The current issue and full text archive of this journal is available at
www.emeraldinsight.com/1469-1930.htm

The nature and extent of voluntary intellectual capital disclosures by Australian and UK biotechnology companies

Gregory White, Alina Lee and Yuni Yuningsih
School of Accounting, Curtin Business School, Curtin University of Technology, Perth, Australia, and
Christian Nielsen and Per Nikolaj Bukh
Department of Business Studies, University of Aalborg, Aalborg, Denmark

Abstract

Purpose – The purpose of this research project is to compare the nature and extent of voluntary intellectual capital disclosures (ICD) by UK and Australian biotechnology companies. The motivating research question was whether the nature and extent of voluntary ICD by preparers of financial report data in these countries reflected the relative maturity of the UK, compared to Australian industry.

Design/methodology/approach – ICD was measured in annual reports and financial statements published on the company websites. A Danish disclosure index was used to evaluate voluntary disclosures by 156 companies about customers, employees, IT, strategy, R&D and processes (78-items scored for each company).

Findings – A significant leverage effect was demonstrated in relation to the "nature" of ICD by UK and Australian biotechnology companies. Interestingly, mean customer ICD were higher in annual reports from high-leveraged compared to low-leveraged Australian firms. In contrast, UK firms showed higher mean R&D ICD for low-leveraged firms than high-leveraged firms. With regards to the "extent" of ICD measured, the study demonstrated a significant country effect.

Research limitations/implications – Potential limitations or bias may exist from the use of the disclosure index: binary scoring of disclosure versus non-disclosure reduces the richness of data otherwise obtainable by limited case study or interviews; and data collection is limiting – narrative with managers actually preparing ICD is not possible.

Practical implications – Australian company financial accountants and managers preparing and/or including ICD information could be in danger of underestimating the importance of information asymmetry existing with lenders.

Originality/value – This finding contrasts the legitimate R&D focused ICD of low-leveraged UK firms; namely to attract stakeholder attention to their expanding intellectual property base, with the findings from Australian firms' with a relatively predictable and naïve customer focus.

Keywords Intellectual capital, Disclosure, Biotechnology

Paper type Research paper

The authors would like to thank the following individuals for their feedback on the content of this paper: Editorial Board of Accounting and Business Research; Delegates of the 32nd European Accounting Association, Annual Congress, Tampere, Finland; Curtin Business School, School of Accounting staff; and Australian School of Business (UNSW, Sydney), Seminar Series participants. This project was funded by a Curtin University of Technology, Strategic Research Grant.

Journal of Intellectual Capital
Vol. 11 No. 4, 2010
pp. 519-536

1469-1930
DOI 10.1108/14691931011085669

1. Introduction

This paper reports a comparison of the "nature" and "extent" of voluntary intellectual capital disclosures (ICD) by UK and Australian biotechnology companies. Voluntary ICD by firm managers in the UK was expected to be more extensive as a reflection of the relative maturity of the UK, compared to Australian industry. Although, prior to completion of the study it was difficult to hypothesize about differences in the "nature" of ICD disclosure between UK and Australian companies in this industry.

Intellectual capital disclosures (ICD) by firms are voluntary; and, in Australia and the UK are unregulated disclosures about intangible firm-value. A recent review by Marr *et al.* (2003) showed that communication of ICD information with shareholders was a central strategic issue. In the current, study annual report data for Australian and UK companies was measured using a disclosure index developed by Per Nikolaj Bukh and colleagues (Bukh *et al.*, 2005). The subsequent use of this instrument in other studies, measuring ICD in IPO prospectuses (Singh and Van der Zahn, 2007, 2008), and general purpose financial reporting (White et. al., 2007), provide comparative data for the analysis of six dimensions of ICD (employees, customers, IT, strategy, processes and R&D).

The Institute of Chartered Accountants in Australia (Chua, 2005), Scotland, England and Wales (Unerman *et al.*, 2007) have independently commissioned research and member reporting guidelines for intellectual capital. These prescriptive papers, which review ICD reporting practice and empirical research of interest, are mirrors of growing academic research interest in the field over the past decade (Bukh *et al.*, 2005; Guo *et al.*, 2004; Guthrie *et al.*, 2006; Kristandl and Bontis, 2007; Vergauwen and van Alem, 2005; Van der Zahn *et al.*, 2007; White *et al.*, 2007). Interpretation and case study practice with companies, within a normative theoretical context, has also enabled speculation about measurement, meaning and management, and the use of dedicated intellectual capital statements for reporting (Mouritsen, 2004).

Early research-based insight about voluntary intellectual capital disclosure (ICD) practice was obtained from companies around 2000 when The Danish guideline for Intellectual Capital Statements was developed and tested among a large number of Danish companies (Boedker *et al.*, 2008; Bukh *et al.*, 2005; Bukh and Jensen, 2008; Mouritsen and Larsen, 2005; Mouritsen *et al.*, 2005; Mouritsen, 2004; Nielsen *et al.*, 2006).

Guo *et al.* (2004) measured competitive costs of disclosure by biotechnology IPOs at the product level. Discussion of this paper for *Journal of Accounting Research* conference feedback by Hribar (2004) highlights that the researchers' "Subject" reporting media is important. In this matter the discussion extended over the topics of information asymmetry and the discretion available to managers with respect to these disclosures. Guo *et al.* (2004) justify the validity of measuring voluntary ICD in their selected media (biotechnology IPO's) because information asymmetry for investors at IPO is abnormally high, with few other statutory disclosures about ICD available.

The theoretical focus or conceptual framework of this study is therefore grounded in economic consequences; that voluntary ICD disclosure policy will matter to biotechnology firm managers who fear increasing cost of capital from information asymmetry with investors and lenders. Managers may choose voluntary disclosures about intangible firm-value like its ICD to reduce information

asymmetry between themselves as agents for equity investors (evidence for reduction in cost of equity: Hail, 2002) and lenders (evidence for reduction in cost of debt: Sengupta, 1998). The decision-making and rational economic self-interest and opportunism of managers (Jensen and Meckling, 1976), monitoring their own accounting-based bonuses will be tempered by attempts at efficient contracting (Watts and Zimmerman, 1986). This efficient contracting perspective predicts that managers will monitor and attempt to reduce information asymmetry with lenders by making voluntary disclosures to bridge that knowledge gap. Wyatt (2008) has explored what financial and non-financial knowledge of intangibles is value-relevant for investors. In particular, her review of studies in the area categorized the firm's technological resources as firms R&D expenditure and related intellectual property. A critical presumption of the current study is that firm managers are concerned with the economic consequences of knowledge about how the firm does things; also, importantly, the ownership it possesses in patented processes that safeguard its future growth.

