CORPORATE GOVERNANCE AND FIRMS' VOLUNTARY DISCLOSURE. AN ANALYSIS OF BIOTECHNOLOGY COMPANIES

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Corporate Governance and Product Related Voluntary Disclosure. An Analysis of Biotech Firms

Abstract

The objective of this study is to assess the impact of corporate governance on firms' product-related disclosure of biotechnology companies in the presence of agency and proprietary costs. In order to conduct this investigation we use regression analysis employing data compiled from 10-K forms and proxy statements. We hypothesize that voluntary disclosure – considering the approach suggested by Lev *et.al*., (2004) – is a function of governance structure measured by a set of independent variables based on the board of directors typology proposed by Hillman *et.al*. (2000) and Baysinger and Butler (1985). The results of this study will shed light on our understanding of corporate governance structure and underlying agency and proprietary costs. The study further explores and provides useful insights and practical implications for corporate governance standard setters. They should consider the various competences of board members such as skills, expertise, knowledge and specific functions of individual directors in expressing the impact of corporate governance on firms' voluntary disclosure.

Keywords: Corporate Governance, Biotechnology Voluntary Disclosure, Proprietary costs, Board composition

1. Introduction

Lev et.al. (2004) shows that managers of R&D-intensive firms will be careful in providing specific information to the capital market to avoid competitive disadvantage. In the same vein, Jones (2000) argued that the higher proprietary costs the lower will be the level of voluntary disclosure in R&D intensive-firms.

Lev et.al. (2004) demonstrate that voluntary disclosure is significantly different and increases by 21% between initial screening stage (0.28) and clinical testing subsample (0.49). Given the design of Lev et.al. (2004) study, we cannot tell whether the amount and form of the product-level disclosure were influenced by outside parties, since much of the analysis was conducted at the product-level instead of firm-level (Hribar, 2004). Therefore, there can be others firms-level unidentified characteristics that may impact on biotech firms voluntary disclosure.

Because the competitive costs related to disclosure are relevant in the biotech sector and could discourage the dissemination of information, company governance mechanisms could play an important role on the board by in orienting the amount of disclosure in the biotech sector. Specifically, appropriate "internal monitoring packages" may force managers to disclose more information, to the reduction of agency costs linked to information asymmetries.

Different from the Lev et.al. (2004) study that examine how different competitive cost proxies relates to the extent of product-voluntary disclosure by biotech IPOs, we want to understand how corporate governance mechanisms impacts on the heterogeneity of firms-related information disclosed by biotech companies. Specifically, we provide information about how corporate governance works, controlling for firms' innovativeness and products at various stages, to determine its disclosure choices.

Baysinger and Hoskisson (1990) underlines that independent directors are not homogeneous in terms of ability to monitor. In other words, our classification of independent directors in insiders, business experts, support specialists and community influentials help to sort their ability to monitor. Additionally, because of their background, directors may value differently the costs and benefits of disclosure, thus affecting companies' disclosure behavior in a different way.

Our sample consists of all biotechnology companies publicly listed on the U.S. Stock Exchange without interruption during the five year period, from 2005 to 2010. The final sample comprises 432 firm-year observations with complete data for analysis.

To measure the quantity and quality of voluntary disclosure by the biotech companies we rely on Lev et.al. (2004) study and we construct a disclosure index for each sample firm's annual report, for all biotechnology products under various stages of development.

Using fixed-effects models, we find that the voluntary disclosure across companies is higher than the voluntary disclosure between various stages of product under development. Our results show that corporate governance plays a role in orienting the heterogeneity of product-level disclosures provided by US biotech companies.

1. Literature review

Positive agency theory (Jensen and Meckling, 1976; Williamson, 1981; Fama and Jensen, 1983) provides a framework for linking corporate governance to voluntary disclosure. According to agency theory a company with high agency costs will try to reduce them by increasing the extent of voluntary disclosure and employing an "intensive" monitoring devices, like the presence of outside directors on a corporation's board. Voluntary disclosure is a function of the governance structure of the firm and managers' attitudes to voluntary disclosure changes accordingly to the trade-off of the costs and benefits involved.

Theoretical and empirical studies on voluntary disclosure benefits have been shown that voluntary disclosure: decreases the cost of capital [e.g., Brown (1979); Barry and Brown (1985); Easley and O'Hara (2004); Hughes *et.al.*,(2007)] by raising the price of stock relative to the share price of firms not disclosing that information, reduce the information asymmetries between informed and uniformed investors and hence improves the firm's stock liquidity [e.g., Glosen and Milgrom (1985); Amihud and Mendelson (1986); Diamond and Verrecchia (1991); Kim and Verrecchia (1994)] and generally affects shareholders' wealth [Richardson and Welker (2001); Lev (1992)].

Disclosure is not costless, as it is associated with the emergence of proprietary and litigation costs [Dye, 1986; Prencipe, 2004; Skinner, 1994, 1997]. The cost of disclosure is the threat to competitive advantage caused by providing proprietary information to competitors.

Because disclosure is selective, managers exercise discretion in the disclosure of information. Previous theoretical models of voluntary disclosure [Verrecchia, 1983] predicts that, in the presence of disclosure-related costs, firms will disclose only when their performance level exceeds a certain threshold, while below the threshold will not. In the presence of rational trader expectations,

managers exercise discretion "choosing the point (the threshold level of disclosure) above which he disclosed what he observes, and below which he withholds his information" (idem, p. 179). The reason behind this is that managers will attend to signal what they knows to achieve economic benefits [see, Spence, 1973; Grossman and Milgrom, 1981]. Although, due to litigation concerns, Skinner (1997) document that managers provide a more timely disclosure of adverse earnings news in order to lower the expected legal costs. In the same vein, Lev [1992] assert that managers voluntary disclosed adverse earnings news "early", before the mandated release date, to reduce stockholder litigation costs.

Moreover, voluntary disclosure is positively associated with firm size [Lang and Lundholm (1993), Raffournier (1995)], with the number of analysts following a firm [Lang and Lundholm (1996)] as well as the listing status and earnings margin [Singhvi and Desai (1971)]. Chow and Wong-Boren (1987) show that financial leverage, proportion of assets-in place are associated with voluntary disclosure choices.

Williamson (1984) has introduced the theoretical framework relating disclosure quality to corporate governance. Based on that, in the last decade a series of empirical researchers has studied how different corporate mechanisms impact on the extent of voluntary disclosure [Gul and Leung, 2004; Ho and Wong, 2001; Eng and Mak, 2003; Cormier et al., 2005; Li et al., 2008].

Eng and Mak (2003) conducted a study on 158 companies listed on Singapore Stock Exchange and they found that board composition, measured by the proportion of outside directors have a negative impact on the amount of corporate voluntary disclosure. Gul and Leung (2004) documented a negative relationship between expert outside directors and the level of voluntary information. In the same vein, Forker (1992) in a study on UK companies, focusing on corporate governance mechanisms, such as the presence of non-executive directors and audit committee document that both mechanisms does not influence the disclosure of share-option compensation in the annual reports. Ho and Wong (2001) using a weighted relative disclosure index in measuring voluntary disclosure in the Hong Kong context, found that family-controlled firms have a negative impact on the extent of voluntary disclosure.

The results are consistent with Eng and Mak (2003), Barako et.al. (2006) studies that argue that when the firm has a higher proportion of outside independent directors on the board there is a substitutive relationship between both mechanisms, meaning that outsiders exercise a stronger and higher monitoring and control role over managers (Williamson, 1984) and therefore, there is a lower need to decrease information asymmetries by increasing the extent of voluntary disclosure.

Conversely, Cheng and Courtenay (2006) suggest that board independence is positively associated with voluntary disclosure, the effect being highly significant for firms with boards dominated by a majority of independent directors. In a sample of Hong Kong listed firms, Leung and Horwitz (2004) find a positive relationship between the board independence and voluntary segment disclosure. Li et.al. (2008) in study based on UK companies document a significant positive association between the proportion of independent directors on corporate boards and voluntary disclosure. Cheng and Jaggi (2000) showed a positive association between firms' discretionary decisions to increase the level of independence on the audit committee above the suggested minimum and the proportion of independent directors. Moreover, Cerbioni and Parbonetti (2007) document a positive relationship between the proportion of independent directors and voluntary disclosure for European biotech companies.

