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# Investment in Employees and Research and Development and the Signalling of Intellectual Capital by UK Listed Companies

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**Abstract**

This paper examines the cross-sectional effect of investment in employees and investment in research and development on the extent of voluntary disclosure of intellectual capital of 443 FTSE All Share Index companies for the year 2003/2004. The extent of disclosure is measured by a disclosure index based on intellectual capital attributes included in the narratives and illustrations of the annual reports. The paper predicts that agency costs may be minimised through voluntary disclosure. In addition, that in some industries, the benefits of signalling valuable, rare, inimitable and non-substitutable attributes may outweigh the competitive costs of reporting this information. The results suggest that large companies operating in non-manufacturing, high-tech and innovative industries that are characterised by investment in employees and research and development processes have higher levels of hidden value; these companies are associated with the signalling of intellectual capital.

**Keywords:** disclosure; intellectual capital, employees, research and development, industry, investment, listed companies

## 1. Introduction

### *1.1 Background*

There appears to be a broad acceptance that intellectual capital (IC) resources applied to generate innovativeness in products and services through investment in employees and research and development are the key drivers of sustained competitive advantage and market value (Chen, Cheng, & Hwang, 2005; Drucker, 1993; Grant, 1996). The process of investment, development and signalling of IC and the realisation of sustained superior returns and share price value as a result, is a lengthy and risky one (Kothari, Laguess, & Leone, 1998). Not all investment in employees generates motivation, innovativeness and efficient productivity; neither is all investment in research and development (R&D) effective in generating successful products, services, brands, licenses, patents (Lev, 2001), customer loyalty, customer retention, market share and market value. In some cases, investments may not be well planned nor well managed (Meremadi, Musso, & Oxgaard, 2013), and in other cases innovative ideas may not be commercially viable.

It appears equity markets are unable to bridge this gap of uncertainty until products and services generate revenue as illustrated by Joos (2002) within the biotechnology industry. The signalling of IC attempts to mitigate this risk of uncertainty by providing information on the investment and return in IC. Financial decisions made by stakeholders require an assessment of the value of organisational IC. Entwistle (1999) examined the R&D disclosure environment of 113 technology firms listed on the Toronto Stock Exchange in 1994 and found that managers consider both capital and product market concerns in their R&D disclosure decisions. Incentives exist therefore for companies to develop those characteristics that set themselves apart from their competitors and to signal their competitiveness. Signalling mechanisms improve the allocation of resources ensuring that companies that are more efficient receive more capital as signalling reveals the company's competitive advantage within the market (Inchausti, 1997).

### *1.2 The Demand for Information on Intellectual Capital*

However, voluntary disclosure of IC is hampered by competitive costs which arise with a lack of value, a lack of rareness, perfectly imitable and an ease of substitution (VRIN) of the IC (Barney, 1991). However, insufficient

IC information may be problematic with respect to the market's identification, analysis, valuation and therefore differentiation of superior and inferior market participants. The onus is therefore on companies to make this information available. Furthermore, IC reporting is limited due to the traditional financial reporting framework not effectively accounting for all intangible assets (IA). Compounding the issue as reported by Lev and Zarowin (1999), book values in financial statements are largely unrepresentative of equity (Amir & Lev, 1996). Moreover, voluntary disclosure as a framework for conveying information may be limited by other factors not specific to IC; agency and political costs are issues influencing management decisions on voluntary disclosure. In addition, the inherent nature of IC makes its title, identification, measurement and reporting complex. Intangible assets are more associated with this complexity than other types of assets such as physical and financial assets, due to the high uncertainty in their value, ill-defined legal and ownership rights (Webster, 1999) and the lack of active markets to provide reliable value estimates (Lev, 2001).

Faced with this dilemma, it seems likely that companies would resort to alternative means of communicating their IC levels particularly as the traditional reporting model neither sufficiently conveys IA nor meets the public's demand for information. The alternative means is found within the traditional reporting framework, the annual report, and takes the form of words, sentences, pictures and diagrams and has been gaining importance as a means of communicating IC. Whereas the traditional reporting model places focus on quantitative audited financial statements; this alternative approach however, examines qualitative, narrative and non-narrative disclosures. There has been a steady shift by investors and analysts towards analysing qualitative disclosures in particular for companies whose value remains hidden from the market.

In response to these demands for information, companies implement policies that identify and report IC generated by the organisation. These policies maintain and disclose important sources of IC including research and development (R&D), sources of innovation and skilled employees. Companies recognise the importance of and economic benefits to be derived from a well-managed disclosure policy (Williams, 2001). As this IC is not visible, the existence of adequate structures for investing in, developing and signalling may be invaluable. Furthermore, this process is likely to be influenced by IC investment, resource availability, market share and its industry membership. Disclosing information on such categories of IC as structural capital (SC), relational or customer capital (RC) and human or employee capital (HC) is likely to reduce uncertainty about future prospects of a company and to facilitate a more precise valuation of the company (Botosan, 1997).

