-1.315)	(-1.303)	(-1.309)	(-1.319)
Duality		1.09	0.010	-0.002	-0.001	-0.003
time			(0.206)	(-0.041)	(-0.014)	(-0.065)
Independent		1.38	0.219	0.204	0.211	0.191
			(1.226)	(1.136)	(1.171)	(1.062)
Audit Quality		1.34	0.257***	0.276***	0.271***	0.279***
			(2.678)	(2.849)	(2.797)	(2.879)
Stickiness		1.15	5.041***	5.026***	5.025***	5.029***
			(65.180)	(64.446)	(64.252)	(64.448)
Year Fixed-Effects			Yes	Yes	Yes	Yes
Quarter Fixed-Effects			Yes	Yes	Yes	Yes

Constant	-6.234***	-6.582***	-7.317***	-6.302***
	(-9.688)	(-10.408)	(-9.091)	(-9.023)
Observations	55,770	55,770	55,770	55,770
No. Firms	1585	1585	1585	1585
Pseudo R^2	0.537	0.538	0.538	0.538

Table 5. Coverage Biases

	Dependent Variable: Voluntary Disclosure					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Independent Variables	Subsample: > median institutional ownership	Subsample: > median Size	Subsample: > median Number of Analysts	Subsample: > median Performance (ROA)	Subsample: Hefling et al (2016)	Subsample: Missing values of "Institutional Ownership" and "Analysts Coverage"
Competition	10.191***	9.164***	9.077***	6.587***	7.068***	9.376***
	(5.939)	(5.087)	(5.087)	(4.006)	(4.559)	(6.049)
Competition^2	-9.419***	-8.147***	-8.325***	-6.219***	-6.790***	-8.653***
	(-6.059)	(-5.032)	(-5.152)	(-4.254)	(-4.828)	(-6.105)
Causal Ambiguity	1.080***	1.197***	1.218***	0.531	0.501	1.196***
	(2.938)	(3.529)	(3.541)	(1.371)	(1.474)	(3.850)
Competition x Causal Ambiguity	-4.475***	-4.474***	-4.725***	-2.514*	-2.505**	-4.804***
	(-3.353)	(-3.579)	(-3.737)	(-1.838)	(-2.044)	(-4.176)
Competition^2 *x Causal Ambiguity*	4.315***	3.970***	4.322***	2.545**	2.730**	4.584***
	(3.620)	(3.555)	(3.811)	(2.107)	(2.490)	(4.353)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-5.943***	-5.508***	-4.972***	-5.648***	-5.133***	-6.182***
	(-7.913)	(-7.234)	(-6.698)	(-7.258)	(-7.606)	(-9.450)
Observations	28,178	27,964	26,237	29,804	34,780	44,578
No. Firms	986	985	1023	1368	1219	1431
Pseudo R^2	0.513	0.523	0.510	0.544	0.501	0.520

Notes: This table shows the coefficients estimates and t-statistics (in parenthesis) of a set of Logit models with firm-clustered errors exploring the effect of market competition and causal ambiguity on voluntary disclosure. The subsample of observations used in the analysis is stated above each model. Variable definitions: *Voluntary disclosure* takes a value of 1 if the firm provides guidance about the EPS of the current period and 0 otherwise. *Competition* is the 4-digit NAICS inverse of price-cost margin in every period (i.e. total operating costs divided by total value of shipments for the same industry.) *Causal Ambiguity* is estimated with the first factor of a factor analysis conducted with the variables *Complexity-Intangibles*, *Complexity-Segments*, and *Predictability* (where *Complexity-Intangibles* is the percentage of firm i's assets that are intangible in period t. *Complexity-Segments* is the number of firm i's business segments in period t. *Predictability* is calculated as the natural logarithm of 1 divided by the standard deviation of firm i's revenues during the last 5 years). All models include the control variables used in our main analysis (Table 4), namely: *Concentration, Entry Barriers, Herding, Market Size, Litigation Risk, Institutional ownership, Analysts Coverage, Firm Size, Leverage, Book to market, Performance, Loss, Adj. Market Returns, EPS increase, Duality*, *Independent, Audit Quality,* and *Stickiness*. Definitions of these variables are presented in Table 1. All models include year and quarter fixed-effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 6. Moderation Analysis using individual proxies of causal ambiguity