The empirical evidence on these studies, shows mixed and controversial results. These may be due to specific institutional settings (Hong Kong, Singapore, UE, US, etc) and/or firm-specific characteristics, the different institutional environments across countries, outside investor rights and legal enforcement [La Porta et. al., 1998; Leuz et.al. 2003], the measurement of corporate governance and voluntary disclosure variables [Dalton et.al., 1998, Ahmed and Courtis, 1999] or different research contexts play a key role in determining the level of voluntary disclosure. Ahmed and Courtis (1999, p.36) argued that "these inconclusive results could be due to differences in socio economic and political environments between countries."

Previous research on governance and voluntary disclosure mainly focused on the agency theory perspective, however results are unable to confirm if corporate governance and voluntary disclosure acts as complementary or substitute mechanisms of control. Corporate governance and voluntary disclosure can be seen as complementary mechanisms, when internal decision making mechanisms, as board of director strengthen the extent of voluntary disclosure. Instead, if the relationship is substitutive, one corporate governance mechanism may substitute for another one, and companies will choose to improve one at the expense of the other one (Rediker and Seth, 1995, p.88). For example, if a company chooses a monitoring mechanism, like the presence of an outside director on a firm's board this may indicate that the firm is being closely monitored already and there is a lower probability that the firm will increases its disclosure level. Also, if information asymmetry in a firm can be reduced as a consequence of "internal monitoring packages", the need of having additional governance devices is smaller.

While previous papers [Gul and Leung, Ho and Wong, Eng and Mak] concentrated mainly on the well known agency theory classification into independent and executive directors, following

Hillman et.al., (2000) and Baysinger and Zardkoohi (1986) typology of board members and ulterior empirically studied by Markarian and Parbonetti (2007), we classify independent directors into four categories, as following: business experts, community influentials, support specialists and insiders.

3. Methodology

3.1. Sample design and data collection

The sample of our study consists of all active biotechnology firms listed on the U.S.Stock Exchanges without interruption from 1 January 2005 until 31 December 2010. Further we restrict our sample of biotechnology companies to only those firms that have product under development, excluding gene therapy, medical devices and research service companies. First we obtained the list of all biotechnology companies listed on the major stock markets in US and sequent we collect from firms' webpages each Annual Report on form 10-K, that companies file in registration with the Securities and Exchange Commission (SEC).

In order to conduct our research we rely on the Business Section of the 10-K form (part I), precisely on the drug development programs, that provides key information about the various products under development of each biotechnology company. The 10-K form includes financial as well as nonfinancial information and it is divided in three parts: Part I includes an overview of the business, the risk it faces, product and market information, Part II contains financial results for the year and management discussion and Part III identifies the firm's directors and large investors.

We hand-collect data concerning products under various stage of development [initial screening, preclinical, clinical (phase I, phase II and Phase III) and FDA review] specified in the Food and Drug Administration (FDA) approval process. Following the approach suggested by Guo et.al. (2004) we build the Product Disclosure Index, that consists of five information categories: product specifications, target disease, clinical trials, future development plans, and market information. "These information items capture the relevant aspects of the firm's proprietary information on products under development….unavailable publicly and is therefore the most important category of information disclosed" [Guo et.al., (2004), p. 15]. Appendix A indicates the components of the disclosure index and the individual score assigned. This methodology allows us to build both a product score and subsequently a firm disclosure score for each company of our sample.

- **Table 1 -Table 2 here -**

3.2. Measurement of variables

3.2.1 Dependent variable: voluntary disclosure.

To measure the extent of firms level voluntary disclosure by the biotechnology companies. we followed the approach developed by Lev et.al. (2004) and build a firm disclosure index. The disclosure index contains five categories: product specifications, target disease, clinical trials, future development plans, and market information. For each category it is assigned a score according to the information provided. The maximum score which a product under development disclosure could earn for all the five categories (previously specified) is 30 if the product is on a clinical phase of development or beyond (phase I, II, III or FDA review) and 22 if the product under development is in screening, IND or preclinical phase, according to the FDA classification on the various phase of development of biotech products.

Table 3 provide the information regarding the scoring procedure for the firm disclosure index, on each item included on the product specifications, target disease, clinical trials, future development plans, and market information categories included. We hand collect the information for a total number of 2845 products under development under various stage of development that US biotech companies has in their portfolio (see Table 4).

- Table 3 here -

3.2.2.Governance related variable

Data pertaining the board composition is hand-collected from the DEF 14-A proxy statements form. We analyzed the biographical information regarding the board members and following the board members typology advanced by Hillman et.al. (2000) and Baysinger and Butler (1986) we classify the board members as into the following categories: business experts, community influential, support specialists and insiders. Table 4 provides some examples of the board director's biographical information stated by companies and the subsequent classification assigned.

Insiders are directors who have been employed or are acting on the board as active managers or former employees, example being CEO, president or vice-president of the firm, that are engaged to perform the day-to-day activities. They are endowed with the expertise, knowledge of daily working activities of the firms and provide firm-specific information (Fama and Jensen, 1983) about the organization actions.

Business experts are former or retired executives of other organizations, they provide organizational legitimacy for the firm, serves as channels of communication between companies, supply advice and counsel on internal operations (Mace, 1971). All these characteristics makes them an key resource to the firm. However, the presence of business experts on the board may result in a better monitoring and this can lead to a smaller need to reduce the information asymmetries by increasing the amount of the information, pointing the substitutive relationship between governance and disclosure.

Support specialists provides linkages and specialized expertise outside the firm's product market in different strategic areas, like capital markets, law, insurance, public relations and helps firms to have an easier access to financial capital and legal support. Even if, they differ from business expert category, in the sense that they lack general management expertise, support specialists perform an important support function to the top managers in dealing with specialized decision problems. Moreover, they has the ability to understand, interpret, provide inputs for the product under development process from conceptualization, initiation, development, test, support, modification to implement the right decisions.

Community influential members are non-executive directors, example being retired politicians, members of clergy, academics, leaders of social organizations. They provide " valuable non-business perspective on proposed actions and strategies" [Hillman et.al., 2000], knowledge, experience and linkages relevant to firm's external environment [Baron, 1985]. As noted by [Hillman et.al. 2000:242]: "Their expertise and influence with the community forces can help the firm to avoid costly mis-steps when its actions might inadvertently conflict with the interests of those groups".

- Table nr 4 -

In a study of Singapore firms, Cheng and Courtenay (2006) found no significant association between board size and voluntary disclosure. By focusing on Hong Kong listed firms, Gul and Leung (2004) study found that CEO duality (CEOs who serve also as chairman of the board) is associated with lower levels of voluntary disclosure being weaker for those firms that have higher proportion of outside directors on the boards. Instead, Cheng and Courtenay (2006) document the absence of a significant relationship between duality and voluntary disclosure.

3.2.3. Control variables

Previous studies identified a list of corporate characteristics to have an impact on corporate voluntary disclosure. Corporate size, listing status, profitability and leverage have been found to be the most significant corporate variables associated with higher disclosure levels (Marston and Shrives, 1991; Ahmed and Courtis, 1999). Following Dedman (2004) we measured firm size as the total market value of the firm. Leverage is measured as the ratio of total debt to total shareholders' equity. Profitability has been found to have a positive and significant relation with voluntary disclosure. Lang and Lundholm (1993); Meek et.al. (1995); Ho and Wong (2001); Camferman and Cook (2002) among others, found that high performing firms are more likely to voluntarily disclose information. We defined profitability as the ratio of profit to assets. Ownership concentration was used also as a control variable. We defined ownership concentration as the percentage of common outstanding shares held by board members. To control for time-variation effects we use year dummies for all the models in our study.