The pre-commercialisation, research and development and proof-of-concept activities of biotechnology companies make them a unique industry in which to study ICD. Bridging information asymmetry by firm managers' through voluntary ICD ("the consequence of corporate disclosure"; Guo *et al.*, 2004) is central to the conceptual framework of this project:

- the "nature" and "extent" of disclosure measured ("determinants of how much"; Guo *et al.*, 2004, p. 319); and
- the possible reporting pressure from external financiers ("presumed objectives of disclosure"; Guo *et al.*, 2004, p. 319).

The latter observation by these researchers is central to the motivation for disclosure measurement and choice of leverage as an independent variable in the current study.

In 2006 Australian and UK markets (Australian Stock Exchange – Code of Best Practice for Reporting by Life Science Companies; Bioindustry Association – Best Practice Guidance on Financial and Corporate Communications) have realized the special information asymmetry problems of stakeholders in biotechnology firms. This situation is especially true as managers try to lower the cost of capital and promote investment and growth over subsequent reporting periods; the effect of the global economic downturn could significantly affect managers' recent annual reporting efforts related to voluntary ICD.

The remainder of discussion in this paper is divided between hypothesis development, methodology, results and discussion, and implications and conclusions.

2. Research question and hypothesis development

Prior research evaluating the nature of voluntary ICD shows mixed evidence from Australian companies. Guthrie and Petty (2000) investigated the disclosure of intellectual capital items by Australia's 19 largest listed companies and one IC best practice company and found 40 percent of the sample reported external (i.e. customer and relational) capital items. The authors stated that one possible reason for this is because of "the emphasis in recent years on rationalizing distribution channels, reconfiguring firm-value chains, and reassessing customer value (customer profitability analysis etc.)". This is consistent with Guthrie *et al.* (2007) findings

which show that most of their Australian sample was in the external (relational) capital category. These findings may indicate that customer items are perceived as a crucial consideration by Australian firm managers.

Bruggen *et al.*'s (2009) study with a sample of 125 publicly-listed Australian firms (including health care; biotechnology) shows that industry-type and firm size play a key role as determinant for disclosure of intellectual capital. Their findings show that structural capital is the most frequently disclosed category, whereas hardly any disclosure of relational capital category (e.g. customer knowledge and capital) can be found.

Prior studies of intellectual capital disclosure by UK companies provide evidence that external relational categories are more important than other possible voluntary disclosures. Striukova *et al.* (2008) investigated ICD by 15 UK companies across four broad sectors (software/IT, pharmaceutical/biotechnology, and real estate/retailing). They found that the nature of biotechnology firms' disclosure were greatest for the external (relational) capital category. In this category voluntary ICD about contract/licensing agreement, customers, company collaboration, business reputation and R&D were favoured. In relation to the disclosure of individual elements, the highest frequency disclosures were about intellectual property (internal capital category) and work-related knowledge (human capital category). The authors stated that this reflects the significance of security in legal protection for intellectual property and the presence of highly skilled employees in developing and marketing products. Bozzolan *et al.* (2006) investigated ICD in the UK and Italy (traditional and knowledge-based firms) and found that in both countries most of the sample's ICDs were about external capital category (e.g. brands, customers, business and research collaboration, licensing agreements). With regard to individual elements, the highest frequencies were disclosure about customers, brands, employees, and patents.

Using in-depth interviews and content analysis with 15 UK companies Brennan (2008) has questioned the importance placed on ICD by stakeholders, with interview evidence from that study indicating annual reports may not be an important vehicle for ICD. The analysis in Brennan's paper suggest that interviewees perceived two serious negative consequences of ICD. First, interviewees indicated they were reticent about disclosure of the firm's secrets. Second, interviewees indicated that ICD had the problem of potentially overloading stakeholders with complex information.

Roslender and Fincham (2004) investigated how IC is viewed, developed, and reported in six knowledge-based organizations in the UK. They found that a key focus of respondents was human capital, especially which related to employee development programmes and employee retention decision. Especially in the petrochemical industry; health, safety, and environmental were regarded as the core of organizational culture. This also highlights the importance of human capital (i.e. employee health and safety) in this industry. Roslender and Fincham (2004) argued that: "Within knowledge-based organizations, the role of human capital and its creativity, ingenuity and capacity for innovation are so central" and " Achieving the right balance of talent was the key challenge".

Guided by the above research findings that are specific to voluntary ICD in the context of UK and Australian biotechnology companies, the following research question is addressed in the current study:

RQ. Is there a measureable difference in the nature or extent of ICD by Australian and UK biotechnology companies?

In the context of the global reporting environment and pressures on companies wishing to debt-finance, managerial stakeholder theory would also predict a heavy emphasis on value-added voluntary reporting towards satisfying the information needs of existing lenders. Lenders, as external financiers, are arguably the biotechnology firm manager's most important stakeholder.

In the traditional agency theory context (Jensen and Meckling, 1976), firm managers are predicted to have motivations for particular accounting policy choice (including voluntary disclosure), because of obligations to lenders in existing debt covenants (Dhaliwal *et al.*, 1982). In the theoretical context of the Positive Accounting Theory, debt hypothesis (Watts and Zimmerman, 1986), Bradbury (1992) discovered a positive correlation between firm leverage and voluntary segment disclosures. Chow and Wong-Boren (1987), however, found no relationship between the same two variables measured in Mexican corporations. It is reasonable to conclude that previous research supports a tenuous link between firm debt and some types of voluntary disclosure practices like segment reporting. In the case of voluntary ICD there is stronger evidence that leverage is a key driver for managers' voluntary ICDs in larger firms, at least in Australian biotech companies (White *et al.*, 2007).