	Causal Ambiguity Proxy: *Complexity-Intangibles*			Causal Ambiguity Proxy: *Complexity-Segments*			Causal Ambiguity Proxy: *Predictability Revenues*		
Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Competition	9.649***	13.443***	9.344***	15.435***	17.524***	14.694***	14.559***	17.534***	13.827***
	(5.386)	(5.175)	(4.665)	(7.253)	(6.348)	(6.632)	(5.199)	(5.341)	(4.862)
Competition²	-8.470***	-11.912***	-8.433***	-13.869***	-15.801***	-13.437***	-13.734***	-16.420***	-13.256***
	(-5.311)	(-5.131)	(-4.788)	(-7.236)	(-6.384)	(-6.786)	(-5.181)	(-5.349)	(-4.944)
Causal Ambiguity	3.413**	3.347**	3.366**	0.901***	0.840***	0.925***	-0.406**	-0.372**	-0.423**
	(2.321)	(2.259)	(2.302)	(4.268)	(4.175)	(4.360)	(-2.393)	(-2.143)	(-2.369)
Competition x Causal Ambiguity	-12.122**	-11.938**	-11.823**	-3.579***	-3.358***	-3.651***	1.741***	1.606**	1.783***
	(-2.164)	(-2.132)	(-2.118)	(-4.882)	(-4.781)	(-4.932)	(2.707)	(2.460)	(2.580)
Competition² x Causal Ambiguity	10.973**	10.825**	10.635**	3.198***	3.005***	3.250***	-1.737***	-1.615***	-1.762***
	(2.098)	(2.086)	(2.036)	(5.109)	(4.985)	(5.120)	(-2.908)	(-2.680)	v
Concentration	-0.200	6.892	-0.120	-0.203	4.386	-0.129	-0.155	6.297	-0.096
	(-0.672)	(1.565)	(-0.394)	(-0.693)	(1.022)	(-0.431)	(-0.525)	(1.375)	(-0.319)
Competition x Concentration		-25.877*			-17.008			-23.518	
		(-1.791)			(-1.212)			(-1.566)	
Competition² x Concentration		22.482*			14.994			20.407*	
		(1.941)			(1.334)			(1.698)	
Entry Barriers	-0.001**	-0.002**	-0.011	-0.002**	-0.002***	-0.017*	-0.002**	-0.002***	-0.016
	(-2.052)	(-2.356)	(-1.178)	(-2.560)	(-2.749)	(-1.714)	(-2.549)	(-2.803)	(-1.565)
Competition x Entry Barriers			0.025			0.045			0.042
			(0.818)			(1.404)			(1.285)
Competition² x Entry Barriers			-0.015			-0.032			-0.030
			(-0.643)			(-1.286)			(-1.191)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-6.816***	-7.852***	-6.689***	-8.318***	-8.886***	-8.081***	-7.785***	-8.610***	-7.560***
	(-9.841)	(-9.328)	(-8.933)	(-11.452)	(-10.263)	(-10.649)	(-8.997)	(-8.972)	(-8.580)
Observations	55,770	55,770	55,770	55,770	55,770	55,770	55,770	55,770	55,770
No. Firms	1585	1585	1585	1585	1585	1585	1585	1585	1585
Pseudo R^2	0.537	0.537	0.537	0.538	0.538	0.538	0.537	0.537	0.537

Notes: This table shows the coefficients estimates and t-statistics (in parenthesis) of a set of Logit models with firm-clustered errors exploring the effect of market competition and causal ambiguity on voluntary disclosure. The proxy for causal ambiguity used in the analysis is stated above each model. Variable definitions: *Voluntary disclosure* takes a value of 1

if the firm provides guidance on the EPS of the current period and 0 otherwise. *Competition* is the 4-digit NAICS inverse of price-cost margin in every period (i.e. total operating costs divided by total value of shipments for the same industry). *Complexity-Intangibles* is the percentage of firm i's assets that are intangible in period t. *Complexity-Segments* is the number of firm i's business segments in period t. *Predictability* is calculated as the natural logarithm of 1 divided by the standard deviation of firm i's revenues during the last 5 years. All models include the control variables used in our main analysis (Table 4), namely: *Concentration, Entry Barriers, Herding, Market Size, Litigation Risk, Institutional ownership, Analysts Coverage, Firm Size, Leverage, Book to market, Performance, Loss, Adj. Market Returns, EPS increase, Duality*, *Independent, Audit Quality,* and *Stickiness*. Definitions of these variables are presented in Table 1. All models include year and quarter fixed-effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 7. Analysis using market-level data from the US Census of Manufacturers (USCM)