3. 3. Data analysis

We consider fixed-effects model to be the most suitable for our empirical analysis and the following models are specified:

Disclosure Index=

$$\alpha + \beta 1 PATENTS + \beta 2 PRECLINICAL + \beta 3 BE + \beta 4 SS + \beta 5 CI + \beta 6 IND + \beta 7 NBOD + \beta 8\, CEO + \beta 9 OWN + \beta 10 lnAT + \beta 11 ROE + \beta 13 LEVERAGE + \beta 14 YEAR + \varepsilon$$

We use as dependent variable the disclosure index, calculated as shown in Appendix A.

All other independent variables are defined as follows:

Patents	Proportion of patented products of total number of products
Preclinical (PRECL)	Proportion of products under screening, development, IND application and preclinical over total number of products per company
Clinical (CL)	Proportion of products under phase I, II and III of development over total number of products per company
Business Experts (BE)	Proportion of business experts members of board of directors
Support specialists (SS)	Proportion of support specialists members of board of directors

Comunity influentials (CI)	Proportion of comunity influentials members of board of directors
Board of directors (NBOD)	Number of members
CEO duality (CEO)	Dummy variable equal to 1 if CEO is also chairman, 0 otherwise
Independent directors (IND)	Proportion of independent directors
Directors shareholding (SHARE_DIR)	Proportion of common outstanding shares owned by board members
Profitability (ROA)	Return on assets
Size (lnAT)	Company size, measured as Natural logarithm of total assets
Leverage (lev)	TotalDebt/shareholder's equity
Year dummies	5 Dummies (2005-2009)

4. Empirical results

In this section we present the empirical results of our study. We first report the univariate analysis in the Section 4.1. and then in Section 4.2 we report the results of our fixed-effects model estimation.

4.1. Descriptive statistics

Table 5 presents the descriptive statistics for the dependent and independent variables used in the study. Our dependent variable, the firm's overall product-related information as measured by the disclosure index has a mean disclosure score of 0.30, with a range of 0.10 to 0.82. The proportion of products under stage 1 of development (screening, development, IND and preclinical) has a mean of 0.32 compared to the proportion of products under stage 2 of development (phase I, II and III and FDA review) that is 0.72, meaning that firms have on average more products in clinical and under the FDA approval process. The proportion of business experts (BE) on the board has a mean of 0.33, while the proportion of insiders (INSIDERS) has a mean of 0.31, the proportion of support specialists is of 0.23 and, the proportion of community influentials (CI) is of 0.14. On average, the proportion of business experts has the highest presence on the board, followed by insiders and then, by support specialists and community influentials. The ratio of independent directors (IND) to total directors on the board was 0.77, and the average number of director on board is approximately 8 (7,87). Table 6 shows that in 42 % of the companies, the CEO is also the chairman of the board.

-Table 5 here -

4.2 Multivariate analysis

Table 6 provides the results for the fixed-effects regression models. Model 1 investigates the relationship between the discl_index (firm disclosure index) and the variables of interests, concentrating on the impact of independent directors on the firms' voluntary disclosure. As regards our variables of interest only preclinical variable has an effect on the extent of disclosure of biotechnology firms. The estimated coefficient is positive and statistically significant (at the 10%). Model 2 considers the future information disclosure index (defined as the sum of future plans and market information disclosure index) as the dependent variable. The CEO duality negatively impact the amount of information disclosed. In the model 3 we provides the results for the relationship between past_info disclosure index (defined as the sum of product specifications, target disease and clinical trials disclosure index) and corporate governance variables as well as the control variables. The proportion of independent directors appears to have a negative and significant impact on past information disclosure index. The preclinical coefficient estimation maintain the expected sign as in the previous models.

-Table 6 here-

Tabel 7 present the results of our estimation using fixed-effects model for testing the impact of corporate governance variables on the extent of voluntary disclosure. In the model 1, we consider the impact of independent directors on biotech firms' voluntary disclosure. Independent board members do not have an statistically significant impact on the amount of the information disclosed.

- Table 7 here-

We disaggregate the annual report disclosures into past information and future information to better understand the impact of corporate governance on firms' voluntary disclosure. Table 8 details the regression results for the past information disclosure. We consider as main board variables IND, BE, the interaction term between independent directors and the proportion of products under preclinical phase of development, as well as the interaction term between independent directors that are business experts, support specialists or community influentials and the proportion of products in preclinical stage. We add to our model the traditional governance variables, as the NBOD and CHCEO and the control variables OWN, ROA, LEV and lnAT. In Model 1, we report the results including the proportion of independent directors on the board, and the results suggest that firms with boards consisting of a larger proportion of independent directors

are associated with low levels of past information disclosure by biotech companies. The results in Model 2, show that the coefficient of IND and the interaction term IND_PRECL are not significant. In the Model 3, 4 and 5 we present the results for BE and BE_PRECL, SS and SS_PRECl and CI and CI_PRECL respectively. We found a negative and significant (p-value ≤ 0.10) impact of the independent members and the proportion of products in preclinical phase of development on the extent of past information voluntary disclosed by biotechnology companies, while the coefficient of business experts is not significant (Model 3). In the model 3 the interaction term, SS_PRECL is a negative and significant meaning that when products are in the preclinical phase of development, maybe because the competitive costs, support specialists tend to protect the private information by exercising a lower pressure on managers to disclose the information. The regression coefficient for the NBOD is positive and significant. Finally, in the model 5 our variables of interest, the proportion of community influentials members on the board of directors (CI_IND) and the CI_PRECL has a negative and significant impact on the extent of past information disclosed by the biotech companies.

- **Table 8 here-**

Table 9 reports regression results for the impact of the governance variables on the extent of future information disclosed by U.S. biotech companies. In the Model 1 we present the results for the IND, in the Model 2 the IND and the interaction term, IND_PRECL and Model 3, 4 and 5 considers the effect of the classification of board members into business experts, support specialists and community influentials and the interaction with the proportion of preclinical products of biotechnology companies. Model 1 and 2 presents the results for independent directors and the interaction with the preclinical products. The coefficient estimation for the IND and IND_PRECL are no longer significant while the PRECL coefficient estimation is negative and significant (p-value ≤ 0.1) meaning that firms with a higher proportion of preclinical products tend to provide less future information disclosed by biotech companies. Business experts seems to not have any impact on the extent of future information (in the Model 3), instead support specialists has a positive and significant impact (at 5% level) on the extent of future voluntary disclosure. When there are high levels of products in preclinical stage of developments, support specialists tend to withhold the information, in this way protecting the firm against adverse action taking by competitors (Model 4). As highlighted by model 5, community influentials has a negative effect on the biotech future disclosure and a positive one when firms are characterized by a high proportion of preclinical products. In all the models of our regression estimation the coefficient of CEO duality (CHCEO) is significant and negative, meaning that when the CEO is also the Chairman of the Board of directors,

firms tend to disclosure less. This results is consistent with Gul and Leung (2002) that document a significant and negative relationship between duality and voluntary disclosure. Disclosure about the firm's future product development plans (this may include information regarding the plans to test the product on other diseases or in combination with other drugs) and market information may affect investors and others' market participants perceptions, which further can increase the firm's market value.

- **Table 9 here-**

In order to quantify the extent of firms voluntary disclosure provided by biotech companies, following the methodology proposed by Lev et.al. (2004), we build a disclosure index to capture the information on the properties of the product under development (product specifications), information on the intended use of the product (target disease), information on the success of the product in the clinical trials (clinical trials), information on the firm's future development plans (future plans) and ultimately, information on the product's market potential.

We disaggregate the total disclosure index into product specifications disclosure index, target disease disclosure index, clinical trials disclosure index, future plans disclosure index and market information disclosure index to better understand the impact of corporate governance on the extent of voluntary information provided by biotech companies.

Table 10 provides the regression results for the product specifications disclosure index. By using fixed-effects model, we found a significant and positive impact of patents (our proxy for competitive costs) on the extent of product specifications voluntary disclosure. Regarding corporate governance variables, we do not found a significant impact on the product specifications disclosure index.

