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«Влияние интеллектуального капитала на эффективность деятельности компаний на развивающихся рынках»

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Introduction

The concept of intellectual capital is one of the most recent and fast developing in current financial literature. The key driver behind its rapid development is the changing conditions of the modern economy. Contemporaneous economy is claimed to be knowledge-based (Stewart, 1997) in which information and knowledge play the greatest role in company's business activity. Induced by the shift to information-based environment, physical and financial assets do not any longer capture the full value of a company, leading to a well-known gap between firm's market and book value. To resolve this problem the idea of intellectual capital was proposed.

Intellectual capital is an unobserved and intangible variable which corresponds to intellectual ability and wealth of the firm. Due to its extensiveness it has a number of definitions. Intellectual capital is viewed as a production factor which stands along with a classic set of labor and capital. In some cases it is claimed to be the main source of value creation in the new economy (Edvinsson, 1997; Sveiby 1997). Due to its vast economic potential, the influence of intellectual capital on company's characteristics such as value and performance became the object of interest of managers, investors, economic institutions and government. Taking all that into account, intellectual capital and its effect on companies is an important and interesting topic to be examined.

The problem of intellectual capital measurement is largely driven by the fact that existing accounting systems ignore it. Consequently, there is no universally acknowledged approximation of intellectual capital in the literature. Every year researchers propose new approaches. It was validated that the best measures of intellectual capital are non-monetary, but these types of measures are subjective and not suitable for empirical research. Due to that, this research concentrates on monetary terms, but applies them indirectly.

The concept of intellectual capital was created and investigated in developed markets. There is much empirical and theoretical evidence from developed economies that intellectual capital has positive and significant influence on company's market value and performance. However, there are not many papers devoted to analogous problems in emerging markets. This study attempts to look into the five biggest emerging markets from BRICS group.

The purpose of the research is to answer the question whether intellectual capital has significant impact on company's performance in emerging markets. This question is answered by application of detailed cross section and panel data analysis. The object under investigation is a set of companies from five emerging countries for several years. In the course of the paper the following problems are solved:

1. Implementation of Sydler et al. (2014) model for IC proxy calculation, calculation of VAIC measure;
2. Evaluation of the impact of IC on company's performance in three dimensions: financial, economic and stock market aspects. Validation of hypotheses;
3. Comparison of the results between IC intensive and IC non-intensive firms.

Pioneer feature of the current paper is threefold. Firstly, an appealing new method of IC valuation, described in Sydler et al. (2014), is calculated based on data from emerging markets. The original paper uses selected industries from UK market. This method has a number of advantages making it, potentially, more realistic and precise for the problem of intellectual capital approximation than other methods based on published financial information. Secondly, the impact of intellectual capital, approximated by Sydler's proxy and by more well-known VAIC measure, is evaluated by means of three dimension analysis of the company's performance on emerging markets, which also has not been done before. Thirdly, the data sample is split into two subsamples - IC intensive firms and IC non-intensive firms, which provide further insights into the features of IC in emerging markets.

This paper also sheds some light on the problem of finding a valid proxy for intellectual capital. Two approximated variables corresponding to two different approaches are calculated and used in the analysis. It was shown that in general the two methods do not contradict each other and suggest similar conclusions concerning the influence of intellectual capital on companies' performance. But, because of principal differences in theoretical backgrounds, there are some interesting differences.

The paper is organized as follows. In the first part theoretical aspects of intellectual capital are discussed. Existing definitions and classifications of intellectual capital are analyzed, the problem of proxy choice is considered. In the second part estimation and evaluation techniques used in this study are presented. Detailed descriptions of models used are provided. The third part concerns the data description. The fourth part represents obtained empirical results.

Literature review

In the circumstances of the knowledge-based economy classic explanation of company's value by means of tangible assets becomes incomprehensive. Due to that, Intellectual capital (further IC) becomes a very important and widely discussed topic which is expected to be able to explain the remaining difference between market and book value of the company. However, IC is a very broad concept with many different aspects, so no common definition exists. The purposes of the first part of this paper are to find an appropriate definition for IC which can be used to perform empirical analysis, understand the main features and assume a convenient classification for IC in order to find suitable proxies.

1.1 Definition and Classification of Intellectual Capital

IC by its nature is intangible, unobserved and exists in various forms, so there is no unique definition neither in theory nor in practice. In this part existing definitions are logically grouped as consistent with economic aspect they explain, and further discussed. Finally, the most suitable for the forthcoming analysis definition is chosen. All the definitions are divided in the following way. Firstly, general definitions which aim is to explain the raw idea of IC are represented. Secondly, definitions that cover the measurement (accounting) aspect are reviewed. The third group concerns the application of IC in company valuation.

The first group of IC definitions is the biggest one. One of the first attempts to define IC was made by Klein and Prusak (1994). They claimed that IC corresponds to formalized, captured and leveraged intellectual material which finally turned into valuable assets. Later the term "intellectual material" was specified and deciphered as some knowledge owned by the company and which can be converted into value or profit, or which can transform raw materials into valuable assets (Edvinsson and Sullivan, 1996; Stewart, 1997; Bontis, 1998). However, determination of IC as just knowledge is a narrow one, so this idea was expanded and generalized. IC started to be defined as the ability of the company to convert knowledge into different forms of wealth (Bradley, 1997; Booth, 1998). The most commercial and well-known definition for IC was given by Edvinsson and Malone (1997). They specified IC as "the possession of knowledge, applied experience, organizational technology, customer relationships and professional skills which provide Skandia[1] with a competitive edge in the market". One of the most recent IC definitions also claims that IC is associated not only with past performance of the company, but also with future flows of benefits (Lev, 2001). All the definitions discussed provide background for the general understanding of the IC concept, but they do not give much information for practical applications. Due to that, second and third groups of definitions emerged.

The second group of IC definitions focuses on accounting aspect. Given high relative importance of IC in a successful corporate management, a question of its acknowledgement and correct measurement emerged. The first idea was that IC should be recognized as an intangible asset due to its nature and features (Kaufmann and Schneider, 2004; Cezair's, 2008). However, it was quickly understood that IC goes beyond the intangibles that are disclosed in the balance sheet. One of the most detailed lists of IC components was proposed by Choong (2008). He claimed, that "IC has been defined to include expenditures on advertising (marketing), training, startup, R&D activities, human resource expenditures, organizational structure, and values that come from brand names, copyrights, covenants not to compete, franchises, future interests, licenses, operating rights, patents, record masters, secret processes, trademarks and trade names". This rather long list gives an overview of the width of IC components and difficulty of its measurement. Nevertheless, considered explanations provide a possibility to evaluate IC with financial figures which are stated in the balance sheet and in the profit and loss statement.

The last group of definitions is the youngest one and makes the greatest emphasis on valuation aspects. This area is not well-investigated yet. The general idea of this group of definitions is that IC is equal to the difference between company's market value and book value (Brooking, 1997; Pablos, 2003). Later this definition was adjusted, and it was claimed that IC is one of the leading factors that explain this difference. Such an interpretation gave a powerful impetus to corresponding empirical investigations.

The purpose of this paper is to reveal empirically whether IC has any impact on company's performance. This influence is going to be revealed by means of publicly available financial figures. Definitions from the second group were chosen as a starting point, but having only a definition is not enough, so a classification of IC components was applied.

There are several classifications of IC which are used in empirical studies. In this paper the most popular classification created by Edvinsson and Malone (1997) is considered. This

[1] Skandia AFS is an old Swedish insurance company which was a pioneer in acknowledgement of IC by a company. In 1997 Edvinsson was assigned as a director of IC in Skandia.

classification divides IC into three parts: human capital (HC), structural capital (SC), and relational or customer capital (RC).

HC is defines as a combined capability of employees to solve business problems. It involves all the knowledge, skills and talent of employees of the company. More systematically HC includes genetic inheritance, education, experience and attitudes about life and business (Bontis, 1998). Sometimes HC is interpreted as organization's efficiency to use its people resources. The main feature concerning HC is that it is not owned by the company. HC leaves the company together with the employees.