Large companies are the subjects of scrutinizing by particular stakeholder groups. Therefore, positive disclosure practices, such as the value-added reporting of intellectual capital, could be predicted to motivate managers to minimize political costs. This study uses market capitalization as a proxy for political visibility and it is predicted that larger firms will report more intellectual capital disclosures. For Danish IPO prospectuses, size was not a determinant of intellectual capital disclosures (Bukh *et al.*, 2005). Robb *et al.* (2001) demonstrate that prospective and historical non-financial disclosures in annual reports were affected by size.

The previous paragraphs lead us to the following hypotheses for this study, regarding the nature and extent of ICD by biotechnology companies:

- $H1A_0$. Leverage has no effect on the extent of ICD by UK or Australian firms.
- $H1B_0$. Leverage has no effect on the nature of ICD by UK or Australian firms.
- $H2A_0$. Country has no effect on the extent of ICD by high or low-leveraged firms.
- $H2B_0$. Country has no effect on the nature of ICD by high or low leveraged firms.
- $H3A_0$. There is no relationship between leverage, size and country and the extent of ICD by firms.
- $H3B_0$. There is no relationship between leverage, size and country and the nature of ICD by firms.

3. Methodology

The annual reports from 104 Australian biotechnology companies (listed on the Australian Stock Exchange) and 52 UK biotechnology companies (listed on the London Stock Exchange) were the original objects of study from which voluntary ICD data were collected. Voluntary ICD in Australian and UK companies' annual reports were scored using the index developed by Bukh *et al.* (2005) (see also Marston and Shrives (1991)). This ICD index has also been used successfully in previous studies (Singh and Van Der Zahn, 2008; White *et al.*, 2007). The ICD index consists of 78-items measuring

items related to employees (27-item), customers (14-item), IT (five-item), processes (eight-item), research and development (nine-item) and strategic statements (15-item). The disclosure information is scored either "1" for yes or "0" for no for each item. The categorical record is converted to a percentage for each company, by simply dividing by the sum of disclosures. In the case of individual dimensions, such as employee or customer disclosures, the number of "1" scores was divided by the total number of items for that dimension. For example, if a company disclosed 16 of the 27 items for the employee dimension, the score would be 59 percent (i.e. 16/27). Therefore since each dimension of the total disclosure index was measured as a percentage of items in the "nature" of that type of disclosure (for example, items related to employees); they were not additive to total the ICD Index percentage.

Bukh *et al.* (2005) referred to Firth (1979) to support the conclusion that an extensive list of items scored in this fashion can be ranked equally since it results in gradual equalization, and other studies have found, in cases like this, that weighting produces little difference in the final results (Chow and Wong-Boren, 1987).

Before analyzing how leverage might have an effect on the extent and nature of voluntary ICD in Australian and UK biotechnology companies, the items contributing to each dimension of voluntary ICD were examined. A number of studies have used the instrument in its original form, for the measurement of voluntary ICD from annual report contents without considering its general applicability in the measurement of ICD since original design for use with Danish IPOs. One of the motivations for this study was to investigate reduction of the original 78-item disclosure index for the capture of data from company annual reports.

In previous experience with the instrument, it has been noted with Australian companies that a significant proportion of the 78 ICD items were not scored in any of the companies annual report data (White *et al.*, 2007). In the current study, it was observed that of the 156 annual reports scored from 104 Australian and 52 UK listed biotechnology companies, a large number of items were not disclosed at all; or only once. For example, when employee disclosures were examined and the Australian and UK frequency data compared the following voluntary ICD were not made by any companies in either country (or by only one in either country): Emp1, Employee breakdown by age; Emp2, employee breakdown by seniority; Emp3, Employee breakdown by gender; Emp4, employee breakdown by nationality; Emp7, employee breakdown by level of education; Emp8, rate of employee turnover; Emp11, employee absenteeism rate; Emp12, discussion of employee interviews; Emp13, statement of policy on competency development; Emp15, education and training expense; Emp16, education and employee expense by number of employees; Emp20, job rotation opportunities; Emp21, career opportunities; Emp25, statement of dependence on key personnel; Emp26, revenue per employee; Emp27, value added per employee. The Appendix (Table AI)presents the final items which contributed to the ICD index measure after removing those that were never disclosed, or disclosed only once.

4. Results and discussion

The aim of this research project was to characterize the specific nature and extent of ICD by biotechnology companies. These organizations can have extremely heterogeneous operating activities, including:

- service-providers (e.g. DNA paternity testing);
- research and development (e.g. University spin-off with patents for several anti-cancer peptides;
- proof-of-concept (e.g. Grant-funded private company obtaining funds from its first IPO to industrialize results from an R&D project); and
- full commercialization of drug candidates after clinical trial (e.g. Pfizer's Viagra).

Australia and the UK are both countries with similar R&D tax concession treatment of deductible research expenditure and Nationally Competitive Grants Programs. UK and Australian firms' managers are also exposed to a similar accounting regulatory framework governing measurement and disclosure of intangible assets in the financial statements. These similarities were expected to contribute to the validity of research design.

In the UK and Australia, as in other countries, companies in the biotechnology sector have also faced increasing competitive pressure from generic-drug competitors, and with the inevitable reduction in significant new drug discoveries over the long-run this has placed many of even the largest companies under significant financial pressure. GlaxoSmithKline for example has recently cut its US and UK sales force. Small proof-of-concept and pre-commercialization biotechnology companies in general face enormous pressure in Australia as well, with the removal of the Commercial Ready grant funding by the new Labor Party government 2008/2009 budget reforms. Although this program of pre-commercialization grant funding for R&D and proof-of-concept companies is to be replaced by an "improved" funding system, no compensation was offered for costs incurred; current round applicants saw their applications terminated without assessment. The data for this research project was collected from a period that immediately precedes the recent economic downturn, and will therefore be useful for later longitudinal studies.

This section will examine the results of comparing the "extent" and "nature" of ICD by UK and Australian biotechnology companies.

The sample of Australian ($n = 104$) and UK ($n = 52$) companies were delineated based on the level of firm leverage (total balance sheet liabilities divided by total assets). The mean leverage score across 104 Australian companies was 0.2187. A total of 71 companies were categorized as low leverage (i.e. their score was less than or equal to the mean) and 33 high (i.e. their score was more than the mean). The mean leverage score across 52 UK companies was 0.3092, 32 companies were categorized as low leverage and 20 as high. A *t*-test performed on company leverage of both countries, found that they were not significantly different.