-Table 10 here -

Table 11 provides the results of the impact of corporate governance variables on the target disease disclosure index. As regards our variables of interests, in the model 1, we observe a positive and significant effect of the interaction effects of BE_PRECL, as opposed to the coefficient estimation of SS_PRECL (Model 2) and CI_PRECL (Model 3). For the other corporate governance and control variables we do not found any impact on the target disease disclosure voluntary disclosure.

- **Table 11 here-**

Table 12 show the regression results for the clinical disclosure index. The results of model 1 shows that independent board directors has a negative and significant effect on firms' voluntary disclosure. Moreover we also found that increased presence of outside directors that are business experts in associated with high levels of voluntary disclosure (in the Model 1), whilst in the Model 2 when independent directors are support specialists, they will tend to reduce the extent of voluntary information when products are in the preclinical phase of development.

- **Table 12 here -**

Tabel 13 presents results of the fixed-effects coefficient estimations using as the dependent variable the future plans disclosure index that is regress on a series of corporate governance and control variables. Model 1 shows that preclinical products (PRECL) and CEO duality (CHCEO) are negatively associated to future plans disclosure. The results in Model 2 lend evidence that when firms have support specialists on the board voluntary disclosure of future information increases. However, the interaction variable SS_PRECL is negative and highly significant (p-value ≤ 0.01). it implies that, for a given percentage change in preclinical products, support specialists impact is more pronounced than for clinical products , probably because of the competitive costs protection. This has not been shown in the prior literature. This findings are consistent with the notion that independent directors may complements for firms' voluntary disclosure. Similarly, the results in Model 3 shows that when independent directors are community influential members, disclosure levels decreases. This findings also adds to prior research that has examined the corporate governance and voluntary disclosure by showing that because of their background independent directors may value differently the costs and benefits of disclosure, thus affecting companies' disclosure behavior differently.

-Table 13 here-

Table 14 reports the results using fixed-effect coefficient estimation considering the market information disclosure index. As can be seen (Model 1-3) independent directors do not have a significant impact on the extent of market information disclosure.

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5. Conclusions and limitations of the study

Baysinger and Hoskisson (1990) underlines that independent directors are not homogeneous in terms of ability to monitor. In other words, the classification of independent directors in business experts, support specialists and community influentials help to sort their ability to monitor. Additionally, because of their background, directors may value differently the costs and benefits of disclosure, thus affecting companies' disclosure behavior in a different way.

Our results show that corporate governance plays a role in orienting the heterogeneity of voluntary disclosures provided by US biotech companies. We find a positive association between support specialists and firms voluntary disclosure when drugs-in-process are in preclinical phase of development. The result is consistent with the complementary relationship between outside directors and voluntary disclosure in monitoring managers.

The results of this paper shed light on our understanding of corporate governance structure and underlying agency and proprietary costs. Corporate governance standard setters should consider the various directors' competences when asserting the optimal design of corporate governance mechanisms.

The paper contributes to the previous literature by providing evidence that corporate governance affects the proprietary costs of disclosure. In particular, we provide evidence that the traditional distinction between independent and non independent directors do not fully capture the variety of directors competencies sitting on the board. Our research has a number of limitations. The endogeneity issue between the presence of independent directors and voluntary disclosure may be deeper investigated. Further research will certainly shed light on this important research area.

Table 1. Total number of annual reports analyzed

Year	**Number of annual reports**
2005	83
2006	86
2007	92
2008	91
2009	91
TOTAL	443

Table 2. Excluded companies from analysis

YEAR	TOTAL	REASON	
		Acquisition or merger	Other
2005	17	12	5
2006	10	6	4
2007	19	13	6
2008	21	18	3
2009	15	14	1
2010	9	8	1
TOTAL	91	71	20

Table 3. Scoring Procedure for the Product Disclosure Index

The disclosure index is constructed for each biotechnology product by hand collecting relevant information from annual report (Business part). Information is derived for the following five categories: product specifications, target disease, clinical trials, future development plans, and market information. The procedure for assigning scores in each category is tabulated (with a detailed example) in appendix A.

I. Product Specifications
1. How does the product work? (3 points = three sentences; 2 = two sentences; 1 = one sentence; 0 = none)
2a. Why is it better than previous products? (2 = name mentioned; 1 = no name mentioned; 0 = no discussion)
2b. Why is it better than competing products? (2 = name mentioned; 1 = no name mentioned; 0 = no discussion)
3. What is the chemical/biological structure (2 = chemical compound; 1=general discussion; 0 = not mentioned)
Subtotal I = total scores of (1 + max(2a, 2b) + 3)

II. Target Disease
1. What kind of diseases does the product treat? (2 = disease name mentioned; 1 = disease name not mentioned; 0 = no discussion)
2. What are other possible uses of the drug? (2 = disease name mentioned; 1 = disease name not mentioned; 0 = no discussion)
Subtotal II = total scores of (1 + 2)

III. Clinical Trials
1. Number of patients (1 = given; 0 = absent)
2. Patients information (with what diseases) (1 = given; 0 = absent)
3. Doses (amounts) used in the clinical trial (1 = given; 0 = absent)
4. Method used in the clinical trial (1 = given; 0 = absent)
5. Treatment schedule (duration or frequency) (1 = given; 0 = absent)
6. Trial results (Detailed = pro and cons + numbers (3); general = numbers (2); brief = no numbers (1); none (0))
Subtotal III = total scores of (1 + 2 + 3 + 4 + 5 + 6)

IV. Future Plans
1a. Is there any plan to try the product on new diseases? (2 = disease name mentioned; 1 = no name mentioned; 0 = no discussion)
1b. Is there any plan to try the product with other products? (2 = name mentioned; 1 = no name mentioned; 0 = not mentioned)
2. Future plan for clinical trials:
2a. Planned date (1 = mentioned; 0 = not mentioned)
2b. Number of patients for the planned trial (1 = mentioned; 0 = not mentioned)
2c. Patient information for the planned trial (what disease) (1 = mentioned; 0 = not mentioned)
2d. Duration (1 = mentioned; 0 = not mentioned)
2e. Method (1 = mentioned; 0 = not mentioned)
3. Possible alliance (2 = name mentioned; 1 = no name mentioned; 0 = not mentioned)
Subtotal IV = total scores of (max(1a, 1b) + 2a + 2b + 2c + 2d + 2e + 3)

V. Market Information
1. Number of patients affected by the disease (1 = mentioned; 0 = not mentioned)
2. Number of incidents (market size) (1 = mentioned; 0 = not mentioned)
Subtotal V = total scores of scores (1 + 2)

***Overall Disclosure Score* =** sum of subtotals I–V.

***Scaled Disclosure Score* =** Overall disclosure score divided by 30 for products either in or beyond the clinical trials phase, and by 22 for the products that did not reach clinical trials.

Table 4. Total number of product-under development

Stage	Substage	Stage Score	No. of products
Initial Screening	Screening	1	51
	Development	2	15
Preclinical Testing	Preclinical testing	3	617
	IND application	4	34
Clinical Testing	Phase I clinical trials	5	739
	Phase II clinical trials	7	780
	Phase III clinical trials	10	354
FDA review	NDA application	12	255
TOTAL			**2845**

Table 5. Descriptive statistics on selected variables.