*1.3 Analytical Framework and Literature Review*

The literature has identified five motivational factors as driving management's disclosure decisions and five factors that may constrain disclosure (Graham, Harvey, & Rajgopal, 2005). The first is explained by Diamond and Verrecchia (1991), who suggest that voluntary disclosure reduces information asymmetry between uninformed and informed investors. The second factor relates to the availability of information to analysts; Lang and Lundholm (1996) argue that not all management information is revealed and therefore analysts may invest in information collection costs. The third motivational factor examines management performance. Healey and Palepu (2001) suggest that the risk of replacement due to poor share price performance encourages management to apply disclosure in reducing the likelihood of undervaluation and the need to explain poor performance. Moreover, Trueman (1986) argues that when management performance is above average, management may have an incentive to signal this performance. The fifth motivational factor emanates from the limitations imposed by mandatory disclosures that ignore non-financial indicators of future earnings (Graham et al., 2005). Management may therefore be motivated to disclose that which has been omitted by mandatory disclosure.

On the other hand, management may be restricted in their voluntary disclosure policy. The first constraint relates to setting a precedent that management may not be able to maintain in the future. Verrecchia (2001) refers to this constraint as the commitment cost of increasing voluntary disclosure. The second constraint relates to the threat of litigation that may induce management not to disclose IC (Skinner, 1997) and that can potentially reduce management's incentives to provide forward-looking information which if materially misstated may result in litigation costs. The third constraint explains why management do not provide full disclosure as it is understood that some disclosures may jeopardise the company's competitive position in the product market (Verrecchia, 2001). This limitation is therefore associated with proprietary costs. The fourth constraint is associated with agency costs and asymmetric information that may result in reduced disclosure as management attempt to perpetuate and entrench their positions (Berle & Means, 1934). Finally, the fifth constraint is motivated by management's need to reduce political costs. Watts and Zimmerman (1978 and 1986) suggest that political costs reduce voluntary disclosure as management shy away from undue attention from regulators.

With respect to the theoretical approach to IC disclosure, the paper refers to Abeysekera (2006) who outlines the development of a theoretical framework underlying IC disclosure. Theories that have been considered include legitimacy and stakeholder (Guthrie, Petty, Yongvanich, & Ricceri, 2004; Abeysekera & Guthrie, 2005), signalling (Penrose, 1959; Wernerfelt, 1984; Bozzolan, Favotto, & Ricceri, 2003; Garcia & Martinez, 2005), resource based view of the firm (RBV) (Barney, 2001), agency (Bozzolan et al., 2003; Garcia & Martinez, 2005) and information asymmetry (Amir & Lev, 1996). Although the IC literature illustrates the application of various theoretical approaches, the general disclosure literature has overall indicated a close association with agency and signalling theories. The number of different theoretical approaches in prior studies is indicative that a theoretical framework of IC investment and reporting has not been established. It is expected nevertheless that various conflicting forces influence management who are contractual bound as agents of the company but who may not necessarily behave as such at all times. This paper proposes that companies' pursuit of a maximum disclosure policy may be explained by the RBV and signalling theory. A minimal or no disclosure policy may be explained by industry membership and or proprietary cost theory as certain firms may be tangible asset intensive due to the nature of their operations and may not possess any IC. Where mitigating factors exist however, a partial disclosure outcome may result from limited success in investments in R&D and employees, limited possession of IC, a lack of comparative advantage in the IC developed, a highly competitive industry in which proprietary costs are prohibitive (Wagenhofer, 1990), lower industry barriers consisting of low R&D investment requirements, low barriers to entry for incumbent firms and barriers that increase the perceived potential disclosure costs for existing firms within the industry. This paper adopts a positivist approach by developing several hypotheses based on selected theories to explain observed management behaviour.

The model for this paper is based on the premises of positive accounting theory (Watts & Zimmerman, 1978; 1986). The theory utilises economics, in particular agency theory (Jensen & Meckling, 1976) to explain and predict observed behaviour. Explanations of accounting behaviour are important, as any changes of accounting practice depend on existing political and economic forces (Gould, 1977). The first theoretical approach proposed by this paper is agency theory that may explain management behaviour when objectives are not aligned with those of shareholders (Barako, Hancock, & Izan, 2006; Berle & Means, 1934; Cheney & Carroll, 1997; Jensen & Meckling, 1976). The second theoretical approach is signalling theory (Spence, 1973; Akerlof, 1970) in which management need to decide on whether the voluntary IC attributes are associated with disclosure costs that take the form of proprietary costs (Dye, 1985; Gray, Meek, & Roberts, 1995; Verrecchia, 1983). The existence of proprietary costs generally leads to minimal or no disclosure however, the existence of mitigating circumstances such as barriers to entry may lead to partial disclosure of IC attributes. These barriers to entry may render otherwise costly disclosures, less costly resulting in partial disclosure depending on management's ability to accurately quantify related benefits and costs. Nevertheless, the lack of mitigating factors renders disclosure costly and may lead to little or no disclosure that may be explained by competitive costs hypothesis and proprietary cost hypothesis.