Hypotheses 1

Independent samples *t*-test comparing low and high leveraged companies in Australia were used to test $H1A_0$. The results indicate that there is no significant difference in the "extent" (ICD index) of voluntary ICD between low and high leveraged firms (see Table I).

To compare the "nature" of disclosures ($H1B_0$), the mean ICD index measured for employee, customer, process, research and development and strategic statement dimensions were again compared by independent samples *t*-test. A significant difference in the mean of customer ICD (mean 12.4 percent customer ICD items

Index	Leverage	n	Mean (%)	SE mean
ICD index	Low	71	23.9	1.6
	High	33	27.1	2.4
ICD Emp	Low	71	17.8	1.8
	High	33	22.3	3.1
ICD Cust	Low	71	12.4*	1.8
	High	33	23.6*	3.2
ICD Proc	Low	71	18.3	2.5
	High	33	19.9	3.2
ICD R&D	Low	71	40.9	2.9
	High	33	34.1	4.4
ICD Strat	Low	71	26.0	2.2
	High	33	32.2	3.5

Note: Significance values $^{*}p \leq 0.001$

Table I.
Independent samples *t*-test of mean Australian biotechnology company voluntary ICD item disclosure between low and high leverage firms

disclosed for low leveraged Australian biotechnology firms compared to 23.6 percent customer ICD items disclosed for high leveraged Australian biotechnology firms (sig. 0.001; see Table I).

Similarly, the UK companies did not demonstrate any significant differences in the "extent" ($H1A_0$) of voluntary ICD between low and high leveraged firms (see Table II) and as such, $H1A$ for UK companies cannot be rejected. However, $H1B_0$ could be partially rejected. Although the UK companies did not demonstrate any significant difference in the mean customer ICD items disclosed as did the Australian companies, a significant difference was discovered in the mean level of research and development ICD (mean 42.2 percent research and development ICD disclosures for low leveraged

Index	Leverage	n	Mean (%)	SE mean
ICD index	Low	32	30.3	2.1
	High	20	30.7	2.9
ICD Emp	Low	32	33.2	3.6
	High	20	39.1	4.4
ICD Cust	Low	32	18.1	4.0
	High	20	20.0	2.9
ICD Proc	Low	32	23.2	4.1
	High	20	27.9	4.9
ICD R&D	Low	32	42.2*	2.4
	High	20	30.6*	3.2
ICD Strat	Low	32	29.1	2.6
	High	20	29.2	3.9

Note: Significance values $^{*}0.01 \leq p \leq 0.001$

Table II.
Independent samples *t*-test of mean UK biotechnology company voluntary ICD item disclosure between low and high leverage firms

UK biotechnology firms compared to 30.6 percent research and development ICD for high leveraged UK biotechnology firms (sig. 0.005; see Table II).

Hypothesis 2

The effect of country on voluntary ICD was investigated by an independent *t*-test of the mean percentage ICD index disclosures and its dimensions between Australian and UK biotechnology companies. In order to address the hypothesis, companies from each country were selected first based on whether they were high or low leverage; mean disclosure levels were then compared between low-leverage Australian and UK firms and then between high-leveraged firms. The results are presented in Tables III and IV below.

Index	Leverage	*n*	Mean (%)	SE mean
ICD index	Australia	71	23.9*	1.6
	UK	32	30.3*	2.1
ICD Emp	Australia	71	17.8**	1.8
	UK	32	33.2**	3.6
ICD Cust	Australia	71	12.4	1.8
	UK	32	18.1	4.0
ICD Proc	Australia	71	18.3	2.4
	UK	32	23.2	4.1
ICD R&D	Australia	71	40.8	2.9
	UK	32	42.2	2.4
ICD Strat	Australia	71	26.0	2.2
	UK	32	29.1	2.6

Note: Significance values *$0.01 \leq p \leq 0.001$; **$p \leq 0.001$

Table III.
Independent samples *t*-test of mean Australian and UK biotechnology company voluntary ICD item disclosure by low-leveraged firms

Index	Leverage	*n*	Mean (%)	SE mean
ICD index	Australia	33	27.1	2.4
	UK	20	30.7	2.9
ICD Emp	Australia	33	22.3*	3.0
	UK	20	39.1*	4.4
ICD Cust	Australia	33	23.6	3.2
	UK	20	20.0	2.9
ICD Proc	Australia	33	19.9	3.2
	UK	20	27.9	4.9
ICD R&D	Australia	33	34.1	4.4
	UK	20	30.6	3.2
ICD Strat	Australia	33	32.2	3.5
	UK	20	29.2	3.9

Note: Significance values *$0.01 \leq p \leq 0.001$

Table IV.
Independent samples *t*-test of mean Australian and UK biotechnology company voluntary ICD item disclosure by high-leveraged firms

A significant country effect was discovered in voluntary ICD between low leveraged biotechnology firms (i.e. $H2A_0$ can be rejected for the low leveraged firms). The total extent of voluntary ICD was significantly different between Australian and UK low leveraged firms as measured by the percentage ICD index. The results demonstrate that UK companies were disclosing more of all the items measured at 30.3 percent compared to Australian companies on average disclosing 23.9 percent. In high-leveraged firms, there was no significant difference between Australian and UK companies' ICD index although the trend appeared reversed in that some of the ICD dimensions were disclosed more by Australian companies (i.e. $H2A_0$ cannot be rejected for the high-leveraged sample).

H2B0 can also be rejected for the ICD employee index, i.e. the percentage disclosure of employee-related items, for both the low leveraged Australian and UK companies. The mean ICD Employee index was 33.2 percent for UK biotechnology firms but only half that amount (17.8 percent) in Australian biotechnology firms. For the high-leveraged firms, the ICD employee index for the Australian and UK companies were 22.3 percent and 39.1 percent, respectively.