	Dependent Variable: Voluntary Disclosure			
Independent Variables	Model 1	Model 2	Model 3	Model 4
Competition	12.925***	14.497***	18.238***	3.165
	(4.963)	(5.164)	(3.910)	(0.564)
Competition²	-10.189***	-11.666***	-14.754***	-3.477
	(-4.882)	(-5.130)	(-3.974)	(-0.825)
Causal Ambiguity	0.006	2.088***	1.973***	1.743**
	(0.158)	(3.141)	(2.931)	(2.422)
Competition x Causal Ambiguity		-7.082***	-6.682***	-5.883**
		(-3.191)	(-2.971)	(-2.460)
Competition² x Causal Ambiguity		5.843***	5.500***	4.829**
		(3.189)	(2.960)	(2.460)
Concentration	-0.905	-0.920	26.532	-1.181
	(-1.103)	(-1.137)	(1.114)	(-1.449)
Competition x Concentration			-93.595	
			(-1.198)	
Competition² x Concentration			78.112	
			(1.227)	
Entry Barriers	-0.029**	-0.034**	-0.039***	-0.916**
	(-1.988)	(-2.273)	(-2.641)	(-2.089)
Competition x Entry Barriers				2.332*
				(1.874)
Competition² x Entry Barriers				-1.517*
				(-1.732)
Control Variables	Yes	Yes	Yes	Yes
Year Fixed-Effects	Yes	Yes	Yes	Yes
Quarter Fixed-Effects	Yes	Yes	Yes	Yes
Constant	-7.942***	-8.322***	-9.445***	-4.449**
	(-9.104)	(-8.986)	(-6.237)	(-2.335)
Observations	55,351	55,351	55,351	55,351
No. Firms	1582	1582	1582	1582
Pseudo R^2	0.536	0.537	0.537	0.537

Notes: This table shows the coefficients estimates and t-statistics (in parenthesis) of a set of Logit models with firm-clustered errors exploring the effect of market competition and causal ambiguity on voluntary disclosure. Variable definitions: *Voluntary disclosure* takes a value of 1 if the firm provides guidance on the EPS of the current period and 0 otherwise. *Competition* is the 4-digit NAICS inverse of price-cost margin in every period calculated using information from the US Census of Manufacturers (i.e. total operating costs divided by total value of shipments for the same industry). *Causal Ambiguity* is estimated with the first factor of a factor analysis conducted with the variables *Complexity-Intangible*s, *Complexity-Segments*, and *Predictability* (where *Complexity-Intangibles* is the percentage of firm i's assets that are intangible in period t. *Complexity-Segments* is the number of firm i's business segments in period t. *Predictability* is calculated as the natural logarithm of 1 divided by the standard deviation of firm i's revenues during the last 5 years). All models include the control variables used in our main analysis (Table 4), namely: *Concentration, Entry Barriers, Herding, Market Size, Litigation Risk, Institutional ownership, Analysts Coverage, Firm Size, Leverage, Book to market, Performance, Loss, Adj. Market Returns, EPS increase, Duality, Independent, Audit Quality,* and *Stickiness*. Definitions of these variables are presented in Table 1. *Competition* and *Entry Barriers* are calculated with information from the US Census of Manufacturers. All models include year and quarter fixed-effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 8. Moderation Analysis using Predictability of other IS items

	Dependent Variable: Voluntary Disclosure		
	Model 1	Model 2	Model 3
Independent Variables	Causal Ambiguity Proxy: *Predictability-COGS*	Causal Ambiguity Proxy: *Predictability-SG&A*	Causal Ambiguity Proxy: *Predictability-Earnings*
Competition	12.553***	6.928***	9.023***
	(4.933)	(3.258)	(3.965)
Competition^2	-12.049***	-7.021***	-8.355***
	(-4.996)	(-3.733)	(-4.063)
Predictability-COGS	-0.180	-0.005	-0.017
	(-0.931)	(-0.028)	(-0.094)
Competition x Predictability	1.194*	0.658	0.441
	(1.718)	(0.914)	(0.662)
Competition^2 *x Complexity-Predictability*	-1.328**	-0.906	-0.532
	(-2.130)	(-1.370)	(-0.872)
Control Variables	Yes	Yes	Yes
Year Fixed-Effects	Yes	Yes	Yes
Quarter Fixed-Effects	Yes	Yes	Yes
Constant	-7.199***	-5.948***	-6.498***
	(-8.952)	(-7.673)	(-8.207)
Observations	55,161	50,189	55,335
No. Firms	1581	1433	1582
Pseudo R^2	0.537	0.530	0.537