Contrary to HC, SC is owned by a company and includes everything that supports employees in their work. In other words, SC enables HC to function (Luthy, 1998). SC consists of all the databases, patents, know-how, brands, routines, etc. of the company. According to this list of components, SC is a diverse conception. Due to that, Edvinsson and Malone (1997) partitioned it into three more terms: organizational capital, process capital and innovation capital. Organizational capital corresponds to company's philosophy; process capital involves techniques, programs and procedures that help company to function. The last part, innovation capital, represents intangible assets and intellectual property of the firm. All the components of SC stay in the company irrelevant of an employee leaving the company or not.

RC is the last and most difficult component to measure. It is defined as the "strength and loyalty of customer relations" (Luthy, 1998). In financial terms RC represents the value of relations between company and its customers. Nowadays the term "customers" should be expanded to the term "stakeholders", as relations with other interested parties such as suppliers or government also play a significant role in company's success.

The classification described is used by researchers in the majority of cases. Nevertheless, sometimes new components are added. For example, some papers suggest innovation capital as a fourth separate part (Tseng and Goo, 2005). They claim that innovation capital requires different managerial actions, so it should be separated from SC. Furthermore, they argue, that exactly innovation capital itself is a key success factor for knowledge-intense economies. However, countries which are examined in this paper do not stand in the advance guard of knowledge-intense economies as Taiwan or Korea do. Because of that, in this work innovation capital is not separated.

One of the most recent additions is the idea to include spiritual capital (Abdullah and Sofian, 2012). It consists of human spirit, motivation, ethics, self-esteem and commitment. However, this kind of capital is very hard to estimate by financial figures and no proxies for this kind of IC are proposed. So, this possible part of IC is also left out from our consideration. All in all, in this work we assume the most common classification of IC which divides IC into three main components: HC, SC and RC.

1.2 Features of Intellectual Capital

When choosing a proxy for IC it is crucial to be aware of the distinct features of the intellectual capital. Five main specifics of IC are usually singled out (Tseng and Goo, 2005):

- intangible nature of IC;
- effect of time delays;
- non-zero sum effect;
- rule of multiplication;
- submission to the law of increasing returns.

The first feature is well reflected in definitions of IC discussed above. On the one hand, IC is a real concept that is under control of the company and can be managed. On the other hand, IC is not directly stated in any of company's financial documents, so it should be taken into account when proxy for IC is chosen. The second feature, effect of time delays, stands for the idea that investments in IC take time to be fully implemented. In other words, the investments implementation process is characterized by inertia.

The third feature indicates that, as opposed to physical capital, IC flows are not necessary added up to zero. One of the examples of this feature is a situation when significant investments into some innovative process can be wasted as the company's infrastructure is not well-prepared for such changes. Because of non-zero sum effect IC components should be viewed at least non-separated. Moreover, it is claimed that the full effect of IC can be caught only if its components are examined in interconnection. However, this interconnection is hard to model and it is something we do not pursue in the present paper.

The forth feature, rule of multiplication, contrasts IC to physical capital. Physical capital is formed according to the rule of addition. This means that one unit of physical capital plus one more unit results in two units. This cannot always be applied to IC. The idea is that one piece of knowledge can be spread with zero transaction costs among many employees instead of one, so the level of IC increases. Some researchers describe the process of IC formation in the following way:

$$IC = People * Internal\ capital * External\ capital.$$

The last feature is one of the most controversial. Law of increasing returns is very often ascribed to IC as a supposition. Unlike physical capital, which is characterized by decreasing return on scale, IC's marginal effect on company's value, profitability and etc. is supposed to be increasing. Nevertheless, empirical check of this hypothesis reveals controversial results and is very sensitive to the sample examined.

To sum up, IC is a specific concept which requires specific approach. Firstly, a financial proxy should be chosen and modeled accurately as the nature of IC is intangible. Secondly, lagged nature of the return on investments in IC should be included into the model. Thirdly, influence of multiplication effect and non-zero sum effect should be taken into account.

1.3 Measuring Intellectual Capital

1.3.1. Main approaches of IC measurement

All of existing IC measurement approaches can be represented as a two by two matrix (Sveiby, 2001). The adjusted version of this matrix is showed in the figure 1.1. On the first level, IC measurement approaches are divided into component-by-component method and measuring without reference to components. On the second level, measurement of IC is done in monetary and non-monetary terms. According to the fact, that the aim of this paper is conducting an empirical research basing on publicly available financial information, we consider only measurement in monetary terms. Non-monetary approaches both require information which is hard to obtain and are very subjective. There are no common benchmarks in this class of methods, so the problem of comparability across firms and countries exists. Monetary methods are also a subject to criticism. It is claimed that financial figures do not reflect the IC concept properly. Nevertheless, these figures are auditable, and monetary approaches show sufficient results in empirical works.

	Non-monetary	Monetary
Organizational level		**Market Capitalization Method** ▪ Market-to-Book Value ▪ Tobin's Q **ROA Method** ▪ Economic Value Added ▪ Calculated Intangible Value ▪ Value-Added Intellectual Coefficient ▪ Intangible Driven Earnings ▪ Residual Income Model
Components level	**Scorecard method** ▪ Balance Scorecard ▪ Value Chain Scoreboard ▪ Skandia Navigator ▪ IC-Index ▪ Intellectual Capital ▪ Benchmarking System	**Direct Intellectual Capital Method** ▪ Citation-Weighted Patent ▪ Real Option Model

Figure 1.1: Intellectual Capital valuation models (taken from Sydler et al., 2014).

Component-by-component measurement implies identification and evaluation of IC components. Components can be evaluated both individually and as an aggregated coefficient. The advantages are that this approach provides a detailed picture of the subject considered, the process goes from the particular to the general, so it is assumed to be more accurate and precise than methods without reference to components. The disadvantage is that this method contains a great part of subjective suggestions about monetary proxies for each component.

Measurement approaches without reference to individual components can be divided into two big groups: market capitalization methods and return on assets (ROA) methods. Market capitalization methods are based on the valuation type definitions of IC. All the proxies for IC which correspond to this class of approaches are based on the idea that IC is equal or strongly related to the difference between market value of the company and book value of its assets which is represented in the balance sheet. This set of methods provides the best possibilities for comparisons. The main criticism is that chosen approach does not catch the features of IC correctly.

The main idea of ROA methods is the following. Measuring IC is based on some efficiency measures which then are compared with some average benchmarks. Usually, the benchmark is calculated on industry level. The difference between the measure and the benchmark is claimed to be related to the value of IC and efficiency of its management. This approach provides not so many possibilities for comparisons as market capitalization method does, because different countries are characterized by different systems of accounting, interest rates and other factors which significantly influence the efficiency measures. However, it still shows satisfactory results in empirical research.

In this paper only monetary methods of measurement are considered. The proxies for IC are chosen both from component-by-component and without reference to individual components groups. The question about appropriate proxies for IC is discussed in the following part.

1.3.2. Review of proxies of IC

Choosing a correct proxy for IC is a difficult question due to intangible and non-physical nature of this kind of capital. As it is showed in the previous part, choice of a proxy for IC also depends on the method of measurement. In table 1.1 monetary proxies for IC and its components proposed in different researches are presented. As it is seen from the table, there is no common approach in proxy selection. There are obvious intersections in columns of components. Moreover, some proxies such as revenue growth or turnover rates do not represent the absolute value of IC components. Also, it is argued that financial figures cannot reflect the value of IC correctly as they do not catch its intangible nature. Because of that in this paper we do not measure IC and its components directly. In case of component-by-component measurement we model IC through financial terms. In case of overall measurement we estimate the efficiency of IC resources deployment. This estimation follows the procedures proposed by Pulic (2000). Detailed description of these procedures is discussed in the next chapter.