This paper introduces an additional dimension which has had very little attention in previous studies; how is the decision on voluntary disclosure of IC (VDIC) influenced by the investment in employees and R&D. Prior investigations have examined either R&D expenditure (Kothari et al., 2002; Amir & Lev, 1996) or employee costs; few studies have examined both investments simultaneously. The survey results in the study by Awano, Franklin, Haskel, & Kastrinaki, (2010) suggest that 42 per cent of UK firms are not active in R&D but are active in one or more other category of intangible spending which includes reputation and branding, software, training, design and business process improvement (Awano et al., 2010). This finding provides evidence suggesting that press releases provide information that is not captured by R&D expenditures reported in financial statements. This study therefore considers both investments in employees and in R&D for the following reasons. On the one hand, a relationship exists between R&D and employee costs as illustrated by Clinch (1991) in which high R&D firms may have higher total compensation contracts in order to retain employees that may be in possession of firm private information in the form of trade secrets. On the other hand, the quality of employees is likely to influence the quality of the R&D, its development and its commercialisation. As such, higher total compensation is likely to attract the required skill that would further the investment in R&D and in employees. Thus, high R&D firms appear to tie compensation awards more closely to stock- and accounting-based performance measures than do low R&D firms (Clinch, 1991).

The analytical framework proposed by this research argues that such investments are geared at generating sustained competitive advantage. If management delay informing markets about the possession of IC and the expected returns (Hunter, Webster, & Wyatt, 2012), mis-pricing may take place in equity markets which may only be rectified once markets become aware of actual earnings attributable to the possession of IC and/or the

reduction in marginal costs of production. The economic decision to invest in intangible inputs must necessarily be based on the economic returns or outputs of the investment; furthermore, the economic returns from a timely voluntary disclosure policy must be accounted for as R&D expenditure and employee costs do not convey the IA value generated by these investments. This approach is consistent with that adopted by Weissa, Falkb, & Zion, (2013) who provide evidence that suggests voluntary press releases provide non-financial information that is not captured by R&D expenditures reported in financial statements. Gelb (2002) undertook a similar study on two high technology industries, in which supplemental voluntary disclosures in (1) annual report (2) quarterly reports and other voluntary publications and (3) investor relations programs, were investigated to determine whether firms with significant levels of intangible assets choose the more flexible voluntary supplemental disclosures ahead of the traditional annual report. The findings indicated an increase in supplemental voluntary disclosures as a result of a higher incidence of investment in R&D and advertising expenditure. These supplementary voluntary disclosures make take the form of patents filed, clinical trial results, analyst reports, press releases, conference calls, company announcements, conference abstracts and medical and scientific journal articles, that are alternative information sources on innovative processes within the pharmaceutical industry (Joos, 2002). The existence of alternative sources of information will vary from industry to industry due to industry stage of development as well as differences in lead times of the process of generating R&D over time (Ball, 1980). What therefore is the information content held in reported employee and R&D expenditure considering the existence of other communication channels and the existence of industry variation? In their study, Lev and Zarowin (1999) illustrated that increased investment in R&D and advertising has contributed to the reduced quality of accounting disclosures due to the traditional reporting framework's inability to convey the value of these investments. As a result, it is likely that greater information asymmetry exists between R&D intensive firms and their investors (Aboody & Lev, 2000). Annual and quarterly reports only provide a small fraction of information on R&D (Joos, 2002). Few mandatory R&D disclosure requirements exist, and accounting standards require the immediate expensing of most R&D activities, which likely understates their long-run value (Lev, 2001).

*1.4 Hypotheses and Research Design*

In order to link the decision to invest in employees and in R&D and the decision for voluntary disclosure, reference is made to the literature on investment in R&D and in employees. On the one hand, Schumpeter's (1950) hypothesis and those of the neo-Shumpeterians refer to market power and economies of scale respectively as necessary elements for investment in innovation to take place. These hypotheses may be influenced by whether the industry’s development is in the innovation, imitation, technological competition or standardisation stage. On the other hand, Hamburg (1963) contends that the laboratories of large firms have not been an important source of major inventions and that their investments in R&D are relatively safe and aimed at modest advances in technology. In addition, Mueller and Tilton (1969) concluded in their study that large firms may not have an advantage over small firms in the imitation stage of R&D. In this stage barriers to entry are relatively low. Nevertheless, during the technological competition stage, economies of scale are able to accelerate the process of product innovation but taper off as the industry's technology becomes standardised (Mueller & Tilton, 1969). Size and industry appear to be determinants of the extent of investment in employees and in R&D. In addition, size and industry have been confirmed as determinants in the process of VDIC. The study's proxy for economies of scale and for market power is market value (MV) which was applied as a determinant in disclosure studies by Hossain, Tan, & Adams, (1994) and Lang and Lundholm (1993). Signalling theory explains the competitive resources available to larger companies in providing VDIC. The perceived benefits of signalling IC are expected to outweigh the potential disclosure costs arising from political and proprietary costs and a significant positive association is expected.