Notes: This table shows the coefficients estimates and t-statistics (in parenthesis) of a set of Logit models with firm-clustered errors exploring the effect of market competition and causal ambiguity on voluntary disclosure. Variable definitions: *Voluntary disclosure* takes a value of 1 if the firm provides guidance on the EPS of the current period and 0 otherwise. *Competition* is the 4-digit NAICS inverse of price-cost margin in every period calculated using information from the US Census of Manufacturers (i.e., Total operating costs divided by total value of shipments for the same industry). The notion of causal ambiguity is measured with the following variables: *Predictability-COGS* is calculated as the natural logarithm of 1 divided by the standard deviation of firm i's cost of goods sold during the last 5 years. *Predictability-SG&A* is calculated as the natural logarithm of 1 divided by the standard deviation of firm i's selling, general and administrative expenses during the last 5 years. *Predictability-Earnings* is calculated as the natural logarithm of 1 divided by the standard deviation of firm i's earnings during the last 5 years. All models include the control variables used in our main analysis (Table 4), namely: *Concentration, Entry Barriers, Herding, Market Size, Litigation Risk, Institutional ownership, Analysts Coverage, Firm Size, Leverage, Book to market, Performance, Loss, Adj. Market Returns, EPS increase, Duality, Independent, Audit Quality,* and *Stickiness*. Definitions of these variables are presented in Table 1. All models include year and quarter fixed-effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

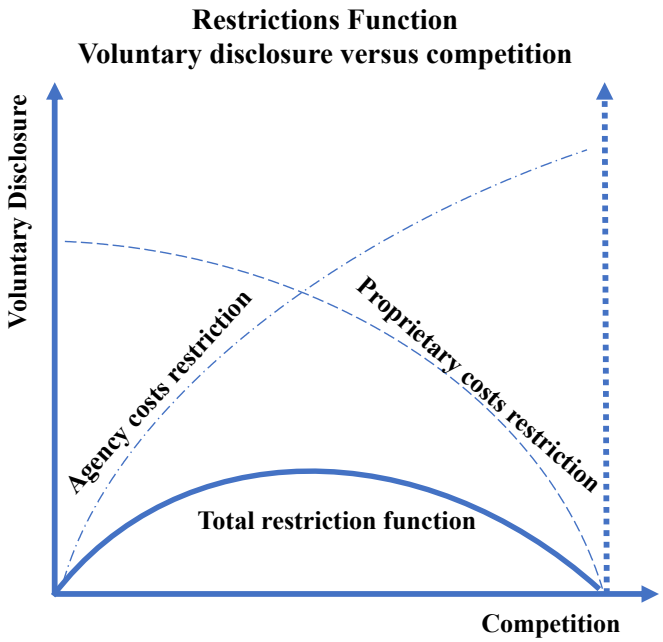

Figure 1: Restrictions Function. This Figure displays the relation between Competition and Voluntary Disclosure, but only in relation to the restrictions.

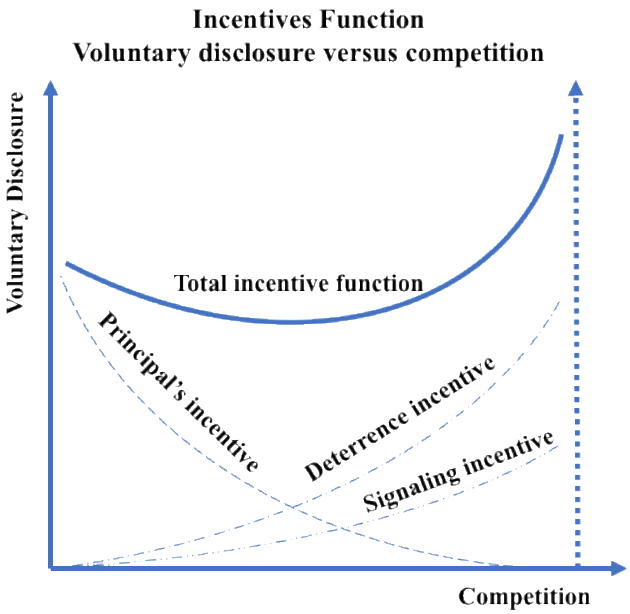

Figure 2: Incentives Function. This Figure displays the relation between Competition and Voluntary Disclosure, but only in relation to the incentives.