Component-by-component measurement approach			Measurement approach without reference to individual components
Human Capital	Structural Capital	Relational Capital	Intellectual Capital
Share of wages in costs;	R&D expenditures;	Commercial expenses per share;	Value Added Intellectual Coefficient (VAIC);
Earnings per employee;	Value of intangible assets;		
		Sales growth rate;	Q-Tobin;
Number of employees;	Administrative expenses per employee;	Advertising expenses;	Economic Value Added (EVA);
Sales per employee;		Value of goodwill;	
Turnover rates	The sum of sales and administrative expenses per employee	Marketing expenses;	Value of intangible assets
		Revenue growth	

Table 1.1: review approximated values of IC proposed in different researches.

2 Analytical Framework

2.1 Models Review

This chapter consists of three parts. In the first and second parts two proxies for IC used in this paper are discussed. In the third part model which examines the impact of IC on company's performance is presented. Corresponding proxies for company's performance are also laid out in the third part.

2.1.1 Sydler et al. (2014) proxy of IC

The proxy of IC proposed by Sydler et al. (2014) corresponds to component-by-component measurement and is estimated by means of a two-step model based on adjusted dynamic residual income model (RIM) (Ballester et al., 2002). Firstly, adjusted RIM and its assumptions are described. Secondly, the process of IC evaluation is considered. The process of the adjusted dynamic RIM development can be divided into three chronological stages. On the first stage resides traditional residual income valuation of assets. Then this method was updated by Ohlson in 1995 (Ohlson, 1995). The last stage of transformation was connected with the understanding of new knowledge-based economy conditions. Following new requirements Ballester et al. (2002) developed an adjusted dynamic RIM.

The classic RIV model is derived from the discounted dividend valuation model. According to this model, the value of the company is equal to present value of all future dividends.

$$P_t = \sum_{\tau=1}^{\infty} R^{-\tau} E_t(d_{t+\tau}) \quad (2.1)$$

In the formula (2.1) P_t is company's value (or the price of its shares); $E_t(d_{t+\tau})$ – expectation at time t of the dividends coming at $(t+\tau)$; R equals to (1+r), where r is a discount rate. To proceed from present value of dividends into the RIV, two assumptions are made. The first assumption is called clean surplus relation (CSR).

$$b_t = b_{t-1} + x_t - d_t.$$

b_t is the company's book value at the end of period t; x_t – net income; d_t – dividends. In other words, book value of the company is assumed to be formed as the sum of already accumulated book value plus the volume of reinvested income[2]. This allows connecting residual income and dividends. The advantage of this condition is that it can be implemented in any accounting system.

The second assumption is called regularity condition. It can be presented by means of the following formula. This condition claims that the book value grows at a rate lower than R.

$$R^{-\tau}E_t(b_{t+\tau}) \xrightarrow{\tau\to\infty} 0$$

These two assumptions allow rewriting the discounted dividends valuation equation to a mathematically equivalent residual income model.

$$P_t = b_t + \sum_{\tau=1}^{\infty} R^{-\tau}E_t(x_{t+\tau}^a) \quad (2.2)$$

$$x_{t+\tau}^a \equiv x_t - r * b_{t-1} \quad (2.3)$$

$x_{t+\tau}^a$ is residual income which is represented according to its economic definition.

RIV is theoretically consistent but fails when applied to practice. The main problem of RIV is that it is difficult to be tested. Forecasting correctly all the future dividends or residual income for the infinite period is a hard task. Due to that, empiricists imply different truncations in their analysis. However, in this case the problem of benchmarking arises. The R^2 of initial model should be equal to unity. Because of truncation R^2 is automatically reduced and becomes less than unity. But there is no evidence of how much less it can be in order to not to reject the model's adequacy. In other words, it is difficult to come up with a theoretical benchmark while working with RIV.

Ohlson model was developed as a solution for the problems with RIV model empirical evaluation. Ohlson's model is empirically testable and shows consistent results. The main contribution made by Ohlson was in modelling and including into RIV information dynamics. Firstly, Ohlson claimed that residual income is characterized by the following time series behavior.

[2] Reinvested income is equal the difference between net income and dividends. Usually reinvested income is spent on company's development.

$$x_{t+1}^a = \omega x_t^a + \nu_t + \varepsilon_{t+1} \quad (2.4)$$

In equation (2.4) ν_t is relevant information that does not influence book value and net income of the company in the period t, ε is mean zero disturbance term. Relevant information also follows an AR(1) process.

$$\nu_{t+1} = \gamma \nu_t + \eta_{t+1} \quad (2.5)$$

η_{t+1} is a mean zero disturbance term. There are also restrictions on the coefficients: $0 < \omega, \gamma < 1$. The lower bound of the restrictions is done due to economic reasons which are proved empirically. The upper bound is imposed to guarantee stationarity of processes (2.4) and (2.5).

After inserting equation (2.5) into equation (2.4) and employing recursive transformation we obtain residual income expressed through mean zero disturbance terms.

$$x_{t+1}^a = \sum_{\tau=1}^{t+1} \omega^{t-\tau+1} \varepsilon_\tau + \sum_{\tau=1}^{t} (\eta_\tau * \sum_{s=\tau}^{t} \omega^{t-s} \gamma^{s-\tau})$$

This expression says that $E_t(x_{t+n}^a) = 0 \ \forall \, n \geq 1$. Due to that, we get the following equation for company's value.

$$P_t = b_t + \alpha_1 x_t^a + \alpha_2 \nu_t \quad (2.6)$$

$$\alpha_1 = \frac{\omega}{R - \omega}, \qquad \alpha_2 = \frac{R}{(R - \omega)(R - \gamma)}$$

The advantage equation (2.6) is that market value is linked to contemporaneous balance values. Moreover, unlike classic RIV (2.2) this model is empirically testable. It is important to mention a couple of details. Firstly, the structure of equations imposes that unconditional expected value of residual income equals to zero. This implies that unconditional expectation of firms' goodwill[3] is also zero. Such a consideration leads to a finding that a company cannot earn more than the cost of capital, so all the projects unconditionally must have zero NPV. However, this does not seem realistic. To solve this problem equation of residual income is

[3] Goodwill is equal to the difference between asset's market and book value at the moment of purchase of this asset.

modified by adding a constant term. This allows a company to achieve positive NPV of its projects. Secondly, the term "other relevant information" is important. It is necessary to emphasize that non-relation to contemporaneous residual income does not mean independence. Independence of x_t^a and ν_t is achieved only in the case of $\gamma = 0$. In other cases correlation exists. Because of that "other information" should be interpreted as a correlated omitted variable.

Now we proceed with adjusted RIM (Ballester et al., 2002). This model deals with only one component of IC – human capital. As it was mentioned earlier, Ohlson model is suitable for any accounting system that satisfies the CSR. In the conditions of knowledge-based economy the authors consider an accounting system that capitalizes labor-related costs. In other words, all the expenditures related to labor are assumed as investments. Secondly, risk neutrality is assumed, so discount rate is considered to be equal to risk-free rate (r_f). The logic is the following. Every period a firm spends some money on labor (w_t). This sum is capitalized with the fraction β. This means that each unit spent on labor adds β units to human capital (L_t). Labor expenses grow each period with the constant rate g.

$$w_t = (1 + g)w_{t-1}$$

Human capital is treated as an asset, so depletion rate is imposed. Already accumulated human capital depreciates each period with the rate δ. Hence, the human capital at the end of period t is formed according to the formula.

$$L_t = \beta w_t + (1 - \delta)L_{t-1}$$

Ballester et al. (2002) assume the following restrictions on accumulation and depreciation rates: 0<β, δ<1. This is done due to common understanding of these types of rates. However, these restrictions are not mandatory for the method to be statistically valid. Implying recursive substitution and assuming that t tends to infinity we get the formula:

$$L_t = \beta w_t [1 + \frac{1-\delta}{1+g} + (\frac{1-\delta}{1+g})^2 + \cdots + (\frac{1-\delta}{1+g})^t] = \beta w_t \left[\frac{1+g}{g+\delta}\right] = \beta \varphi w_t$$
$$where\ \ \varphi = \frac{1+g}{g+\delta}$$