Hypothesis 3

Regression analysis was performed to examine the effect of firm leverage, country and firm size on the extent and nature of voluntary ICD. In order to test this hypothesis, the following model was used:

$$\text{ICD Index}_j = \lambda_j + \beta 1 \text{ ln leverage} + \beta 2 \text{Country} + \beta 3 \text{ ln MarkCap} + \eta_j$$

Regression analysis of the three independent variables against the extent of ICD (ICDindex) demonstrated a highly significant country and size effect but no leverage effect (see Table V). As such, $H3A_0$ can be rejected.

To examine the nature of voluntary ICD, a regression was performed for each dimension of ICD against the three independent variables of leverage, country and size. For three of the five ICD dimensions (employee, processes and strategy), size and country were shown to have a significant and positive impact on the levels of disclosure. For example, ICD employee showed a strong positive relationship between size and country but not leverage (see Table VI). As such, $H3B_0$ can be rejected, as the nature of the disclosure is different between Australian and UK biotechnology companies.

Of the two remaining dimensions (customer and R&D) that did not show a similar determination, the model for ICD R&D index was not significant (see Table VII). In contrast, the ICD customer index showed that customer disclosures were significantly

Table V.
Results of regression of the relationship between firm leverage, country and firm size on ICD index

Variables	β	t-statistic	p
Constant	−1.165	−0.166	0.869
lnleverage	0.538	0.554	0.580
Country	9.716	4.222	0.000
lnMarkCap	2.674	4.370	0.000

Notes: $n = 149$; $R^2 = 0.177$; Adjusted $R^2 = 0.177$; $F = 10.478$; $p = 0.000$

positively associated with the level of firm leverage, but not for country and firm size (see Tables VIII-X).

5. Implications and conclusions

It is expected that the reduced disclosure index presented in the Appendix (Table AI) would be useful for future analysis of company annual report data. It is expected that simplification of the measured items would increase accuracy of data collected when the index is scored:

$H1B_0$. Leverage has no effect on the nature of ICD by UK or Australian firms.

Variables	β	t-statistic	p
Constant	−13.583	−1.441	0.152
lnleverage	1.399	1.076	0.284
Country	20.470	6.642	0.000
lnMarkCap	3.496	4.4266	0.000

Notes: $n = 149$; $R^2 = 0.282$; Adjusted $R^2 = 0.267$; $F = 19.127$; $p = 0.000$

Table VI. Results of regression of the relationship between firm leverage, country and firm size on ICD employee index

Variables	β	t-statistic	p
Constant	19.907	1.589	0.114
lnleverage	−4.304	−2.490	0.014
Country	3.403	0.831	0.408
lnMarkCap	0.987	0.906	0.366

Notes: $n = 149$; $R^2 = 0.042$; Adjusted $R^2 = 0.022$; $F = 2.138$; $p = 0.098$

Table VII. Results of OLS regression of the relationship between firm leverage, country and firm size on ICD R&D index

Variables	β	t-statistic	p
Constant	8.507	0.863	0.390
lnleverage	4.317	3.174	0.002
Country	4.464	1.385	0.168
lnMarkCap	1.638	1.911	0.058

Notes: $n = 149$; $R^2 = 0.114$; Adjusted $R^2 = 0.095$; $F = 6.236$; $p = 0.001$

Table VIII. Results of regression of the relationship between firm leverage, country and firm size on ICD customer index

Variables	β	t-statistic	p
Constant	−3.450	−0.289	0.773
lnleverage	1.072	0.650	0.516
Country	10.038	2.570	0.011
lnMarkCap	2.394	2.305	0.023

Notes: $n = 149$; $R^2 = 0.071$; Adjusted $R^2 = 0.051$; $F = 3.696$; $p = 0.013$

Table IX. Results of regression of the relationship between firm leverage, country and firm size on ICD processes index

The analysis which rejected $H1B_0$ demonstrated that customer ICD index of high and low leveraged Australian firms was significantly different. Customer ICD index disclosures were positively correlated with the level of firm leverage. This finding supports the proposition that high-leveraged firms wishing to satisfy the competing interests of existing and future debt-providers will adopt voluntary value-added IC disclosures related to their customers. The previous research of Li *et al.* (2008) identified that customer disclosures are often significantly correlated and this is attributed to the extent this information available to financial report preparers:

$H1A_0$. Leverage has no effect on the extent of ICD by UK or Australian firms.

UK companies did not demonstrate a similar positive correlation and $H1A$ could not be rejected for the UK sample. However, the nature of UK company disclosures allowed rejection of $H1B_0$ since R&D ICD index was significantly different between low and high-leveraged firms. In this case, the correlation was negative in that low leveraged firms reported 42.2 percent of R&D items, whereas high leveraged firms reported only 30.6 percent. This result could be attributed to low-leveraged firms trying to increase their ICD R&D disclosures in order to reduce their risk profile and information asymmetry with lenders:

$H2A_0$. Country has no effect on the extent of ICD by high or low-leveraged firms.

$H2B_0$. Country has no effect on the nature of ICD by high or low leveraged firms.

$H2$ tested the difference in the nature and extent of IC disclosures between low leveraged and high leveraged firms in Australia and the UK. In rejecting $H2A_0$, it was discovered that UK companies with low leverage were disclosing 30.6 percent of all ICD index items, whereas on average, Australian companies were only disclosing 23.9 percent. The extent of UK disclosures exceeding Australian disclosures could be due to the UK recessionary pressures upon low-leveraged firms seeking their first round of debt financing. In other words, these low leveraged firms may have been relying on their initial IPO reserves and now are investing in value-added voluntary reporting of intellectual capital items in their annual reports to improve the credentials in the market.

$H2B_0$ was also rejected. The ICD employee index showed the extent of disclosure was different between the low and high leveraged firms in both countries. It is interesting to note that UK firms disclosed more about the nature of employee intellectual capital disclosures for both high and low leveraged firms than did the Australian firms, while the remaining dimensions are not significantly different:

$H3A_0$. There is no relationship between leverage, size and country and the extent of ICD by firms.

Variables	β	t-statistic	p
Constant	−6.105	−0.621	0.536
lnleverage	1.046	0.771	0.442
Country	6.362	1.979	0.050
lnMarkCap	3.565	4.170	0.000

Notes: $n = 149$; $R^2 = 0.124$; Adjusted $R^2 = 0.106$; $F = 6.910$; $p = 0.000$

Table X.
Results of OLS regression of the relationship between firm leverage, country and firm size on ICD strategy index

H3B$_0$. There is no relationship between leverage, size and country and the nature of ICD by firms.