High investment in employee remuneration and benefits may result in management signalling HC attributes to disclose investment in employees that differentiates it from its competitors. The motivation for the variation in VDIC due to the variation in employee cost (EMPC) may be explained by signalling theory. EMPC captures the degree to which management is efficient in hiring the optimal number of employees under the assumptions of competitive labour and product markets and in extracting value from investment in HC. Human resource management is therefore a crucial feature of research and development (R&D) management. Chen and Huang (2009) find evidence that knowledge management capacity plays a mediating role between strategic human resource practices and innovation performance. High remuneration may provide the company with a competitive edge in attracting quality employees and retaining existing ones, signalling of HC attributes may ensue as management disclose successful management practice. Furthermore, Sofian, Tayles, & Pike, (2005) reiterate the importance of investment in employees adding that such investment is associated with management accounting practices, organisational culture and corporate performance. However, despite the benefits to be gained from

disclosure of these investments, pressure from competitors, may curb full disclosure due to the mobility of employees in some industries. Furthermore, political costs may restrict such voluntary disclosures due to the risk of pressure from labour unions and other regulatory bodies. Where management voluntarily disclose, companies can differentiate themselves from their peers within their industry through the signalling of high-quality HC (Akerlof, 1970). An expectation to see companies with a higher investment in human resources voluntarily disclosing more HC exists. This paper expects that higher EMPC as measured by staff costs including all employee benefits such as health insurance and pension plan contributions divided by the number of employees representing both full and part time employees of the company may lead to more VDIC. The arguments are derived from RBV and signalling theory and the propensity of companies to disclose their competitive advantage. These motivations are expected to outweigh any competitive pressures and labour related proprietary costs that are associated with such disclosures.

The expectation is a positive association between R&D development expenditure (R&D) and VDIC. High R&D companies are likely to be characterised by high levels of VDIC due to asymmetric information on IA. This independent variable identifies whether R&D necessarily leads to VDIC. R&D is also highly firm-specific and is associated with higher information asymmetry and uncertainty (Aboody & Lev, 2000; Kothari et al., 2002). Although R&D is associated with IA generation, patents and copyrights protection may take lengthy processes before successful registration. R&D may signal success to the market, as investment in IC is made possible by surplus earnings. Lev and Sougiannis (1996) developed a model relating companies' earnings (output) to their investment inputs, including expenditures on R&D. The authors reported that the average duration of R&D benefits varies across industries from five to nine years and the estimated benefits of these R&D programs vary from $1.66 to $2.63 per dollar of R&D spending. Gray et al., (1995) confirmed a positive significant relationship with the voluntary disclosure of 64 UK and 116 USA companies and R&D information. R&D is defined as all direct and indirect costs related to the creation and development of new processes, techniques, applications and products with commercial possibilities. As R&D has been found to increase IA and growth prospects, the paper expects an increase in VDIC associated with new venturing activities/projects. Greater R&D spending translates into lower expected marginal costs. Hughes and Kao (1991), describe a two stage game in which, in one disclosure regime, only the level of R&D investment is publicly reported and in the other regime, both the level of R&D investment and the actual marginal cost benefit which results, are reported. The former regime can be viewed as analogous to immediate write-off and the latter can be viewed as a stylised extension of selective capitalisation. This study considers narrative disclosures as informative with regard to the actual marginal cost reduction attributed to the reported investment in R&D. Management in R&D intensive companies may provide more VDIC as a measure of signalling potential and successful projects. Nevertheless, as indicated by Williams (2001, p. 201), where IC performance is too high the amount of disclosure may be reduced, suggesting that companies reduce VDIC when performance reaches a threshold level for fear of competitive losses. However, competitive costs may be exceeded by potential benefits of signalling when proprietary costs may be mitigated by barriers to entry. These barriers may be due to the complexity of IC and the requirement for additional financial resources, technical expertise and regulatory barriers.