For large t the following expression is also applicable.

$$L_{t-1} = \beta\varphi w_{t-1}$$

As we consider a new accounting system, the old one should be adjusted. Human capital is acknowledged as an asset now, so, on the one hand, capitalized part of labor expenses increases net income of the company. On the other hand, depreciated part of human capital increases the overall depreciation, so decreases the company's net income.

$$x_t = x_t^R + \beta w_t - \delta L_{t-1}, \qquad where\ x_t^R\ is\ net\ income\ reported\ by\ the\ company$$

Book value should be increased by value of human capital as well.

$$b_t^a = b_t + L_t$$

Finally, adjusted dynamic RIM based on Ohlson model looks as follows.

$$x_t^{adj} = x_t^R + \beta w_t - \delta L_{t-1} - r_f * b_t^a \quad (2.7)$$
$$P_t = b_t^a + \alpha_1 x_t^{adj} + \beta_3 \nu_t$$

Now we proceed with Sydler ar al. (2014) method of IC calculation. Hereafter the authors' original notation is used. This model has identical to Ballester et al. (2002) logic. The difference lies in the IC definition. Ballester at al. (2002) concentrated only on HC. Sydler at al. (2014) went further and included all three components of IC into the model. Note that Sydler et al. (2014) model corresponds to component-by-component measurement approach. Following adjusted RIM (2.7) the authors assume that IC is formed from the corresponding expenditures on HC, SC and RC. These types of expenditures are approximated by total expenditures on employees, expenditures on R&D and marketing expenses correspondingly. Overall expenses on IC are named intellectual expenses ($IE_{t)}$.

$$IE_t = Personell\ expenses_t + R\&D\ expenses_t + Marketing\ expenses_t$$

HC as all other IC components is intangible by its definition. We cannot measure the level of employees' talent and expertise directly. However, we can approximate the ability of a company to attract and then retain highly qualified people. According to Ballester et al. (2002) and Wakelin (1998) company's expenditures on wages is a good proxy for accumulated HC. Nevertheless, this measure can be improved by adding expenditures on personnel trainings and recruiting expenses. Expensive trainings are expected to increase the level of employees' proficiency, and significant expenditures on recruiting increase the probability of hiring most suitable and talented people. All in all, total labor expenditures are assumed to be a good proxy for HC. This idea is proved empirically by Lajili and Zeghal (2006), where it is showed that investors view high total labor expenses as high level of HC.

Expenditures on R&D are associated with creation of new technological assets for the company and improvement of existing production processes (Chan et al., 1992). Among the results of such expenses are new patents and licenses which correspond to the concept of SC. Moreover, capitalized R&D expenditures are significantly and positively correlated with stock prices (Lev and Sougiannis, 1996). This effect is also ascribed to IC and its components. All in all, R&D expenditures are considered to be a good proxy for SC.

As it is mentioned before, RC is the most difficult component to measure. In this case total expenditures on advertising and marketing are suggested as a proxy. Advertising expenses and positively correlated with company's brand value (Barth et al., 1998), which in turn increases customer loyalty, firm's flexibility in conditions of competitive market and efficiency of marketing communications. High level of marketing expenditures imply close contact with customers, better understanding of their needs and corresponding efficient actions to improve possible dissatisfaction. All these factors make total expenditures on marketing and advertising a good proxy for RC.

In Sydler et al. (2014) parameter α stands for accumulation rate of IC, δ stands for depreciation rate. Expenditures on IC grow with a constant rate g every period. The total amount of intellectual capital at each moment of time can be expressed by the following formula:

$$IC_t = \alpha(IE_t) + (1 - \delta)(IC_{t-1})$$

Applying recursion:

$$IC_t = \alpha(IE_t) * \left[\frac{1+g}{g+\delta}\right] = \alpha(IE_t)\phi \quad (2.8)$$

Applying (2.4) and (2.5):

$$MV_t = \beta_1(BV_t + IC_t) + \beta_2\left[(NI_t^R + \alpha IE_t - \delta IC_t) - r_f(BV_{t-1} + IC_{t-1})\right] + \beta_3 \upsilon_t$$

MV_t – market capitalization of a company;

BV_t – book value of assets which is reported by a company;

NI_t^R – reported net income;

r_f – risk-free rate;

υ_t – other relevant information which influences market value.

Rearrangement of equations gives the following formula:

$$MV_t = A_0 + A_1 BV_t + A_2\left(NI_t^R - r_f BV_{t-1}\right) + A_3 IE_t + A_4 IE_{t-1} \quad (2.9)$$

$A_0 = \beta_3 \upsilon_t$

$A_1 = \beta_1$

$A_2 = \beta_2$

$A_3 = \alpha(\beta_1\, \phi + \beta_2)$

$A_4 = -\beta_2 \alpha \phi(\delta + r_f)$

$\phi = \frac{1+g}{\delta+g}$

Evaluation of the equation gives values for the coefficients A_1, A_2, A_3 and A_4. Once these values are known, we can solve the following system of equations for accumulation rate α and depreciation rate δ:

$$\begin{cases} A_1 = \beta_1 \\ A_2 = \beta_2 \\ A_3 = \alpha(\beta_1\, \phi + \beta_2), \\ A_4 = -\beta_2 \alpha \phi\left(\delta + r_f\right) \\ \phi = \frac{1+g}{\delta+g} \end{cases} \quad (2.10)$$

Obtained values for accumulation and depreciation rates allow calculation of IC for each company and period. This value is assumed to be the first proxy for IC used in this paper.

Proxy for IC proposed by Sydler et al. (2014) is expected to be a good choice for several reasons. Firstly, its calculation is based on publicly available financial measures which, as it is discussed above, approximate IC components well. Secondly, it is not a direct evaluation of IC by means of balance sheet figures but rather a latent variable modelling which accounts for IC features as an asset. Finally, this proxy discloses important information about mechanism of IC formation, which can be used in management field.

2.1.2 Pulic (2000) proxy of IC: Value Added Intellectual Coefficient

Value Added Intellectual Coefficient was invented by Pulic (2000) and became very popular among researchers who investigate IC. This coefficient shows the ability of a company to create value and represents a measure for business efficiency in a knowledge-based economy (Ståhle et al., 2011). The crucial word in this definition is "efficiency", as VAIC is measured in relative, not absolute terms. This coefficient reflects the ability of a company to employ its resources (intellectual and physical) efficiently. Thus, it does not provide a direct estimate of the company's IC.

Before describing the measurement procedure it is important to mention pros and cons of VAIC. They are showed in a table below.

Pros of VAIC	Cons of VAIC
Easy-to-calculate	Easy-to-calculate (too simple)
Standardized	Financial data does not catch the intangible nature of intellectual capital properly
Consistent (empirically proved)	
Allows effective comparative analysis	Does not include relational capital, which is the most difficult component to measure
Requires financial statement data which is publicly available	

Table 2.1: advantages and disadvantages of VAIC as an approximated value of IC

As it is seen from the table 2.1, easiness-to-calculate is both an advantage and disadvantage. The positive side of easiness-to-calculate is in usage of publicly available financial information. The procedures of calculation are transparent and well-understood. The negative side consists in specific assumptions that not always correspond to reality. Despite this fact, VAIC is a consistent, empirically proved measure of IC (Zeghal and Maaloul, 2010; Berzkalne and Zelgalve, 2014; Chen et al., 2014). Moreover, its basement on particular financial information makes VAIC a standardized measure applicable to cross-country or cross-company comparisons. Nevertheless, the main disadvantage of VAIC is its incompleteness as it does not include RC. Also VAIC is characterized by all the limitations of a financial proxy of IC.

VAIC is calculated by means of a three-step procedure.

1st step: calculation of Value Added (VA).