In conclusion, the final regression analysis shows that the extent of ICD Index disclosures have a significant relationship with country and size as expected. The size effect is expected as a proxy for political visibility, but has probably also resulted from the amount of resources that larger biotechnology firms can dedicate towards the preparation of voluntary intellectual capital disclosures. Verrecchia (1983) also proposes that voluntary disclosure is dependent on the costs associated with dissemination relative to company size. This proposition is known as the cost of disclosure argument. This theory suggests that voluntary disclosure is affected by company size, as larger companies have relatively lower information production costs (Meek *et al.*, 1995). For example, some of these companies may be applying the extended financial reporting programs outlined by stakeholder groups like the Global Reporting Initiative (GRI) in their G3 guidelines.

Voluntary ICD has been measured in the annual reports of 70 listed New Zealand companies (Whiting and Miller, 2008) and demonstrated that only "revaluing-firms" showed a significant positive relationship between levels of hidden value and voluntary ICD. Van der Zahn *et al.* (2007) used the ICD Index of Bukh *et al.* (2005), to which they had made minor modifications, to examine the relationship between ICD, long-run performance and under pricing in 228 Singapore IPOs. Outside of the capital markets context of the previous two studies, White *et al.* (2007) measured ICD in a sample of listed Australian biotechnology companies interpreting traditional agency theory drivers of ICD. In that study, regression analysis indicated that ICD were driven by board independence and firm leverage in a firm-size dependent fashion. Interestingly, the observed relationship between voluntary ICD and board independence and leverage was only significant in larger firms. This perhaps indicated that governance driven firm-value disclosures in smaller and younger firms may not be resolved by board composition.

Guthrie and Petty's (2000) and Guthrie *et al.*'s (2007) findings are consistent with the findings in this project, that high-leveraged Australian companies disclose more about of customer (relational) items. The disclosure of customers items is argued to be important for high-leveraged Australian biotech firms because they are usually subject to higher demands for information from creditors and shareholders than the low-leveraged ones (Camfferman and Cooke, 2002 cited in Bruggen *et al.*, 2009).

Given Striukova *et al.* (2008) and Bozzolan *et al.* (2006) findings discussed in the research question and hypothesis development section above, it was not surprising to find that R&D elements such as patents are a focus of biotechnology company ICD in the UK. Bosworth and Rogers (2001) and Lev and Sougiannis (1996) (both cited in Gracia-Meca and Martinez, 2007) confirm that R&D (i.e. R&D expenditures and patent activity) are positively related to firm's market value and subsequent stock return. It is argued that disclosing R&D is more significant for UK low leveraged companies for the following reasons. Eccles and Mavrinac (1995) found that most of high-tech companies' managers thought that their firms' shares were slightly too significantly undervalued. Having less reliance on debt-financing, low leveraged companies may try to release information that help ensure a fair and stable share price and thus a more favorable cost of capital. This may be done by intensifying and, thus, releasing

information regarding R&D because such disclosures (e.g. patent-related measures, R&D expenditure and investment) are found to have statistically positive association with market-to-book values of public companies (Deng *et al.*, 1999; Hirschey, 1998; Lev, 2001; Brynjolfsson and Yang, 1999). Managers might prefer to rely more on their retained profit to fund investment initially rather than use outside funds (Donaldson, 1961 cited in Beattie *et al.*, 2006). As investment in R&D is proven to increase current and future operating income (Aboody and Lev, 1998), low leverage companies may intensify the R&D activities (and thus the disclosure of the activities) to boost their profit.

UK biotech companies (both high and low leveraged companies) disclose a relatively high amount of employee-related ICD is in line with previous researchers' (Roslender and Fincham, 2004; Striukova *et al.*, 2008; Bozzolan *et al.*, 2006) findings and arguments. Therefore, it is not surprising that UK biotech companies disclose more information pertaining to the employee ICD than Australian companies. While, Striukova *et al.* (2008) found that 21.93 percent of their sample reported human employee capital and Bozzolan *et al.* (2006) also found that 15.37 percent their UK samples reported it, Guthrie *et al.* (2007) only found 10 percent of Australian sample reported this category).

These findings provide scope for reflection in an industry where the information gap between owners/investors and managers is purportedly very wide, and managers must be constantly vigilant and sensitive to the needs and demands of potential financiers.

References

Aboody, D. and Lev, B. (1998), "The value relevance of intangibles: the case of software capitalization", *Journal of Accounting Research*, Vol. 36, p. 161.

Aboody, D. and Lev, B. (2000), "Information asymmetry, R&D, and insider gains", *The Journal of Finance*, Vol. 55 No. 6, pp. 2747-66.

Beattie, V., Goodacre, A. and Thompson, S.J. (2006), "Corporate financing decision: UK survey evidence", *Journal of Business Finance & Accounting.*, Vol. 33 Nos 9/10, p. 140.

Boedker, C., Mouritsen, J. and Guthrie, J. (2008), "Enhanced business reporting: international trends and possible policy directions", *Journal of Human Resource Costing and Accounting*, Vol. 12 No. 1, p. 14.

Bosworth, D. and Rogers, M. (2001), "Market value, R&D, and intellectual property: an empirical analysis of large Australian firms", *The Economic Record*, Vol. 77 No. 239, p. 323.

Bozzolan, S., O'regan, P. and Ricceri, F. (2006), "Intellectual capital disclosure (ICD): a comparison of Italy and the UK", *Journal of Human Resource Costing & Accounting*, Vol. 10 No. 2, p. 92.

Bradbury, M.E. (1992), "Voluntary disclosure of financial segment data: New Zealand evidence", *Accounting and Finance*, Vol. 32 No. 1, p. 15.

Brennan, N. (2008), "UK reporting of intellectual capital", *Accounting and Business Research*, Vol. 38 No. 1, p. 96.

Bruggen, A., Vergauwen, P. and Dao, M. (2009), "Determinants of intellectual capital disclosure: evidence from Australia", *Management Decision*, Vol. 47 No. 2, p. 233.