The understanding is that innovative and technological intense companies firstly, may apply more IC in their operations and secondly, may disclose such IC in their annual reports. Such high IC in technological, innovative and R&D intense companies may be represented in a listing on a technological index (TechMARK). The first industry classification is therefore represented by the LSE TMRK that is the LSE international market for innovative technology companies and includes computer hardware, computer servicing, internet, semi-conductors, software, telecom equipment, biotechnology, specialist pharmaceuticals, drug delivery and medical technology. Following Bozzolan et al. (2003), the expectation is of a positive significant association. Listing on this exchange may be justified through signalling theory as firms promote their R&D and technological developments. The second industry classification is supported by Camfferman and Cooke (2002), Cooke (1991) and Ho and Wong (2001) who report a significant association between disclosure and manufacturing and non-manufacturing. Industries are classified into manufacturing, high value tangible assets, low profile; and into non-manufacturing, low value tangible assets, service, high tech and high profile industries. The approach in this investigation is that manufacturing companies are less likely to have higher levels of VDIC as non-manufacturing companies that are expected to utilise more IC than tangible assets in their operations. The motivations are derived from the RBV of the firm and signalling theory; non-manufacturing companies are expected to apply unique and non-replicable IA and IC in their operations. These companies disclose IC attributes due to the existence of hidden value and the lack of disclosure costs, consistent with disclosures in sectors of high entry barriers.

## 2. Method

### *2.1 Firm Characteristics and Sampling Procedures*

Companies were selected from the FTSE All Share Index for the year 2003/2004 in the Financial Times with the exclusion of companies in the banks, financial, insurance, life assurance, mining, oil and gas, real estate, speciality and other finance and investment and property industries. A content analysis of the entire annual reports of a sample of listed companies was conducted by adapting the methodologies of Guthrie et al., (1999), Bozzolan et al., (2003) and Milne and Adler (1999). This involves codifying IC attributes into SC, RC and HC in order to derive patterns in the presentation and reporting of IC (Guthrie & Petty, 2000, p. 244). The intellectual capital framework (ICF) adopted by this paper encompasses twenty-three IC attributes grouped into the three IC categories of SC, RC and HC as summarised in Table 1. This paper proposes its operational definition of voluntary disclosure of an IC attribute as: 'Any IC information, financial or non-financial, illustrations, diagrams and graphical presentation contained in the annual reports that is not required to be disclosed by the Companies Act 1989, International Accounting Standards, EC Directives (Fourth and Seventh), Statement of Standard Accounting Practice, FRS (7, 10 and 11) and the disclosure rules issued by the LSE.

### *2.2 Disclosure Index and Research Design*

A recording unit that captures all manner of IC attribute disclosure including phrases, sentences, groups of words, pictures, diagrams and graphs may be more appropriate, as individual words are deemed insufficient to meet the requirements of an IC attribute (Davison & Skerratt, 2007), sentences may contain more than one IC attribute and both words and sentences ignore non-narratives. As such with respect to narrative disclosures, consistent with the approach applied by Beattie et al., (2004, p. 32), this paper splits sentences into text units with each group of words able to meaningfully convey independently, a single IC attribute. With respect to non-narrative disclosures, consistent with the suggestions of Davison and Skerratt (2007, p. 9) and Unerman (2000), the use of narratives alone will capture only partial disclosures. This paper therefore includes other visual forms of communication that have been found to provide an immediate and effective means of corporate disclosure (Beattie & Jones, 2001; Beattie & Thompson, 2006). Davison and Skerratt (2007) provide evidence that within the top 100 UK companies, 94% of pictures communicated intangible aspects of companies businesses.

Table 1. Intellectual capital framework

| Internal Structural Capital (SC) | External Relational Capital (RC) | Human Capital (HC) |
|---|---|---|
| Patents | Brands | Know-how |
| Copyrights | Customers | Education |
| Trademarks | Customer loyalty | Vocational qualifications |
| Management philosophy | Distribution channels | Work-related knowledge |
| Corporate culture | Business collaborations | Work-related competencies |
| Management processes | Licensing agreements | Entrepreneurial spirit, |
| Information systems | Favourable contracts | Innovativeness, proactive and reactive abilities, changeability |
| Networking systems | Franchising agreements | |
| Financial relations | | |

Source: Adapted from Brooking (1996), Ch'ang and Yastreboff (2003, p170), Guthrie (2001, p35), Abeysekera (2001), IFAC (1998), the Australian Society of CPAs and the Society of Management Accountants of Canada (1998), Stewart (1997) and Sveiby (1997).

As illustrated in Table 1, the 23 IC attributes have been identified as representative of the spread of IC attributes that may bring comparability to existing IC studies (Guthrie et al., 2004; Bozzolan et al., 2003). To ascertain that the scoring was consistent and accurate according to the chosen scoring procedure a verification test was carried out by three researchers from the field in a similar process as that conducted by Guthrie and Petty (2000). Toms (2002) proposes that the volume of disclosures may be potentially misleading when it is the credibility or quality of disclosure that is important. Furthermore, Hasseldine, Salama, & Toms, (2005) proposes that to capture the underlying relationship, it may be important to apply a quality adjusted content analysis method in which disclosures are counted and weighted to identify their likely significance (Beattie & Thompson, 2006, p. 11). This approach minimises coding errors that may be associated with as Toms (2002) describes, rhetoric and non-verifiable disclosures that are largely without commitment as opposed to the more informative and higher quality disclosures. The competitive advantage scheme applied in this paper, accounts for the proactive identification, development, management and utilisation of IA in organisations. The coding of the disclosure

index was conducted by the researcher. Under the weighted disclosure index (WDI), disclosure illustrating a competitive advantage earned a score of "2", disclosure earned a score of "1" and no disclosure earned a score of "0". In this way, WDI may be described as disclosure of the IC competitive advantage attribute: 'The competitive advantage of signalling a unique product, service, process, IP, relationship or human resource when the competitive advantage cannot be replicated due to barriers to entry, the company can sustain above normal returns that place it ahead of competitors'.