Value added in terms of VAIC calculation stands for the difference between firm's total output and input which are approximated by balance sheet figures. Output is approximated by total volume of company's sales. Input includes all the expenditures which were incurred to produce the output. Following (Riahi-Belkaoni, 2003) and simple rules of accounting the following relationship must hold:

$$S - cogs = DP + W + I + DD + T + R$$

S – sales revenue;

cogs – costs of goods sold;

DP – depreciation;

W – wages;

I – interest paid;

DD – dividends paid;

T – taxes paid;

R – changes in retained earnings.

The sum of dividends and changes in retained earnings results in net income of the company:

$$DD + R = NI$$

Value Added is defined as:

$$VA = S - cogs - DP$$

Employing the above mentioned relationship:

$$VA = OUTPUT - INPUT = S - cogs - DP = W + I + T + NI$$

Obtained equality gives us two formulas to calculate VA. In this paper the second one based on W, I, T and NI is used due to data availability reasons.

2nd step: calculation of three major components of company's resources.

Pulic (2000) in his work singles out three major components of overall firm's resources: human capital, structural capital and capital employed (CE). SC and HC together form intellectual part of firm's resources. CE is defined according to the formula:

$$CE = physical\ capital + financial\ assets = Total\ assets - intangible\ assets$$

HC is approximated by the overall expenditures on employees; SC is calculated as the difference between VA and HC.

3rd step: calculation of VAIC.

VAIC measures the efficiency of company's resources employment. Corresponding efficiency rates for each component are determined as follows.

$$VACA = \frac{VA}{CE}\ for\ capital\ employed$$

$$VAHU = \frac{VA}{HC}\ for\ human\ capital$$

$$STVA = \frac{SC}{VA}\ for\ structural\ capital$$

VACA represents how much value added is generated per one unit spent on capital employed. VAHU shows how much value added is generated per one unit spent on human capital. STVA is the inverse version of the analogous ratio. This inversion is done because structural capital and human capital are reverse to each other. VAIC is the sum of three efficiency ratios.

$$VAIC = VACA + VAHU + STVA \quad (2.11)$$

For the purposes of analysis usually the sum of VAHU and STVA is separately considered. This sum shows the efficiency of intellectual capital employment.

$$VAIN = VAHU + STVA$$
$$VAIC = VACA + VAIN \quad (2.12)$$

The formula (2.12) decomposes the efficiency of resources usage into intellectual and tangible aspects. Zeghal and Maaloul (2010) whose model is estimated in this paper employ this decomposition in their work.

2.1.3 Zeghal and Maaloul (2010) model of IC impact on company's performance

The model proposed by Zeghal and Maaloul (2010) examines whether IC has any impact on company's performance. The advantage of this model is that as opposed to other similar models it decomposes company's performance into three important aspects: economic performance, financial performance and stock market performance. In compliance with this division the model consists of three equations. This model is claimed to be more comprehensive and robust compared to single equation models as company's efficiency[4] is a general concept that can be further segmented and measured in different ways. Because of that considering only one aspect (and one proxy, correspondingly) is not enough for the analysis. In this paper we further broaden the set of variables responsible for company's performance and include in total seven measures. This is done in order to get additional insights in the way IC affects different areas of company's business. Below all the measures are stated and grouped into three above mentioned groups.

The first group of the company's performance is concerned with the economic efficiency of a firm. The idea is to measure how IC affects the capability of a firm to efficiently turn the inputs into outputs with minimal production, distribution and all kind of other costs. In accordance with that, a typical production process is split into two logical stages - the relative efficiency gained on the stage of manufacturing and delivering a product and the relative efficiency gained on the stage of serving the borrowed capital required to produce a product and paying taxes. Consequently, the measure of the first stage includes EBIT/Sales (also known as operational profitability) and NI/EBIT stands for the measure of the second stage. The intuition behind the influence of IC on this area of company's performance is as follows. Highly skilled employees (HC) can enhance the volume of goods

[4] In this paper terms "performance" and "efficiency" are used as synonyms.

and services sold and increase company's operational margins as well as optimize the taxation schedule. Talented researchers can implement innovations which increase the level of production efficiency, cut production costs. High relational capital (RC) can allow the company to raise debt at lower interest rates. Altogether, IC should have positive impact on company's economic performance.

The second group of measure of a firm's efficiency deals with financial performance. The financial performance reflects the ability of invested by the company capital to earn a particular level of profit. The connection between financial performance and IC was found in many other studies. For example, it was shown that IC intensive companies are more successful in generating the returns on their investments (Youndt et al., 2004; Chen et al., 2005). The basic idea is that high level of management expertise and accumulated knowledge about markets allows performing deep and sophisticated analysis of investment opportunities and thus making successful investment decisions. Return on assets coefficient (ROA), economic value added (EVA) and the residual income (RI) were taken as proxies for financial performance.

The last group measures the stock market part of a firm's performance. The stock market term is split into two aspects. Firstly, it concerns the difference between company's market and book value, or the value of its book-to-market ratio. It is suggested that if the market is efficient, companies with higher level of IC are valued more by investors (Firer and Williams, 2003; Youndt et al., 2004; Chen et al., 2005; Skinner, 2008). Due to that, IC is assumed to have positive influence on market value of the company. Secondly, B. Lev postulates in his article "Sharpening the Intangibles Edge" that investments in IC actually increase the cost of capital for the company especially for high R&D intensive firms. The reason is that R&D investments are more risky than most other types of investments when evaluated as the volatility of future R&D cash flows. At the same time, investors' perception of the risk is exaggerated since companies typically either do not disclose any information about R&D investments at all, or provide few details in the corporate prospects. Lev et al. (2012) further look at the reasons behind the increased risk of R&D intensive firms and find that investments in R&D actually reduce competition risk, which they define as future volatility of sales, and operational risk, defined as the future volatility of cost of goods sold, but increase disruptive technology risk, defined as the future volatility of special items. Accordingly, book-to-market ratio and cost of equity were decided to be used as proxies for the stock market performance.

Corresponding equations are presented below. First seven equations correspond to Sydler et al. (2014) proxy for IC, second group employ VAIC approach. To avoid obvious omitted variable bias in the estimate of IC component other factors that influence company's performance should be taken into account. Following Zeghal and Maaloul (2010) and many other studies therein two control variables are included: company's size and leverage. The size of a firm is approximated by natural logarithm of total assets and leverage is specified as the ratio of total debt to equity.

$$\frac{EBIT}{Sales} = \beta_0 + \beta_1 IC + \beta_2 Size + \beta_3 Lev + \varepsilon$$

$$\frac{NI}{EBIT} = \beta_0 + \beta_1 IC + \beta_2 Size + \beta_3 Lev + \varepsilon$$

$$ROA = \beta_0 + \beta_1 IC + \beta_2 Size + \beta_3 Lev + \varepsilon$$

$$EVA = \beta_0 + \beta_1 IC + \beta_2 Size + \beta_3 Lev + \varepsilon$$

$$Residual\ Income = \beta_0 + \beta_1 IC + \beta_2 Size + \beta_3 Lev + \varepsilon$$

$$\frac{Book\ value}{Market\ value} = \beta_0 + \beta_1 IC + \beta_2 Size + \beta_3 Lev + \varepsilon$$

$$Cost\ of\ equity = \beta_0 + \beta_1 IC + \beta_2 Size + \beta_3 Lev + \varepsilon$$

$$\frac{EBIT}{Sales} = \beta_0 + \beta_1 VAIN + \beta_2 VACA + \beta_3 Size + \beta_4 Lev + \varepsilon$$

$$\frac{NI}{EBIT} = \beta_0 + \beta_1 VAIN + \beta_2 VACA + \beta_3 Size + \beta_4 Lev + \varepsilon$$

$$ROA = \beta_0 + \beta_1 VAIN + \beta_2 VACA + \beta_3 Size + \beta_4 Lev + \varepsilon$$

$$EVA = \beta_0 + \beta_1 VAIN + \beta_2 VACA + \beta_3 Size + \beta_4 Lev + \varepsilon$$

$$Residual\ Income = \beta_0 + \beta_1 VAIN + \beta_2 VACA + \beta_3 Size + \beta_4 Lev + \varepsilon$$

$$\frac{Book\ value}{Market\ value} = \beta_0 + \beta_1 VAIN + \beta_2 VACA + \beta_3 Size + \beta_4 Lev + \varepsilon$$

$$Cost\ of\ equity = \beta_0 + \beta_1 VAIN + \beta_2 VACA + \beta_3 Size + \beta_4 Lev + \varepsilon$$

2.2 Hypotheses Stated

The first set of hypotheses corresponds to the impact of IC on company's performance. It is important to emphasize that in hypothesis three negative influence of IC on B/M ratio is expected. Other things being equal, higher IC values correspond to higher market valuation which in turn drives the ratio boot-to-market down. The following set of hypotheses is stated with IC proxy defined by Sydler et al. (2014), but it generalizes to VAIC proxy by adding VAIN and VACA instead of IC variable.