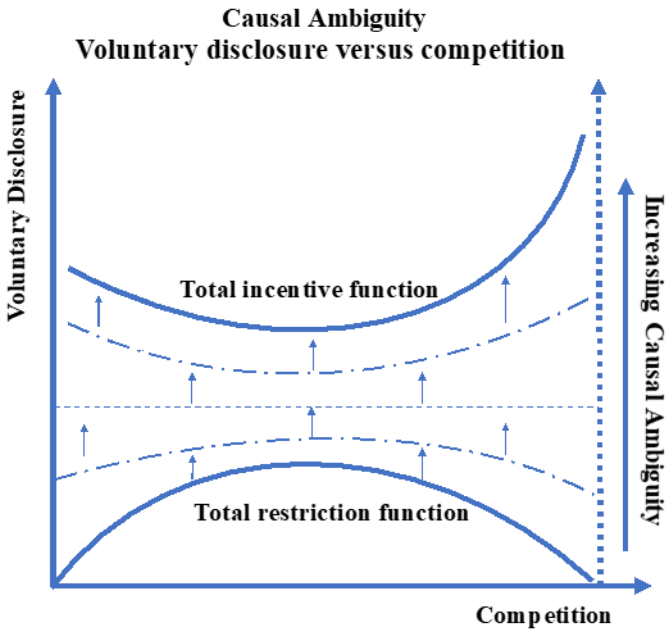

Figure 3. Causal Ambiguity. This figure displays how the relation between Competition and Voluntary Disclosure changes when Causal Ambiguity increases.

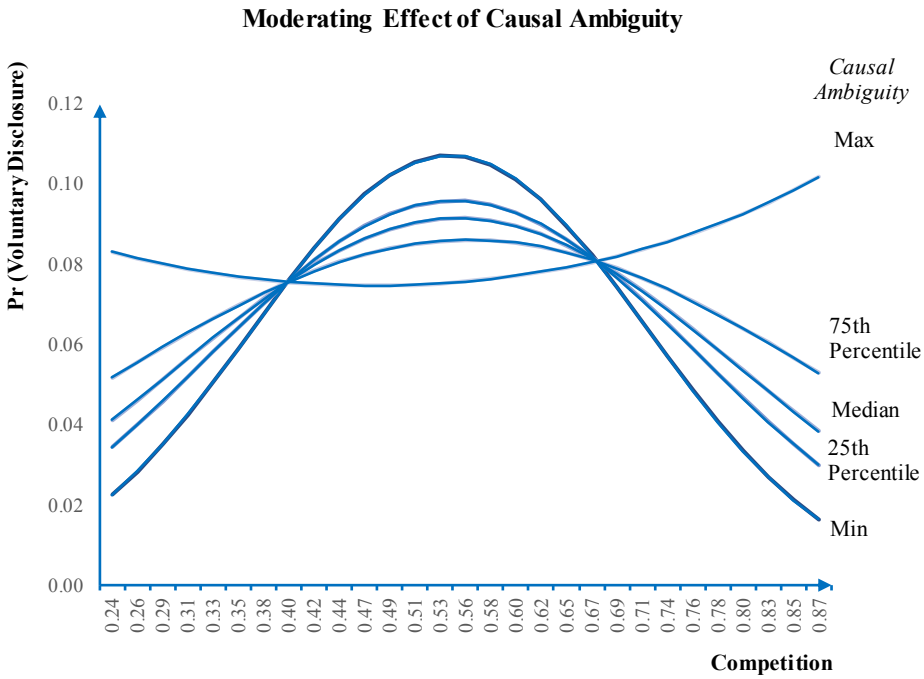

Figure 4: Moderating effect of causal ambiguity. This figure presents the moderating effect of *Causal Ambiguity* on the relation between *Competition* and *Voluntary Disclosure* according to the models estimated in Table 4. The x-axis shows the different levels of the variable *Competition*. The y-axis shows the Pr(*Voluntary disclosure*) calculated using the mean of all control variables. Lines in the graphic show the effect of *Competition* on Pr(*Voluntary Disclosure*) at the minimum, 25th percentile, median, 75th percentile and maximum levels of *Causal Ambiguity*.