### *2.3 Measures and Statistical Methods*

Empirical tests were applied using the statistical package, STATA. Parametric tests were used to determine the relationship between VDIC (WDI), market value (MV), technological listing (TMRK), manufacturing (MANU), employee cost (EMPC) and R&D (R&D). The Pearson coefficient and Spearman correlation tests was applied to test the association between these variables and VDIC and then the variables were entered into the multiple regression equation. Seven models were run to cater for the two models, the robust ordinary least squares regression model (OLS) (Model I) and the non-parametric quantile regression (QREG) (Model II). A further five models were run using the (QREG) model (Models III to VII), dropping one independent variable at a time in order to determine the impact of each on the regression model.

## 3. Results

### *3.1 Descriptive Statistics*

The results of the descriptive statistics on WDI indicate that there is a wide range of variation in the extent of VDIC. This result indicates that the sample companies have great flexibility in their IC voluntary disclosure practices. Dichotomous variables indicate that 16% of the sample companies are members of the TechMARK listing and that 48% companies are involved in manufacturing activities. Although variables EMPC and R&D indicate large standard deviations in their distribution, data and statistical analysis indicates that of the continuous variables, only MV required transformation to achieve normal distribution. A significant correlation is found between WDI and MV, TMRK, MANUF, EMPC and R&D; in general, the direction of the relationships is consistent with the expected sign; however, the partial correlation coefficient of WDI with R&D is negative indicating that increasing R&D expenditure may result in lower VDIC. The paper attributes this trend with management's awareness of competitive losses that may result in the disclosure of proprietary information. The benefits of signalling may be outweighed by proprietary costs resulting in R&D being insignificant in explaining the variation in VDIC. MANUF as a non-IC based industry classification is negative and significant at 1% confidence level.

### *3.2 Correlation Tests*

Tests of association indicate that there is no significant correlation between WDI and any of the independent variables. The results of the correlation test illustrate that companies that engage in R&D expenditure make significantly more IC disclosures than those with no R&D investment. The collinearity between TMRK and MANUF (-0.32) illustrates that high-tech companies are non-manufacturing. The largest level of collinearity in Model I exists between MV and R&D (+0.37). This association indicates increasing shareholder value with increasing investment in R&D. Significant collinearity identified between the IC variables suggests that TMRK companies are generally not very large. However, these companies are associated with non-manufacturing; this finding is consistent with non-manufacturing companies being more IC intensive and consistent with evidence that suggests innovative companies are smaller. Furthermore, firms listed on the TMRK are smaller as illustrated by the partial correlation coefficient of MV with TMRK (-0.13) that is negative; these firms are relatively more non-manufacturing than manufacturing based. The partial correlation coefficient of EMPC and R&D (-0.01) is negative and insignificant; nevertheless; the direction of the sign may indicate lower remuneration for firms involved in R&D activities. Lower remuneration however is associated to a greater extent with manufacturing companies than with R&D intensive firms.

Table 2. Intellectual capital investment

| Variable | Mean | SD | Min | Max | COR | SRWDI | LNMV | TMRK | MANUF | EMPC | R&D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SRWDI | 0.561 | 0.118 | 0.265 | 0.866 | | 1 | | | | | |
| LNMV | 5.624 | 2.013 | 0.536 | 11.436 | 0.455 *** | 0.393 *** | 1 | | | | |
| TMRK | 0.164 | 0.371 | 0.000 | 1.000 | 0.225 *** | 0.217 *** | -0.127 *** | 1 | | | |
| MANUF | 0.476 | 0.500 | 0.000 | 1.000 | -0.234 *** | -0.230 *** | 0.129 *** | -0.324 *** | 1 | | |
| EMPC | 48.210 | 302.911 | 0.000 | 6323.900 | 0.096 ** | 0.112 ** | 0.038 | 0.003 | -0.048 | 1 | |
| R&D | 66.161 | 386.396 | 0.000 | 3841.780 | -0.084 * | 0.094 ** | 0.366 *** | 0.025 | 0.028 | -0.013 | 1 |

The table reports the results of the descriptive statistics, the univariate analysis (COR) and the person correlation matrix of the disclosure index (WDI) and the independent variables; the annotation *** indicates results significant at a 0.01%, **, at 0.05% and * at 0.10% levels of significance; variables transformed by square roots are prefixed with SR; Variables transformed by logs are prefixed with LN;

SRWDI: Weighted disclosure index based on disclosed IC attributes measured as a square root transformation;

LNMV: Size being MV representing the share price multiplied by the number of ordinary shares in issue measured as a log-transformed variable;

TMRK: dichotomous variable that scores "1" for listing on the TechMARK listing and "0" otherwise;

MANUF: dichotomous variable that scores "1" for manufacturing and "0" for non-manufacturing;

EMPC: staff costs including all employee benefits such as health insurance and pension plan contributions / number of employees (representing the number of both full and part time employees of the company);

R&D: research and development expenditure.