Variable	Obs	Mean	SD	Min	p25	Median	p75	Max
DISCL_INDEX	432	0.29	0.10	0.00	0.21	0.27	0.35	0.64
PATENT	432	0.74	0.29	0.08	0.50	0.83	1.00	1.00
PRECLINICAL	432	0.28	0.29	0.00	0.00	0.25	0.50	1.00
CLINICAL	432	0.72	0.29	0.00	0.50	0.75	1.00	1.00
BE	432	0.33	0.18	0.00	0.20	0.33	0.45	0.80
SS	432	0.23	0.15	0.00	0.12	0.22	0.33	0.67
CI	432	0.14	0.14	0.00	0.00	0.12	0.20	0.71
INSIDERS	432	0.30	0.18	0.00	0.17	0.29	0.43	0.88
NBOD	432	7.87	1.70	4.00	7.00	8.00	9.00	13.00
IND	432	0.70	0.18	0.12	0.71	0.78	0.86	1.00
CEO	432	0.42	0.49	0.00	0.00	0.00	1.00	1.00
OWNERSHIP	432	0.21	0.19	0.02	0.06	0.14	0.29	0.91
ROA	432	-0.44	0.55	-4.79	-0.59	-0.36	-0.19	1.65
AT	432	808.76	3883.38	2.49	41.76	89.58	237.26	39629.00
LEVERAGE	432	-5.54	400.37	-6335.90	0.00	0.08	11.55	3305.57

DISCL_INDEX disclosure index calculated as shown in the appendix A, PATENT proportion of patented products over total number of products of the company, PRECLINICAL proportion of products under screening, development, IND application and preclinical phase over total number of products per company, CLINICAL proportion of products under phase I, II and III trial and NDA review over total number of products per company, BE proportion of business experts

members of board of directors, SS proportion of support specialists members of board of directors, CI community influential members of board of directors, INSIDERS proportion of insider members of board of directors, NBOD number of board members, IND proportion of independent directors, CEO dummy variable equal to 1 if CEO is also chairman, 0 otherwise, OWNERSHIP proportion of common outstanding shares owned by board members, ROA return on assets, AT company size, measured as Logarithm of assets, LEVERAGE, measured as long-term debt/ Shareholder's equity.

Table 6. Spearman correlation

	Discl_index	Patents	Precl	Clinical	BE	SS	CI	Insiders	IND	CHCEO	NBOD	ON BOARD	OWN	AT	LEV	ROA
DISCL_INDEX	1															
PATENTS	0.1661*	1														
PRECL	-0.3036*	-0.5227*	1													
CLINICAL	0.3036*	0.5227*	-1	1												
BE	0.0086	-0.0023	-0.01	0.01	1											
SS	0.1119*	-0.024	-0.0094	0.0094	-0.3166*	1										
CI	-0.0622	0.0151	-0.0941*	0.0941*	-0.1798*	-0.3220*	1									
INSIDERS	-0.0557	-0.0044	0.0527	-0.0527	-0.6206*	-0.1441*	-0.2633*	1								
IND	0.0561	0.0046	-0.0539	0.0539	0.6185*	0.1456*	0.2641*	-0.9998*	1							
CHCEO	0.1925*	0.0358	-0.047	0.047	0.0433	0.008	-0.0172	-0.0264	0.0271	1						
NBOD	0.0399	0.0335	-0.0052	0.0052	0.0519	-0.1149*	0.0546	-0.1211*	0.1171*	-0.0996*	1					
ONBOARD	-0.0469	-0.0748	-0.0816	0.0816	-0.0744	-0.0295	0.2184*	-0.0354	0.036	-0.0802	0.0417	1				
OWN	0.1670*	-0.0145	0.0837	-0.0837	-0.0696	0.1340*	-0.1414*	0.0448	-0.0446	0.0631	-0.0059	-0.342	1			
AT	0.0675	-0.1044*	-0.0704	0.0704	-0.0041	-0.1096*	0.1328*	-0.1036*	0.1047*	0.0302	0.4037*	0.2269*	-0.2177*	1		
LEV	-0.02	-0.0974*	0.0115	-0.0115	0.0463	-0.1370*	0.0808	-0.0613	0.0619	-0.0044	0.2670*	0.0461	-0.0779	0.3712*	1	
ROA	-0.0177	0.0002	0.0869	-0.0869	-0.018	-0.1665*	0.1214*	-0.0378	0.0396	-0.0487	0.1582*	0.2128*	-0.1801*	0.6345*	0.2426*	1

*Correlation is significant at the 0.05 level (two-tailed)

Table x presents the Spearman correlation matrix between the dependent and independent variables. Patents are positively correlated to the disclosure index. The proportion of the products in clinical trials are positively correlated to the amount of voluntary disclosure. Instead the proportion of products in a preclinical phase of development are negatively correlated to the disclosure index. Support specialists are positively correlated to disclosure index at the 5% significance level. The presence of a CEO that it is also the Chairman of the board of directors appears to be positively correlated to the firms voluntary disclosure. Disclosure index it is also positively correlated with the shareholders ownership. The other independent variables are not significantly correlated to the disclosure index.

Table 7. Fixed-effects coefficient estimation considering the typology of disclosure and the interaction term (ind_precl)

	(1) discl_index	(2) discl_index	(3) discl_index	(4) discl_index	(5) discl_index
Constant	0.295***	0.271***	0.293***	0.196**	0.381***
	(5.25)	(4.41)	(5.18)	(3.20)	(6.46)
PATENTS	0.047	0.048	0.044	0.050	0.029
	(1.75)	(1.79)	(1.62)	(1.91)	(1.09)
PRECL	-0.114***	-0.056	-0.122**	-0.018	-0.184***
	(-4.43)	(-0.87)	(-2.95)	(-0.52)	(-6.17)
IND	-0.045	-0.007	-0.053	0.055	-0.106*
	(-0.99)	(-0.12)	(-1.11)	(1.08)	(-2.24)
IND_PRECL		-0.078			
		(-0.97)			
BE_IND			0.026		
			(0.94)		
BE_PRECL			0.011		
			(0.11)		
SS_IND				0.060*	
				(2.01)	
SS_PRECL				-0.373***	
				(-4.24)	
CI_IND					-0.116**
					(-3.01)
CI_PRECL					0.508***
					(4.18)
OWN	0.044	0.044	0.048	0.051	0.045
	(1.32)	(1.32)	(1.42)	(1.56)	(1.39)
CHCEO	-0.007	-0.009	-0.007	-0.009	-0.007
	(-0.49)	(-0.62)	(-0.49)	(-0.64)	(-0.54)
ROA	-0.001	-0.001	-0.002	-0.001	0.001
	(-0.17)	(-0.17)	(-0.26)	(-0.17)	(0.16)
LnAT	-0.001	-0.001	-0.001	-0.001	-0.003
	(-0.18)	(-0.21)	(-0.14)	(-0.21)	(-0.43)
LEV	7.07e-II	7.16e-II	6.80e-II	7.63e-II	6.55e-II
	(1.05)	(1.07)	(1.01)	(1.16)	(1.00)
NBOD	0.004	0.004	0.004	0.005	0.005
	(1.19)	(1.07)	(1.07)	(1.37)	(1.39)
Year dummies	YES	YES	YES	YES	YES
R^2	0.11	0.10	0.10	0.09	0.11
N	432	432	432	432	432

Absolute value of *t* statistics in parentheses. Coefficient and t statistics are not report for year dummies (to count for time-variation disclosure) for the models 1-3.

DISCL_INDEX disclosure index calculated as shown in the appendix A. PATENT proportion of patented products over total number of products of the company, PRECL proportion of products under screening, development, IND and preclinical stage of development over total number of products per company, BE proportion of business experts members of board of directors, BE_PRECL interaction term between proportion of business experts members of the board of directors and the proportion of products in preclinical stage, SS proportion of support specialists members of board of directors, SS_PRECL interaction term between proportion of support specialists members of the board of directors and the proportion of products in preclinical stage, CI community influential members of board of directors, CI_PRECL interaction term between proportion of community influential members of board of directors and proportion of products under preclinical phase, IND proportion of independent directors, CEO dummy variable equal to 1 if CEO is also chairman, 0 otherwise, OWNERSHIP proportion of common outstanding shares owned by board members, ROA return on assets, AT company size, measured as Logarithm of assets, LEVERAGE, measured as long-term debt over shareholder's equity.