H1: IC has significant and positive influence on company's economic performance: positive coefficients in front of IC term for both $EBIT/Sales$ and $NI/EBIT$ regressions are expected.

H2: IC has significant and positive influence on company's financial performance: positive coefficients in front of IC term for ROA, $EVA\ spread$ and $Residual\ Income$ are expected.

H3: IC has significant and positive influence on company's stock market performance in the form of a negative coefficient in front of IC in B/M regression. The impact of IC on the company's risk is twofold - it increases the disruptive technology risk but decreases operational and competition risk. Overall effect of IC on the cost of capital depends on the distribution of intellectual capital expenditures and a particular sign is not hypothesized.

3 Data Description

3.1 Data Mining

All the data was taken from Bloomberg database. Initial sample had the following structure:

- five emerging economies residing in the group BRICS: Brazil, Russia, India, China and South Africa;
- time period: 2005-2012 years;
- 8090 companies from 10 industries traded on local stock markets (64 720 observations).

3.1.1 Variables used in the research

Detailed description of main variables used in analysis is provided in Appendix A in table A.1. Description of additional variables which are not directly used in the investigation are provided in table A.2. Two variables deserve special attention: growth rate of expenditures on IC and risk-free rate used for Sydler et al. (2014) IC proxy calculation. In the original research growth rate is defined as a return of six-month US Treasury bill plus risk premium that is estimated by means of expert evaluation. We consider such a method a little bit ambiguous. Firstly, such a growth rate is supposed to be equal in all the countries considered and this does not correspond to reality. Secondly, the mechanism of risk premium evaluation is not explained and seems to be a kind of educated guess. Due to that, in this paper another approach was used. According to theoretical assumptions, the long-term growth rate is needed. Since time period in the model is assumed to tend to infinity, we suppose that company's expenditures on such a long period cannot grow faster than its country's GDP growth. A considered growth rate is an expected value, so we further assume it equal to the last observed value. The growth rate for each year and country is presented in table 2.1.[5]

[5] Data source - World Bank

Growth rate of GDP (g)					
	Brazil	Russia	India	China	South Africa
2006	0.040	0.082	0.093	0.127	0.056
2007	0.061	0.085	0.098	0.142	0.055
2008	0.052	0.052	0.039	0.096	0.036
2009	-0.003	-0.078	0.085	0.092	-0.015
2010	0.075	0.045	0.103	0.104	0.031
2011	0.027	0.043	0.066	0.093	0.036
2012	0.010	0.034	0.047	0.077	0.025

Table 2.1: growth rate of country's GDP (g)

The risk-free rate in the original research is assumed to be equal to return of six-month US Treasury bill. Such an approach does not reflect individual risks of each country and should be adjusted. In this work the risk-free rate was assumed to be equal to return on 10-year government bond of each country.[6] The 10-year period was chosen as its length is the closest one to the period's examined in this research and yet being sufficiently often traded at the countries' stock markets. Return on government bonds suits our purposes best as it is the least risky for each individual country and catches the difference in local risks.

Risk-free rate (r_f)					
	Brazil	Russia	India	China	South Africa
2006	0.126	0.070	0.076	0.030	0.079
2007	0.132	0.067	0.076	0.046	0.086
2008	0.126	0.075	0.062	0.027	0.073
2009	0.134	0.099	0.077	0.036	0.090
2010	0.124	0.078	0.079	0.039	0.081
2011	0.111	0.081	0.086	0.036	0.079
2012	0.092	0.082	0.080	0.036	0.064

Table 2.2: country's risk-free rate (r_f)

The main two problems with initial sample are potential measurement mistakes due to low level of transparency and authenticity in emerging markets and high share of missing observations. Below we deal with both these problems in turn.

[6] Data source - World Bank

3.1.2 Measurement mistakes and outliers

The first step of data mining consists in cleaning the raw data in order to eliminate obvious data recording mistakes. This procedure includes checks for non-negativity of financial variables and dropping observations with missing year or industry variable. The total number of observations after the cleaning decreased from 64 720 to 58 397.

As it was mentioned before, data from emerging markets may suffer from measurement mistakes. This reflects in presence of outliers in the sample that can bias the results of estimation. In order to detect outliers both visual and numerical analysis was performed. This analysis revealed that all the variables in all countries are characterized by a presence of particular number of outliers. In order to deal with such observations winsorization was performed. This method allows getting rid of extreme values without reducing the sample. Largest and smallest 1% of observations were replaced by corresponding 1st and 99th percentile values for each country and variable.

Next stage of data mining deals with missing observations. Table 2.3 provides an overview of the problem of missing data in our sample. On the whole 90% of the observations have at least one missing data in the set of variables used in the analysis. The distribution of missing observations is demonstrated in Appendix A in table A.3.

Country	Percent of observations with at least one missing	Total number of observations
Russia	99.9	8850
China	76.6	22329
Brazil	97.4	2804
India	98.9	21908
South Africa	98.3	2506
Total	90.4	58397

Table 2.3: Missing data per county

We can conclude that the problem of missing data is highly relevant for our sample. Particularly, out of five countries only China has more or less enough data to work with. All other countries' observations have only a marginal influence on the remaining sample.

Although the time interval is taken the most recent, i.e. from 2006 till 2012, obviously, there are still reporting and disclosing issues in the emerging markets which hinder the availability of sound and verifiable data for the purposes of our analysis. The data problem has made our sample, in fact, consisting almost solely of Chinese companies.

Missing values are tested for randomness in order to detect possible selection bias if any. The following dummy variable is created:

$$\text{dum\_miss} = \begin{cases} 1, \text{if there is at least one missing value in a row} \\ 0, \text{otherwise} \end{cases}$$

Three tests for randomness were performed: correlation analysis, testing for equality of group means and logit model.

3.1.3 Correlation analysis of missing values

Correlation values between variables and created dummy dum_miss are showed in table 2.4. Significant on the 5% level of confidence correlations are in bold: 7 variables have significant correlation with missing observations indicator. The number of observations varies from 15 030 for R&D expenses to 58 397 for year and industry variables. Only one variable is characterized by correlation higher that 10% in absolute value - year. Negative correlation between dum_miss and year is explained by increasing level of transparency and disclosure over time, which lowers number of missing data, yet, as we have seen earlier, is still not enough to increase the sample size.

Variable	dum_miss	Variable	dum_miss
year	**-0.325**	ni	0.007
industry_1	**-0.024**	cost_eq	0.000
oi	0.008	bv_share	0.005
pers_exp	**0.019**	roa	0.005
depr_amort	0.008	eps	0.003
ta	**0.014**	d_eq	0.002
intang	0.003	risk_prem	-0.001
rd_exp	-0.004	eva	-0.003
marketing	**-0.072**	eva_spread	-0.001
price	0.006	**tot_cap_inv**	**0.027**
num_shares	0.006	**sales**	**-0.017**
		wacc	0.001

Table 2.4: correlation between variables and dum_miss

3.1.3 Tests for equality of group means

Tests for equality of group means were done only for those variables that showed significant correlation with dum_miss. The idea of these tests is the following. All the company-year observations are divided into two groups: with and without missing observations. Then, mean values of variables for each group separately are calculated. Finally, the significance of differences in mean values between two groups is tested by use of a simple t-test. The null hypothesis that the difference between mean values is zero is tested against three alternative hypotheses: that the difference is not zero, more than zero and less than zero. If the difference is significant, so there is some possibility of non-randomness of missing data in the sample. Also, depending on alternative hypotheses, signs of differences can be analyzed and corresponding conclusions can be made.