Brynjolfsson, E. and Yang, S. (1999), "The intangible cost and benefits of computer investment: evidence from financial markets", MIT working paper, Cambridge, MA.

Bukh, P.N. and Jensen, I.K. (2008), "Intellectual capital statements in the Danish utility sector: materialization and enactment", *Journal of Human Resource Costing and Accounting*, Vol. 12 No. 3, p. 148.

Bukh, P.N., Nielsen, C., Gormsen, P. and Mouritsen, J. (2005), "Disclosure of information on intellectual capital in Danish IPO prospectuses", *Accounting, Auditing and Accountability Journal*, Vol. 18 No. 6, p. 713.

Camfferman, K. and Cooke, T.E. (2002), "An analysis of disclosure in the annual report of UK and Dutch companies", *Journal of International Accounting Research*, Vol. 1, p. 3.

Chow, C.W. and Wong-Boren, A. (1987), "Voluntary financial disclosures by Mexican corporations", *The Accounting Review*, Vol. 62 No. 3, p. 533.

Chua, W.F. (2005), "Extended performance reporting: an overview of techniques", The Insitute of Chartered Accountants in Australia, available at: www.charteredaccountants.com.au/files/documents/EPR_an_overview_of_techniques.pdf (accessed 1 September, 2006).

Deng, Z., Lev, B. and Narin, F. (1999), "Science and technology as predictors of stock performance", *Financial Analyst Journal*, Vol. 20, p. 20.

Dhaliwal, D.S., Salamon, G.L. and Smith, E.D. (1982), "The effect of owner versus management control on the choice of accounting methods", *Journal of Accounting and Economics*, Vol. 4 No. 1, p. 41.

Eccles, R.G. and Mavrinac, S. (1995), "Improving the corporate disclosure process", *Sloan Management Review*, Vol. 36, p. 11.

Firth, M. (1979), "The impact of size, stock market listing, and auditors on voluntary disclosure in corporate annual reports", *Accounting and Business Research*, Vol. 9, Autumn, p. 273.

García-Meca, E. and Martínez, I. (2007), "The use of intellectual capital information in investment decisions: an empirical study using analyst reports", *The International Journal of Accounting*, Vol. 42 No. 1, p. 57.

Guo, R-J., Lev, B. and Zhou, N. (2004), "Competitive costs of disclosure by biotech IPOs", *Journal of Accounting Research*, Vol. 42 No. 2, p. 319.

Guthrie, J. and Petty, R. (2000), "Intellectual Capital: Australian annual reporting practices", *Journal of Intellectual Capital*, Vol. 1 No. 3, p. 241.

Guthrie, J., Petty, R. and Ricceri, F. (2006), "The voluntary reporting of intellectual capital: comparing evidence from Hong Kong and Australia", *Journal of Intellectual Capital*, Vol. 7 No. 2, p. 254.

Guthrie, J., Petty, R. and Ricceri, F. (2007), "Intellectual capital reporting: lesson from Hong Kong and Australia", research report, The Institute of Chartered Accountants of Scotland, Edinburgh.

Hail, L. (2002), "The impact of voluntary corporate disclosures on the ex-ante cost of capital for Swiss firms", *European Accounting Review*, Vol. 11 No. 4, p. 741.

Hirschey, M. (1998), "How much is a tulip worth?", *Financial Analyst Journal*, Vol. 54 No. 4.

Hribar, P. (2004), "Discussion of competitive costs of disclosure by biotech IPOs", *Journal of Accounting Research*, Vol. 42 No. 2, p. 357.

Jensen, M.C. and Meckling, W.H. (1976), "Theory of the firm: managerial behaviour, agency costs and ownership structure", *Journal of Financial Economics*, October, p. 305.

Kristandl, G. and Bontis, N. (2007), "The impact of voluntary disclosures on cost of equity capital estimates in a temporal setting", *Journal of Intellectual Capital*, Vol. 8 No. 4, p. 577.

Lev, B. (2001), *Intangibles: Management, Measurement, and Reporting*, The Brookings Institution, Washington, DC.

Lev, B. and Sougiannis, T. (1996), "The capitalization, amortization, and value-relevance of R&D", *Journal of Accounting and Economics*, Vol. 21 No. 2, p. 107.

Li, J., Pike, R. and Haniffa, R. (2008), "Intellectual capital disclosures and corporate governance structures in UK firms", *Accounting and Business Research*, Vol. 38 No. 2, p. 137.

Nielsen, C., Bukh, P.N., Mouritsen, J., Rosenkrands, M. and Johansen, P.G. (2006), "Intellectual capital statements on their way to the stock exchange: analyzing new reporting systems", *Journal of Intellectual Capital*, Vol. 7 No. 2, p. 221.

Marr, B., Gray, D. and Neely, A. (2003), "Why do firms measure their intellectual capital?", *Journal of Intellectual Capital*, Vol. 4 No. 4, p. 441.

Marston, C.L. and Shrives, P.J. (1991), "The use of disclosure indices in accounting research: a review article", *British Accounting Review*, Vol. 23, p. 195.

Meek, G.K., Roberts, C.B. and Gray, S.J. (1995), "Factors influencing voluntary annual report disclosures by US, UK and continental European multinational corporations", *Journal of International Business Studies*, Vol. 26, pp. 555-72.

Mouritsen, J. (2004), "Measuring and intervening: how do we theorise intellectual capital management", *Journal of Intellectual Capital*, Vol. 5 No. 2, p. 257.

Mouritsen, J. and Larsen, H.T. (2005), "The 2nd wave of knowledge management: the management control of knowledge resources through intellectual capital information", *Management Accounting Research*, Vol. 16 No. 3, p. 371.

Mouritsen, J., Thorbjørnsen, S., Bukh, P.N. and Johansen, M.R. (2005), "Intelletual capital and the discourses of love and entrepreneurship in new public management", *Financial Accountability and Management*, Vol. 21 No. 3, p. 279.

Robb, S.W.G., Single, L.E. and Zarzeski, M.T. (2001), "Non-financial disclosures across Anglo-American countries", *Journal of International Accounting, Auditing and Taxation.*, Vol. 10, p. 71.