*Statistically significant at the 0.10 level; ** statistically significant at 0.05 level; *** statistically significant at 0.01 level

Table 8. Fixed-effects model coefficient estimation considering the relationship between disclosure index (past information) and interaction effects

	(1) past_info	(2) past_info	(3) past_info	(4) past_info	(5) past_info
Constant	0.227***	0.207***	0.223***	0.188***	0.270***
	(5.64)	(4.71)	(5.53)	(4.25)	(6.29)
PATENTS	0.036	0.037	0.032	0.037	0.027
	(1.86)	(1.91)	(1.63)	(1.93)	(1.39)
PRECL	-0.061***	-0.015	-0.062*	-0.015	-0.095***
	(-3.33)	(-0.32)	(-2.10)	(-0.62)	(-4.40)
IND	-0.068*	-0.037	-0.074*	-0.017	-0.098**
	(-2.06)	(-0.86)	(-2.18)	(-0.47)	(-2.86)
IND_PRECL		-0.063			
		(-1.09)			
BE_IND			0.035		
			(1.82)		
BE_PRECL			-0.012		
			(-0.19)		
SS_IND				0.007	
				(0.33)	
SS_PRECL				-0.186**	
				(-2.92)	
CI_IND					-0.059*
					(-2.11)
CI_PRECL					0.246**
					(2.79)
NBOD	0.005*	0.005	0.005	0.005*	0.006*
	(2.08)	(1.94)	(1.83)	(2.12)	(2.20)
OWN	0.044	0.044	0.048*	0.050*	0.044
	(1.83)	(1.83)	(1.99)	(2.10)	(1.87)
CHCEO	0.006	0.005	0.006	0.006	0.006
	(0.63)	(0.47)	(0.58)	(0.59)	(0.60)
ROA	-0.001	-0.001	-0.002	-0.001	0.001
	(-0.16)	(-0.16)	(-0.29)	(-0.20)	(0.05)
lnAT	-0.006	-0.006	-0.006	-0.006	-0.007
	(-1.23)	(-1.26)	(-1.19)	(-1.31)	(-1.39)
LEV	5.93e-II	6.00e-II	5.56e-II	5.89e-II	5.68e-II
	(1.23)	(1.25)	(1.16)	(1.24)	(1.20)
Year dummies	YES	YES	YES	YES	YES
R^2					
N	432	432	432	432	432

Absolute value of *t* statistics in parentheses. Coefficient and t statistics are not report for year dummies (to count for time-variation disclosure) for the models 1-5.

DISCL_INDEX disclosure index calculated as shown in the appendix A, PATENT proportion of patented products over total number of products of the company, PRECL proportion of products under screening, development, IND and preclinical stage of development over total number of products per company, BE proportion of business experts members of board of directors, BE_PRECL interaction term between proportion of business experts members of the board of directors and the proportion of products in preclinical stage, SS proportion of support specialists members of board of directors, SS_PRECL interaction term between proportion of support specialists members of the board of directors and the proportion of products in preclinical stage, CI community influential members of board of directors, CI_PRECL interaction term between proportion of community influential members of board of directors and proportion of products under preclinical stage of development, IND proportion of independent directors, CEO dummy variable equal to 1 if CEO is also chairman, 0 otherwise, OWNERSHIP proportion of common outstanding shares owned by board members, ROA return on assets, AT company size, measured as Logarithm of assets, LEVERAGE, measured as long-term debt over shareholders' equity.

*Statistically significant at the 0.10 level; ** statistically significant at 0.05 level; *** statistically significant at 0.01 level

Table 9. Fixed-effects estimation considering the typology of disclosure (future disclosure)

	(1) future_info	(2) future_info	(3) future_info	(4) future_info	(5) future_info
Constant	0.055	0.049	0.058	-0.003	0.092**
	(1.67)	(1.34)	(1.74)	(-0.07)	(2.60)
PATENTS	0.022	0.023	0.024	0.024	0.015
	(1.40)	(1.42)	(1.47)	(1.57)	(0.92)
PRECL	-0.036*	-0.021	-0.049*	0.012	-0.065***
	(-2.38)	(-0.54)	(-1.99)	(0.60)	(-3.63)
IND	0.016	0.026	0.012	0.063*	-0.010
	(0.58)	(0.73)	(0.43)	(2.10)	(-0.35)
IND_PRECL		-0.021			
		(-0.44)			
BE_IND			-0.011		
			(-0.66)		
BE_PRECL			0.037		
			(0.69)		
SS_IND				0.050**	
				(2.85)	
SS_PRECL				-0.180***	
				(-3.44)	
CI_IND					-0.051*
					(-2.19)
CI_PRECL					0.206**
					(2.84)
NBOD	0.001	-0.001	0.001	0.001	0.001
	(0.01)	(-0.04)	(0.13)	(0.23)	(0.12)
OWN	-0.009	-0.009	-0.009	-0.008	-0.009
	(-0.46)	(-0.46)	(-0.45)	(-0.42)	(-0.44)
CHCEO	-0.021*	-0.021*	-0.012*	-0.022**	-0.021*
	(-2.49)	(-2.52)	(-2.37)	(-2.69)	(-2.55)
ROA	-0.001	-0.001	-0.001	-0.001	0.002
	(-0.17)	(-0.17)	(-0.19)	(-0.12)	(0.05)
LnAT	0.005	0.005	0.005	0.005	0.004
	(1.24)	(1.22)	(1.28)	(1.30)	(1.09)
LEV	1.1e-07	1.34e-07	2.18e-07	6.88e-07	-8.87e-08
	(0.03)	(0.03)	(0.05)	(0.18)	(-0.02)
Year dummies	YES	YES	YES	YES	YES
R^2					
N	432	432	432	432	432

Absolute value of *t* statistics in parentheses. Coefficient and t statistics are not report for year dummies (to count for time-variation disclosure) for the models 1-3.

Future_info, future information disclosure index calculated as the sum of future plans and market information disclosure index, PATENT proportion of patented products over total number of products of the company, PRECL proportion of products under screening, development, IND and preclinical stage of development over total number of products per company, BE proportion of business experts members of board of directors, BE_PRECL interaction term between proportion of business experts members of the board of directors and the proportion of products in preclinical stage, SS proportion of support specialists members of board of directors, SS_PRECL interaction term between proportion of support specialists members of the board of directors and the proportion of products in preclinical stage, CI community influential members of board of directors, CI_PRECL interaction term between proportion of community influential members of board of directors and proportion of products under preclinical phase, IND proportion of independent directors, CEO dummy variable equal to 1 if CEO is also chairman, 0 otherwise, OWNERSHIP proportion of common outstanding shares owned by board members, ROA return on assets, AT company size, measured as Logarithm of assets, LEVERAGE, measured as long-term debt over shareholders' equity.

*Statistically significant at the 0.10 level; ** statistically significant at 0.05 level; *** statistically significant at 0.01 level.

Table 10. Fixed-effects coefficient estimation considering the typology of disclosure (products specifications disclosure index)

	(1) product_specif	(2) product_specif	(3) product_specif
Constant	0.038*	0.038*	0.035*
	(2.56)	(2.33)	(2.25)
PATENTS	0.022**	0.022**	0.023**
	(3.16)	(3.18)	(3.20)
PRECL	0.007	0.014	0.012
	(0.69)	(1.54)	(1.49)
IND	-0.003	0.002	0.001
	(-0.24)	(0.14)	(0.03)
BE_IND	0.001		
	(0.18)		
BE_PRECL	0.012		
	(0.52)		
SS_IND		-0.005	
		(-0.64)	
SS_PRECL		-0.009	
		(-0.37)	
CI_IND			0.005
			(0.48)
CI_PRECL			0.006
			(0.18)
OWN	0.012	0.012	0.011
	(1.37)	(1.40)	(1.29)
NBOD	0.001	0.001	0.001
	(0.68)	(0.63)	(0.73)
CHCEO	-0.001	-0.001	-0.001
	(-0.31)	(-0.34)	(-0.32)
ROA	0.003	0.003	0.003
	(1.53)	(1.58)	(1.65)
lnAT	-0.003	-0.003	-0.003
	(-1.70)	(-1.81)	(-1.83)
LEV	2.01e-06	1.95e-06	1.99e-06
	(1.15)	(1.12)	(1.14)
Year dummies	Yes	Yes	Yes
R^2			
N	432	432	432

Absolute value of *t* statistics in parentheses. Coefficient and t statistics are not report for year dummies.
Product_specifications, Product specifications disclosure index calculated as shown in the appendix A, PATENT proportion of patented products over total number of products of the company, PRECL proportion of products under screening, development, IND and preclinical stage of development over total number of products per company, BE proportion of business experts members of board of directors, BE_PRECL interaction term between proportion of business experts members of the board of directors and the proportion of products in preclinical stage, SS proportion of support specialists members of board of directors, SS_PRECL interaction term between proportion of support specialists members of the board of directors and the proportion of products in preclinical stage, CI community influential members of board of directors, CI_PRECL interaction term between proportion of community influential members of board of directors and proportion of products under preclinical phase, IND proportion of independent directors, CEO dummy variable equal to 1 if CEO is also chairman, 0 otherwise, OWNERSHIP proportion of common outstanding shares owned by board members, ROA return on assets, AT company size, measured as Logarithm of assets, LEVERAGE, measured as long-term debt over shareholder's equity.