The null hypothesis was rejected on the 5% level for: operational income, personnel expenses, depreciation and amortization, total assets, marketing, price, number of shares, net income, book value per share, roa, total capital invested and sales. According to the results obtained there is some tendency for missing data to be present in large companies. This is quite counter-intuitive as large companies provide more information and typically have more analysts following them. It might be the case because of largely unequal groups with and without missings. To prove the non-randomness of the missings observations a logit model is further evaluated.

3.1.4 Logit regression as a test for randomness of missing values

The logit model is estimated in order to answer a question: whether any variable influences the possibility of missing observation appearance. On the left side stands the dummy variable dum_miss. On the right side appear selected after t-tests variables. The results of such a model evaluation are presented in the table below (coefficients for year and country dummies are not reported but present in the model).

dum_miss	Coef.	z	P-value
oi	0.000	1.550	0.122
pers_exp	-0.002	**-4.780**	0.000
depr_amort	0.001	**4.400**	0.000
ta	0.000	0.070	0.942
marketing	0.000	**-3.050**	0.002
price	-0.006	-0.610	0.539
num_shares	0.000	0.130	0.896
ni	0.000	-0.110	0.914
bv_share	0.015	0.750	0.455
roa	-1.812	**-3.880**	0.000
tot_cap_inv	0.000	0.440	0.662
sales	0.000	**-2.150**	0.032
Intercept	3.423	6.730	0.000

Number of obs	7295
LR chi2(14)	1992.24
Prob>chi2	0
Pseudo R2	0.2522
Log likelihood	-2953.72

Table 2.4: results of logit regression estimation in terms of testing missing values for randomness

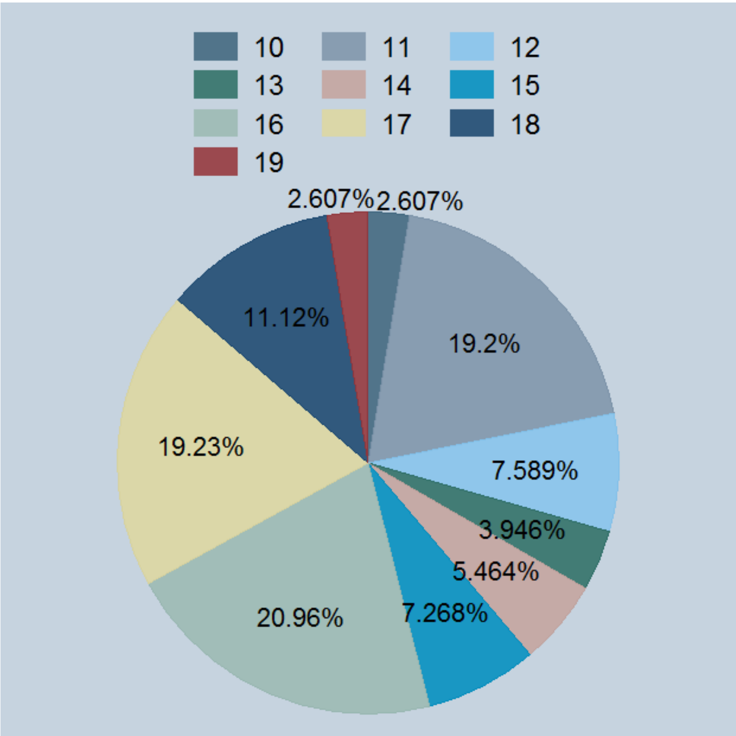
Overall the model appears to be significant in explaining the nature of missing data in the sample. Pseudo R-squared is about 25% with significant chi statistics. Five variables turn out to be useful for predicting the missing value in a given observation - personnel expenses, depreciation and amortization, marketing expenses, roa and sales. This allows us to make a conclusion that the influence of considered variables on the fact of missing data appearance is non-negligible. Taking all that into account, we can reject the hypothesis that our missings are completely random, there is some sort of dependence. Due to that, when we drop all data that have any number of missing values, we potentially run into the risk of creating a sample bias, which would bias the estimates. To overcome this problem one would need to evaluate the form of dependence in the missing date and recover the missings by means of the revealed and estimated dependence form. This, however, is a challenging task in itself and is not pursued in this study. Therefore, the problem of missing data limits the results of the current analysis, and some future research could be done along these lines.

3.2 Final Sample Description

After all the procedures of data mining remained sample looks as follows:

- 5 emerging markets: Russia (0,16%), China (93,34%), Brazil (1,29%), India (4,48%), South Africa (0,73%);
- time period: 2005-2012 years;
- 2481 companies from 10 industries (5600 observations after lagging).

The distribution of companies by industries is presented in figure 2.1. The composition of industries is diverse, major industries are consumer discretionary, industrials and materials. Together they account for more than 60% of the sample. In this study we follow the approach used in B. Lev. (2004) and Lev et al. (2012) and distinguish between IC-intensive firms and IC non-intensive firms. Particularly, for each year we rank firms according to intellectual capital and label the upper half (50^{th} percentile) as IC-intensive firms in this particular year. Then the procedure is repeated for the subsequent year. It is important to notice, that such method of selecting IC intensive firms do not stick to particular industries. Contrariwise, this approach allows any firm in any industry to be IC intensive in the sense that it invests actively and heavily in IC components compared to its peers. As outlined by Lev et al. (2004) IC can be a feature of any company with good management, highly qualified personnel, etc. irrelevant of the industry it originates from.



10. Communications
11. Consumer Discretionary
12. Consumer Staples
13. Energy
14. Financials
15. Health Care
16. Industrials
17. Materials
18. Technology
19. Utilities

Figure 2.1: distribution of companies in sample by industries.

Table 2.5 shows descriptive statistics of examined variables after data mining. According to the table, it can be found that the spread of values for nearly each variable is high even after winsorization. The conclusion that could be made is that rather low R^2 is expected. High variability of emerging markets' data is the main difficulty for the cross-sectional analysis, hence fixed or random effects models might be appropriate to partly mitigate this variation.

Looking at three components of IE - personnel, marketing and R&D expenditures - we observe that personnel and marketing expenses are roughly the same - 54 mln. USD. In contrast, R&D investments are approximately 5 times smaller - only 8 mln. This indicates that companies in emerging markets drive their competitive edge from personnel and marketing capital - i.e. optimizing production costs, increasing profit margins, advertising, expanding, etc. This is what we would intuitively expect from developing markets - opportunities for increasing the volumes, geographical expansion by means of aggressive advertising, ample opportunities for cost-cutting programs. Investments in research and development capital are more vital for developed competitive markets, where other sources of competition are already exhausted. Another insight from this table is that, since investments in R&D are comparably low to other components of IC capital, we would expect the risk increasing effect of R&D-related expenses documented by Lev et al. (2012) to be rather low for this particular sample.