*3.3 Regression Analysis*

Table 3 presents the results of the inferential models; Models I to VII present the results using non-parametric quantile regression (QREG) and the ordinary least squares (OLS) model. The results of the QREG model provide supporting results to that of the OLS model, with the exception of R&D that is insignificant in the QREG model. Although the results of the partial and Pearson correlation matrix provide inconsistent results with respect to the influence of R&D on VDIC, the multivariate analysis is consistent with respect to the predicted sign. Furthermore, analysis of the residuals in the OLS model provides assurance of their normal distribution indicating that the model is robust. The results of Models I to VII confirm that for larger companies, the benefits of signalling IC outweigh the potential disclosure costs. The expectation that large companies as measured by MV are associated with VDIC has been realised consistent with disclosure studies by Hossain et al., (1994) and Lang and Lundholm (1993). Being larger and having access to more resources, larger companies may be able to institute barriers to entry. Management behaviour is explained by signalling theory as successful management practices are advertised to inform markets of the company's competitive advantage. Consistent with the disclosure of RC attributes that signal the IC embedded in the processes that expand markets, build and maintain customer relations and ensure adequate distribution channels.

Table 3. Intellectual Capital Investment: Regression Results

$$WDI = \beta_0 + \beta_1 LNMV + \beta_2 TMRK - \beta_3 MANUF + \beta_4 EMPC + \beta_5 R\&D + \varepsilon \quad (1)$$

Model I : INTELLECTUAL CAPITAL (WDI)

| | | (i) | | (ii) | | (iii) | | (iv) | | (v) | | (vi) | | (vii) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | OLS | | QREG | | QREG | | QREG | | QREG | | QREG | | QREG | |
| Independent \ Predicted sign | | Coef. | Sig. | Coef. | Sig. | Coef. | Sig. | Coef. | Sig. | Coef. | Sig. | Coef. | Sig. | Coef. | Sig. |
| Constant | + | 0.418 | *** | 0.411 | *** | 0.411 | *** | 0.441 | *** | 0.391 | *** | 0.414 | *** | 0.430 | *** |
| LNMV | + | 0.028 | *** | 0.029 | *** | 0.029 | *** | 0.027 | *** | 0.027 | *** | 0.029 | *** | 0.026 | *** |
| TMRK | + | 0.066 | *** | 0.073 | *** | 0.073 | *** | | | 0.088 | *** | 0.068 | *** | 0.056 | *** |
| MANUF | - | -0.051 | *** | -0.063 | *** | -0.063 | *** | -0.077 | *** | | | -0.072 | *** | -0.067 | *** |
| EMPC | + | 0.000 | *** | 0.000 | *** | 0.000 | *** | 0.000 | *** | 0.000 | *** | | | 0.000 | *** |
| R&D | + | 0.000 | ** | 0.000 | | 0.000 | | 0.000 | | 0.000 | | 0.000 | | | |
| Mean VIF | | 1.120 | | | | | | | | | | | | | |
| z | | 0.14 | | | | | | | | | | | | | |
| F | | 63.62 | *** | | | | | | | | | | | | |
| $R^2$ | | 0.28 | | 0.16 | | 0.16 | | 0.13 | | 0.13 | | 0.15 | | 0.15 | |
| N | | 439 | | 439 | | 439 | | 439 | | 439 | | 439 | | 439 | |

Companies that have been admitted as members of the TMRK listing are associated with higher levels of IC disclosure relative to non-members as illustrated by Models I to III and V to VII. Previous industry studies by Bozzolan et al., (2003), Williams (2001) and Cooke (1989, 1991 and 1992) yielded significant positive results. The theoretical motivation is derived from signalling theory. The MANU variable indicates that disclosure of IC attributes is industry specific varying from low to high levels as sectors move from manufacturing to non-manufacturing. The results of Model I to IV and VI to VII, are consistent with the findings of Camfferman and Cooke (2002), Cooke (1991) and Ho and Wong (2001).