*Statistically significant at the 0.10 level; ** statistically significant at 0.05 level; *** statistically significant at 0.01 level.

Table 11. Fixed-effects coefficient estimation considering the typology of disclosure (target disease disclosure)

	(1) target_disease	(2) target_disease	(3) target_disease
Constant	0.086***	0.068***	0.097***
	(6.95)	(5.00)	(7.37)
PATENTS	0.003	0.004	0.001
	(0.49)	(0.61)	(0.05)
PRECL	-0.019*	0.012	-0.009
	(-2.06)	(1.60)	(-1.29)
IND	-0.005	0.017	-0.007
	(-0.48)	(1.53)	(-0.63)
BE_IND	0.002		
	(0.37)		
BE_PRECL	0.042*		
	(2.12)		
SS_IND		0.010	
		(1.54)	
SS_PRECL		-0.056**	
		(-2.87)	
CI_IND			-0.025**
			(-2.86)
CI_PRECL			0.037
			(1.36)
OWN	0.005	0.004	0.003
	(0.67)	(0.53)	(0.45)
NBOD	-0.001	-0.001	-0.001
	(-0.28)	(-0.25)	(-0.46)
CHCEO	-0.003	-0.004	-0.004
	(-0.95)	(-1.28)	(-1.35)
ROA	0.001	0.002	0.002
	(0.70)	(0.99)	(0.96)
lnAT	-0.001	-0.001	-0.001
	(-0.67)	(-0.91)	(-0.78)
LEV	2.01e-07	3.29e-07	2.48e-07
	(0.14)	(0.22)	(0.17)
Year dummies	YES	YES	YES
$\mathbf{R^2}$			
N	432	432	432

Absolute value of *t* statistics in parentheses. Coefficient and t statistics are not report for year dummies (to count for time-variation disclosure) for the models 1-3. Target_disease, Target disease disclosure index calculated as shown in the appendix A, PATENT proportion of patented products over total number of products of the company, PRECL proportion of products under screening, development, IND and preclinical stage of development over total number of products per company, BE proportion of business experts members of board of directors, BE_PRECL interaction term between proportion of business experts members of the board of directors and the proportion of products in preclinical stage, SS proportion of support specialists members of board of directors, SS_PRECL interaction term between proportion of support specialists members of the board of directors and the proportion of products in preclinical stage, CI community influential members of board of directors, CI_PRECL interaction term between proportion of community influential members of board of directors and proportion of products under preclinical phase , IND proportion of independent directors, CEO dummy variable equal to 1 if CEO is also chairman, 0 otherwise, OWNERSHIP proportion of common outstanding shares owned by board members, ROA return on assets, AT company size, measured as Logarithm of assets, LEVERAGE, measured as long-term debt over shareholder's equity.

*Statistically significant at the 0.10 level; ** statistically significant at 0.05 level; *** statistically significant at 0.01 level

Table 12. Fixed-effects coefficient estimation considering the typology of disclosure (clinical disclosure index)

	(1) clinical_tr	(2) clinical_tr	(3) clinical_tr
Constant	0.099**	0.082*	0.137***
	(3.11)	(2.33)	(4.04)
PATENTS	0.006	0.011	0.004
	(0.42)	(0.72)	(0.25)
PRECL	-0.051*	-0.041*	-0.099***
	(-2.18)	(-2.12)	(-5.74)
IND	-0.066*	-0.036	-0.092***
	(-2.46)	(-1.25)	(-3.38)
BE_IND	0.032*		
	(2.07)		
BE_PRECL	-0.067		
	(-1.30)		
SS_IND		0.002	
		(0.11)	
SS_PRECL		-0.121*	
		(-2.38)	
CI_IND			-0.040
			(-1.78)
CI_PRECL			0.203**
			(2.91)
OWN	0.031	0.034	0.030
	(1.63)	(1.79)	(1.59)
NBOD	0.004*	0.005*	0.005**
	(2.11)	(2.48)	(2.62)
CHCEO	0.001	0.011	0.011
	(1.24)	(1.40)	(1.43)
ROA	-0.006	-0.006	-0.005
	(-1.33)	(-1.37)	(-1.07)
LnAT	-0.002	-0.002	-0.002
	(-0.46)	(-0.46)	(-0.60)
LEV	3.35e-06	3.61e-06	3.44e-06
	(0.88)	(0.96)	(0.91)
Year dummies	YES	YES	YES
R^2			
N	432	432	432

Absolute value of *t* statistics in parentheses. Coefficient and t statistics are not report for year dummies (to count for time-variation disclosure) for the models 1-3.

Clinical_tr, Clinical trial disclosure index calculated as shown in the appendix A, PATENT proportion of patented products over total number of products of the company, CLINICAL proportion of products under phase I, II and III trial and NDA review over total number of products per company, BE proportion of business experts members of board of directors, BE_CL interaction term between proportion of business experts members of the board of directors and the proportion of products in clinical stage, SS proportion of support specialists members of board of directors, SS_CL interaction term between proportion of support specialists members of the board of directors and the proportion of products in clinical stage (phase I, III , III and NDA review), CI community influential members of board of directors, CI_CL interaction term between proportion of community influential members of board of directors and proportion of products under clinical phase (phase I, II, III and NDA review) , IND proportion of independent directors, CEO dummy variable equal to 1 if CEO is also chairman, 0 otherwise, OWNERSHIP proportion of common outstanding shares owned by board members, ROA return on assets, AT company size, measured as Logarithm of assets, LEVERAGE, measured as long term debt over shareholder's equity.

*Statistically significant at the 0.05 level; ** statistically significant at 0.01 level; *** statistically significant at 0.10 level.

Table 13. Fixed-effects coefficient estimation considering the typology of disclosure (future plans index)

	(1) future_info	(2) future_info	(3) future_info
Constant	0.058	-0.003	0.092**
	(1.74)	(-0.07)	(2.60)
PATENTS	0.024	0.024	0.015
	(1.47)	(1.57)	(0.92)
PRECL	-0.049*	0.012	-0.065***
	(-1.99)	(0.60)	(-3.63)
IND	0.012	0.063*	-0.010
	(0.43)	(2.10)	(-0.35)
BE_IND	-0.011		
	(-0.66)		
BE_PRECL	0.037		
	(0.69)		
SS_IND		0.050**	
		(2.85)	
SS_PRECL		-0.180***	
		(-3.44)	
CI_IND			-0.051*
			(-2.19)
CI_PRECL			0.206**
			(2.84)
OWN	-0.001	-0.008	-0.009
	(-0.45)	(-0.42)	(-0.44)
NBOD	0.001	0.001	0.001
	(0.13)	(0.23)	(0.12)
CHCEO	-0.020*	-0.022**	-0.021*
	(-2.37)	(-2.69)	(-2.55)
ROA	-0.001	-0.001	0.001
	(-0.19)	(-0.12)	(0.05)
LnAT	0.005	0.005	0.004
	(1.28)	(1.30)	(1.09)
LEV	2.18e-07	6.88e-07	-8.87e-08
	(0.05)	(0.18)	(-0.02)
Year dummies	YES	YES	YES
R^2			
N	432	432	432

Absolute value of *t* statistics in parentheses. Coefficient and t statistics are not report for year dummies (to count for time-variation disclosure) for the models 1-3.