Roslender, R. and Fincham, R. (2004), "Intellectual capital accounting in the UK: a field study perspective", *Accounting, Auditing and Accountability Journal*, Vol. 17 No. 2, p. 178.

Sengupta, P. (1998), "Corporate disclosure quality and the cost of debt", *The Accounting Review*, Vol. 73 No. 4, p. 459.

Singh, I. and Van der Zahn, J-L.W.M. (2007), "Does intellectual capital disclosure reduce an IPO's cost of capital: the case of underpricing", *Journal of Intellectual Capital*, Vol. 8 No. 3, p. 494.

Singh, I. and Van der Zahn, J-L.W.M. (2008), "Determinants of intellectual capital disclosure in prospectuses of initial public offerings", *Accounting and Business Research*, Vol. 38 No. 5, p. 409.

Striukova, L., Unerman, J. and Guthrie, J. (2008), "Corporate reporting of intellectual capital: evidence from UK companies", *The British Accounting Review*, Vol. 40, p. 297.

Unerman, J., Guthrie, J. and Striukova, L. (2007), *UK Reporting of Intellectual Capital*, Centre for Business Performance, The Institute of Chartered Accountants in England and Wales, London.

Van der Zahn, M.J-L.W., Singh, I. and Heniro, J. (2007), "Is there an association between intellectual capital disclosures, under-pricing and long-run performance", *Journal of Human Resource Costing and Accounting*, Vol. 11 No. 3, p. 178.

Vergauwen, P.G.M.C. and van Alem, F.J. (2005), "Annual report IC disclosures in The Netherlands", *France and Germany, Journal of Intellectual Capital*, Vol. 6 No. 1, p. 89.

Verrecchia, R. (1983), "Discretionary disclosure", *Journal of Accounting and Economics*, Vol. 5, pp. 179-94.

Watts, R.L. and Zimmerman, J.L. (1986), *Positive Accounting Theory*, Prentice Hall, Englewood Cliffs, NJ.

White, G., Lee, A. and Tower, G. (2007), "Drivers of voluntary intellectual capital disclosure in listed biotechnology companies", *Journal of Intellectual Capital*, Vol. 8 No. 3, p. 517.

Whiting, R.H. and Miller, J.C. (2008), "Voluntary disclosures of intellectual capital in New Zealand annual reports and the 'hidden value'", *Journal of Human Resource Costing and Accounting*, Vol. 12 No. 1, p. 26.

Wyatt, A. (2008), "What financial and non-financial information on intangibles is value relevant? A review of the evidence", *Accounting and Business Research*, Vol. 38, pp. 217-56.

Further reading

Abeysekera, I. (2006), "The project of intellectual capital disclosure: researching the research", *Journal of Intellectual Capital*, Vol. 7 No. 1, p. 61.

ASX (2009), *Code of Best Practice for Reporting by Life Science Companies*, available at: www.asx.com.au/products/pdf/biotech_best_practice.pdf (accessed 4 August 2009).

Ax, C. and Marton, J. (2008), "Human capital disclosures and management practices", *Journal of Intellectual Capital.*, Vol. 9 No. 3, p. 433.

Fincham, R. and Roslender, R. (2003), "Intellectual capital accounting as management fashion: a review and critique", *European Accounting Review*, Vol. 12 No. 4, p. 781.

Kamath, B. (2008), "Intellectual capital disclosure in India: content analysis of 'TecK' firms", *Journal of Human Resource Costing and Accounting*, Vol. 12 No. 3, p. 213.

Marr, B. and Chatzkel, J. (2004), "Intellectual capital at the crossroads: managing, measuring, and reporting of IC", *Journal of Intellectual Capital*, Vol. 5 No. 2, p. 224.

Oliveras, E., Gowthorpe, C., Kasperskaya, Y. and Perramon, J. (2008), "Reporting intellectual capital in Spain", *Corporate Communications*, Vol. 13 No. 2, p. 168.

Vergauwen, P., Bollen, L. and Oirbans, E. (2007), "Intelletual capital disclosure and intangible value drivers: an empirical study", *Management Decision*, Vol. 45 No. 7, p. 1163.

Appendix

Table AI.
Measurement items retained for each dimension of voluntary ICD after discarding items either not disclosed or rarely disclosed (only one company in the sample disclosed) in 156 individual annual reports

Employees (originally 27 items)
E5 Employee breakdown by department
E6 Employee breakdown by job function
E9 Comments on changes in the number of employees
E10 Comment on employee health and safety
E14 Description of competency development programs and activities
E17 Employee expenses by number of employees
E18 Recruitment policies of the firm
E19 Separate indication firm has a HRM department, division or function
E22 Remuneration and incentive systems
E23 Pensions
E24 Insurance policies
Customers (originally 14 items)
C2 Sales breakdown by customer
C3 Annual sales per segment or product
C5 Dependence on key customers
C7 Description of customer relations
C12 Rel. mkt share (not expressed as percentage) of the firm
Processes (originally 8 items)
P1 Information and communication within the company
P2 Efforts related to the working environment.
P4 Internal sharing of knowledge and information
P5 External sharing of knowledge and information
P6 Measure of internal or external processing failures
P7 Discussion of fringe benefits and company social programs
P8 Environmental approvals and statements/policies
Research and Development (R&D) (originally 9 items)
RD1 Statements of policy, strategy and/or objectives of R&D activities
RD2 R&D expenses
RD4 R&D invested into basic research
RD5 R&D invested into product design and development
RD6 Details of future prospects regarding R&D
RD7 Details of existing company patents
RD8 Number of patents and licenses etc.
RD9 Information on pending patents
Strategic statement (originally 15 items)
SS1 Description of new production technology
SS3 Information about strategic alliances of the firm
SS4 Objectives and reason for strategic alliances
SS5 Comments on the effects of the strategic alliances
SS6 Description of the network of suppliers and distributors
SS7 Statements of image and brand
SS8 Corporate culture statements
SS9 Statements about best practises
SS10 Organisational structure of the firm
SS11 Utilization of energy, raw materials and other input goods
SS12 Investment in the environment
SS13 Description of community involvement
SS14 Information on corporate social responsibility and objective
SS15 Description of employee contracts/contractual issues

Corresponding author
Gregory White can be contacted at: greg.white@cbs.curtin.edu.au