Although the *t*-statistic for remuneration per employee is small, the results of Models I to V and VII illustrate that EMPC positively influences management to greater levels of VDIC. Increasing salary cost per employee may be attributed to higher levels of education, more experience and highly complex professions. In an environment in which measurement of HC is complex, EMPC is a proxy for the value of HC in companies or alternatively, the rent required to maintain the HC in place. The motivation for this hypothesis is based on signalling theory. Proprietary costs are mitigated in the first instance by the perceived benefits of signalling and in the second by the disclosure of "better than the worst case scenario" that the markets would have assumed. This signalling is consistent with investment in training, health insurance and pension plans as employers signal their successful investment in HC through VDIC. The theoretical explanations are taken from signalling theory the expectation of a significant positive relationship is confirmed. Effective human resource practices are expected to lead to signals that indicate a competitive labour force to the markets.

## 4. Discussion

The results suggest that large companies operating in non-manufacturing, high-tech and innovative industries that are characterised by investment in employees and research and development processes have higher levels of hidden value; these companies are associated with the signalling of intellectual capital. Tests of association indicate that the partial correlation coefficient of WDI with R&D is negative indicating that increasing R&D expenditure may result in lower VDIC however, the Pearson correlation coefficient indicates a positive association for these independent variables. Models I to VII however illustrate that increasing investment in R&D is positively and significantly associated with the variation in VDIC although the relationship is weak. The results confirm the analytical framework encompassing the three disclosure outcomes; the pursuit of a maximum disclosure policy may be explained by the RBV and signalling theory. A minimal or no disclosure policy may be explained by industry membership and or proprietary cost theory and a partial disclosure outcome may be attributed to the competitive costs hypothesis, political cost hypothesis and proprietary cost hypothesis.

Although market forces may lead to IC disclosure on information demanded by external forces, the absence of a framework for IC, the necessity to disclose credible information, the threat of loss of competitive advantage and the risk of litigation has restricted the level of IC disclosure. Companies compete by erecting barriers in order to maintain their demand-side advantage or cost-side advantage (Abernathy and Clark, 1995). Generally, any advantage generated from standard and tangible asset investment is easy for competing companies to imitate (Webster, 1999). Intangible asset investment on the other hand is often company specific, making it difficult for companies to imitate. Hayton (2005) argues that IC offers a unique source of advantage that facilitates entrepreneurial activities by reducing the firm-specific risk and increasing the returns from investment in innovation and venturing (new projects). In this way, IA can achieve competitive advantage. As such, these additional disclosure costs render markets less efficient particular in risk assessment, equity valuation and resource allocation. VDIC may reduce information asymmetries that may otherwise be exploited by internal agents and external analysts. Information asymmetry provides the opportunity to generate value by moving share prices closer to their intrinsic values. These opportunities may arise in companies with higher levels of unreported IC. Minority shareholders may benefit from increased VDIC, as they may not have access to some information that major shareholders possess. Furthermore, given the existence of information asymmetry between management, shareholders, minority shareholders, analysts and investors, it may be necessary that IC information be made publicly available if markets are to remain truly competitive.

With reference to Gray and Roberts (1989) who considered the costs and benefits of disclosure and investigated these empirically, the paper acknowledges their suggestions that disclosure improves the image and reputation of the company, provides better investment decisions for stakeholders, improves accountability to shareholders, enables more accurate risk assessment by shareholders and provides a more accurate valuation of share prices. Nevertheless, despite these potential benefits, companies do not always disclose IC; constraints to voluntary disclosure take different forms, costs of competitive disadvantage, agency costs and costs of data collection and processing that may be higher for IC due to its intangible nature and inherent problems of identification, measurement and reporting. Companies with substantial resources may be able to dedicate more resources to this

function. This paper extends this work by examining the influence of investment in employees and R&D as determinants VDIC.

Future research may include advertising, marketing and public relations expenditure as determinants of VDIC in order to include all discretionary expenses that are associated with IA. In addition, due to the varying nature of R&D from one year to the next it may be appropriate to examine VDIC in a longitudinal study that may identify any relationships other than cross-sectional as researched in this paper. The results illustrate that industry is a significant determinant of the variation in VDIC. Regulators may therefore focus on an industry by industry analysis of the cost benefit of increasing disclosure of IC; not all industries have the IC to disclose. Furthermore, from a policy and regulatory perspective it is important to note that firms that have the more significant and successful investments voluntary disclose information through other channels that exclude financial statements. These firms are conscious of the two stage disclosure game in which merely investing in IA in the first stage of the game is insufficient to meet stakeholder needs; these firms take proactive steps in the second stage of the game to inform markets of the expected returns from such investments and the expected production cost savings from the innovation and technology. As such, the expectation that these companies channel IC voluntary disclosure and sustained competitive advantage through the narratives and illustrations of the annual report have not been realised. If financial statements are to be decision useful and fairly presented, regulators should ensure that both expenditure in employees and in R&D is accompanied by a statement of expected returns on such investments to enable projections of future cash in-flows to be made by investors. Further research can be all encompassing by examining all potential disclosure channels such that management motivation may be more closely studied particularly for firms that make use of early disclosure and of alternative channels of disclosure.

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