Future_plans, Future plans disclosure index calculated as shown in the appendix A, PATENT proportion of patented products over total number of products of the company, PRECLINICAL proportion of products under screening, development, IND and preclinical phase of development over total number of products per company, BE proportion of business experts members of board of directors, BE_PRECL interaction term between proportion of business experts members of the board of directors and the proportion of products in preclinical stage, SS proportion of support specialists members of board of directors, SS_PRECL interaction term between proportion of support specialists members of the board of directors and the proportion of products in preclinical stage, CI community influential members of board of directors, CI_PRECL interaction term between proportion of community influential members of board of directors and proportion of products under preclinical phase, IND proportion of independent directors, CEO dummy variable equal to 1 if CEO is also chairman, 0 otherwise, OWNERSHIP proportion of common outstanding

shares owned by board members, ROA return on assets, AT company size, measured as Logarithm of assets, LEVERAGE, measured as long-term debt/Shareholder's equity.

*Statistically significant at the 0.05 level; ** statistically significant at 0.01 level; *** statistically significant at 0.10 level.

Table 14. Fixed-effects coefficient estimation considering the typology of disclosure (market information index)

	(1) market_info	(2) market_info	(3) market_info
Constant	0.009	0.008	0.006
	(0.98)	(0.78)	(0.61)
PATENTS	0.006	0.006	0.006
	(1.24)	(1.24)	(1.37)
PRECL	0.003	0.001	0.003
	(0.42)	(0.21)	(0.50)
IND	0.004	0.003	0.005
	(0.44)	(0.37)	(0.56)
BE_IND	-0.001		
	(-0.15)		
BE_PRECL	-0.006		
	(-0.45)		
SS_IND		0.001	
		(0.25)	
SS_PRECL		-0.004	
		(-0.25)	
CI_IND			0.005
			(0.77)
CI_PRECL			-0.016
			(-0.78)
OWN	0.005	0.006	0.006
	(0.97)	(1.03)	(1.03)
NBOD	-0.001	-0.001	-0.001
	(-1.03)	(-1.01)	(-1.05)
CHCEO	-0.003	-0.003	-0.003
	(-1.37)	(-1.34)	(-1.30)
ROA	0.001	0.001	0.001
	(0.20)	(0.14)	(0.09)
LnAT	0.001	0.001	0.001
	(0.68)	(0.74)	(0.76)
LEV	-6.97e-07	-6.89e-07	-6.92e-07
	(-0.61)	(-0.61)	(-0.61)
Year dummies	YES	YES	YES
R^2			
N	432	432	432

Absolute value of *t* statistics in parentheses. Year dummies (to count for time-variation disclosure) for the models 1-3. Market_ info INDEX disclosure index calculated as shown in the appendix A, PATENT proportion of patented products over total number of products of the company, CLINICAL proportion of products under phase I, II and III trial and NDA review over total number of products per company, BE proportion of business experts members of board of directors, BE_PRECL interaction term between proportion of business experts members of the board of directors and the proportion of products in clinical stage, SS proportion of support specialists members of board of directors, SS_PRECL interaction term between proportion of support specialists members of the board of directors and the proportion of products in clinical stage (phase I, III , III and NDA review), CI community influential members of board of directors, CI_PRECL interaction term between proportion of community influential members of board of directors and proportion of products under clinical phase (phase I, II, III and NDA review) , IND proportion of independent directors, CEO dummy variable equal to 1 if CEO is also chairman, 0 otherwise, OWNERSHIP proportion of common outstanding shares owned by board members, ROA return on assets, AT company size, measured as Logarithm of

assets, LEVERAGE, measured as long term debt over shareholder's equity, *Statistically significant at the 0.05 level; ** statistically significant at 0.01 level; *** statistically significant at 0.10 level.

APPENDIX A

Table x. Disclosure Index Scoring Sheet: An example

Company	Maxygen
Product	MAXY-G34
Development stage for MAXY-G34	Phase II
Disclosure Index (Information is drawn from the Business Section)	Score contents
I. Product Specifications	
1. How does the product work? (3 = three sentences; 2 = two sentences; 1= one sentence; 0 = none)	1. Help the body make blood cells
2a. Why is it better than previous products ? (2 = name mentioned; 1 = no name mentioned; 0 = not mentioned)	2. MAXY-G34 reduces the duration of neutropenia when compared to the currently marketed products (Neulasta and Neupogen)
2b. Why is it better than competing products ? (2 = name mentioned; 1 = no name mentioned; 0 = not mentioned)	2. MaXY-G34 protects patients from chemotherapy and radiation therapy-related infections, shorten the duration of hospital stays and help keep patients on schedule for their cancer treatments.
3. What is the chemical structure in addition to its chemical name? (2= name mentioned; 0 = not mentioned)	0. not mentioned
Subtotal I = total scores of (1 + max (2a, 2b) + 3)	3 out of maximum of 7.
II. Target Diseases	
1. What kind of diseases does the product treat ? (2 = disease name mentioned; 1 = disease name not mentioned; 0 = not mentioned)	2. Neutropenia
2. What are the other possible uses? (2 = disease name mentioned; 1 = disease name not mentioned; 0 = not mentioned)	0. Not mentioned
Subtotal II = total scores of (1 + 2)	2 Out of maximum of 4
III. Clinical Trials	
1. Number of patients (1= mentioned; 0 = not mentioned)	1. 47

2. Patients information (with what disease) (1 = name mentioned; 0 = not mentioned)	1. Patients with breast cancer who have failed at least one potentially curative treatment regimen
3. Doses (amounts) used in the clinical trial (1 = mentioned; 0 = not mentioned)	1. 5 to 100 µg/kg was given
4. Method (via what kind of media) used in the clinical trial (1 = mentioned; 0 = not mentioned)	1. Subcutaneous injection
5. Treatment schedule (duration or frequency)	1. Single dose MAXY-G34 therapy being administered per three week chemotherapy cycle with each patient receiving six cycles of docetaxel
6. Results (3 = detailed discussion; 2 = general discussion;1 = brief discussion; 0 = no discussion)	2. The results of this phase I clinical trial indicate that the drug MAXY-G34 was generally safe and well tolerated through the study
Subtotal III = total scores of (1 + 2+ 3 + 4 + 5 + 6)	7 Out of a maximum of 8

IV. Future Development Plans

1a. Is there any plan to try the product on new diseases? (2 = name mentioned; 1 = no name mentioned; 0 = not mentioned)	2. Hemophilia
1b. Is there any plan to try the product with other products? (2 = name mentioned; 1 = no name mentioned; 0 = not mentioned)	0. not mentioned
2. Future plan for clinical trials	
2a. Planned date (1 = mentioned; 0 = not mentioned)	1. 2008
2b. Number of patients for the planned trial (what disease) (1 = mentioned; 0 = not mentioned)	0. not mentioned
2c. Patient information for the planned trial (what disease) (1 = mentioned; 0 = not mentioned)	1. Breast cancer patients
2d. Duration (1= mentioned; 0 = not mentioned)	0. not mentioned
2e. Method (1 = mentioned; 0 = not mentioned)	0. not mentioned
3. Alliance (2 = name mentioned; 1 = no name mentioned; 0 = not mentioned)	2. We entered into a strategic alliance with Roche
Subtotal IV = total scores of [max (1a, 1b) + 2a + 2b + 2c + 2d + 2e + 3)	6 Out of a maximum of 9

V. Market Information

1. Number of patients affected by the disease	0. not mentioned
2. Number of incidents (market size)	0
Subtotal V = total scores of (1 + 2)	0 out of a maximum of 2
Overall Disclosure Score = Sum if subtotal I-V	18 out of a maxumum of 30
Scalled Disclosure Score *= Overall disclosure score divided by 30 because MAXY-G34 is in clinical trials phase*	0.60 Out of a maximum of 1.00

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