Variable	Obs	Mean	Std. Dev.	Min	Max
oi	5600	92.47	278.42	-116.58	5650.63
pers_exp	5600	53.13	185.78	0.09	3106.84
depr_amort	5600	35.70	101.85	0.05	1870.99
ta	5600	1490.50	3328.06	4.78	30515.37
intang	5600	51.55	364.11	0.00	11172.79
rd_exp	5600	8.50	26.78	0.00	214.34
marketing	5600	54.44	353.25	0.02	12069.86
econ_grth	5600	0.09	0.02	-0.08	0.14
price	5600	1.67	2.67	0.04	65.88
num_shares	5600	1080.46	1914.53	0.94	15193.01
ni	5600	64.80	192.25	-815.07	4096.19
cost_eq	5600	0.14	0.03	0.04	0.23
bv_share	5600	0.69	1.43	0.03	32.34
roa	5600	0.06	0.06	-0.23	0.66
eps	5600	0.07	0.23	-1.26	4.91

lev	5600	0.67	0.95	0.00	22.46
risk_prem	5600	0.10	0.04	0.00	0.19
eva	5600	-2.94	78.32	-2069.54	1593.89
eva_spread	5600	-0.05	0.08	-0.59	0.48
tot_cap_inv	5600	111.19	754.45	0.26	20023.25
sales	5600	1020.58	2412.05	0.27	23259.79
r_f	5600	0.04	0.01	0.03	0.13
wacc	5600	0.12	0.03	0.05	0.23

Table 2.5: descriptive statistics of variables

4 Evaluation and Estimation

4.1 Estimation of Approximated Values of IC

4.1.1 Sydler et al. (2014) proxy of IC

The Sydler et al. (2014) proxy of IC is estimated by means of a two-step analysis. First step consists in evaluation of an adjusted RIM, obtaining coefficients and solving the system of equations (2.10). The second step consists in estimation of IC value basing on (2.8).

1st step: estimation of accumulation and depreciation rates of IC

The structure of examined data allows us to suppose that final model should be two-way fixed effects. Fixed effects are supported by the fact that each company is possessed of specific time-invariant characteristics which influence company's results and profitability, for example, corporate practices which are developed in the company. Concerning time effects, examined time period includes crisis years which effect on companies can differ across countries, so time effects should be taken into account. Also the problems of heteroskedasticity and multicollinearity are expected. Heteroskedastisity can occur because the sample includes companies of different sizes. As it was discussed before, size influences all characteristics of companies significantly, so the residuals can be dependent on some variables. Measurement of company's size is a tricky question. In this paper size is approximated by a natural logarithm of total assets, but it can also be approximated by market capitalization or book value. Taken all that into account, chosen proxy can catch not all the features associated with differences in firms' size. Multicollinearity can be caused by the fact that both current and lagged expenditures on IC are included into the model. Companies rarely change their expenditures on employees, marketing and R&D significantly every period, so these variables can be highly correlated.

Firstly, pooled OLS models with different sets of dummies were estimated. It was done in order to get the first impression about the data and understand what possible problems can occur. Initial Breusch-Pagan test revealed heteroskedasticity, so in order to deal with it further clustered sandwich estimator for variance-covariance matrix of estimators is employed, used in many papers dealing with panel data. This type of estimator is usually employed when model residuals are characterized by clustered correlation. Such a phenomenon signifies that residuals can be grouped into independent between each other clusters. The correlation arises between residuals that belong to one cluster. Clusterization is usually done basing on some common characteristics of observations. The observations can be grouped on the basis of their country or industry membership. In this paper the clusterization variable is company.

Calculation of VIF's and correlation analysis showed that there is moderate multicollinearity in the initial model. As it is presented in tables 3.1 and 3.2, there is high level of correlation between current and lagged values of expenditures on IC, VIFs are higher than the accepted benchmark of 10. To mitigate the effect of multicollinearity as well as further to reduce the heteroscedasticity in the data, one can divide each variable in the model by some other variable. This will not change the theoretical framework, but could decrease the degree of above mentioned problems. Therefore, we follow Sydler et al. (2012) and also divide the model by lagged book value of equity per share. The resulting model shows reduced mean VIF of 7.02 with highest factor for intellectual expenses variable equal to 13.1.

	bv_share	RI_share	IE_share	IE_share_lag
bv_share	1			
RI_share	-0.0888*	1		
IE_share	0.6162*	-0.0231	1	
IE_share_lag	0.6593*	-0.0377*	0.9704*	1

Table 3.1: correlation analysis of independent variables from Sydler et al. (2014) model; star indicates significance on 5% level.

Variable	VIF	1/VIF
IE_share	17.74	0.0564
IE_share_lag	17.27	0.0579
bv_share	1.84	0.5446
RI_share	1.01	0.9863
Mean VIF	9.47	

Table 3.2: VIF values for variables from Sydler et al. (2014) model.

Pooled OLS model was estimated with and without a set of dummy variables: for year, industry, country and portfolio. Table 3.3 shows that including dummies does not influence the quality of model significantly, except, probably, for the portfolio dummy. There are no big differences between information criteria and adjusted R2 for year, industry and country dummies.

№		AIC	BIC	R^2
1	Pooled OLS	14941.8	14971.6	0.1260
2	Pooled OLS, with year dummy	14864.5	14930.1	0.1539
3	Pooled OLS, with industry dummy	14875.3	14958.8	0.1486
4	Pooled OLS, with country dummy	14906.3	14959.9	0.1379
5	Pooled OLS, with portfolio dummy	14641.2	14724.6	0.2153

Table 3.3: comparison of AIC, BIC and R^2 of pooled OLS models: approximated value follows Sydler et al. (2014)

The summary of results for pooled OLS estimations are presented below. Main conclusions are ordered correspondingly to the serial number of the model:

1. The coefficients obtained in the original model differ substantially neither in values nor in significance by including new dummy variables.
2. All coefficients on year dummies are not significant except coefficient on 2008 year. This year also has the greatest impact on stock prices. Since we use the crisis sample, it is preferable to allow the year dummy to capture some abrupt change in other variables which took place in 2008 year.
3. Industry dummies show overall insignificance, so this dummy can be omitted from the analysis for this particular model.
4. As it might be expected, country dummies are insignificant, and their inclusion does not improve the model, so the sample can be examined as one big emerging market. This is not surprising, given that 93% of the sample consists of one country.
5. All portfolio dummies are significant. This finding indicates that size of the company matters. This model shows a moderate improvement in AIC, BIC and R^2. However, inclusion of variable “size” into Sydler et al. (2014) IC estimation model is not preferable, as it would break the theoretical structure of the model. The potential solution could be to estimate a panel model with fixed effects where the individual term will capture at least partly the initial difference in size between the firms.

All the models above pool the data and restrict every company to have the same coefficients in front of all explanatory variables. Since the data structure has a panel nature, it is necessary to validate such restricted "pooled" models. For this purpose Chow poolability tests were performed. These tests compare the residual sum of squares of both restricted and unrestricted models, weight them by the corresponding degrees of freedom, and provide a statistics showing whether the data is "poolable" by some variable. Since the data set has two dimensions - objects and time, "poolability" tests by individual effects and time effects are executed. Both tests output very small p-value, meaning that the data is not poolable neither by objects, i.e. companies, nor by time. Therefore, we proceed with panel data models.

Four panel data models were estimated: one-way and two-way fixed and random effects correspondingly. Fixed effects models reveal significant decrease in AIC and BIC as well as an improvement in within R-squared (table 3.4), especially if time effects are included in the model. In order to choose between fixed and random effects Hausman test was implemented. The resulting very small p-value suggested that random effects are inconsistent, so the fixed effects estimator is preferred.

	AIC	BIC	R^2 within	R^2 overall	F-stat/Chi-stat
One-way fixed effects	9386.873	9410.726	**0.1865**	0.0981	20.56
Two-way fixed effects	8681.172	8740.803	**0.3664**	0.1016	27.5
One-way random effects	-	-	0.1796	**0.1229**	71.45
Two-way random effects	-	-	0.3497	**0.1356**	279.23

Table 3.4: comparison of panel data models: approximated value by Sydler et al. (2014) estimation.

Taking all the factors into account, two-way fixed effects scaled model was chosen. This type of model provides the lowest values of information criteria, highest value of R^2 and consistent estimators as opposed to random effects model. Moreover, this model suits the assumption stated in this paper: it reflects the difference in individual time-invariant characteristics between companies, accounting for the size effect, and it also allows for the influence of the crisis year. Estimation results of this model are presented in table 3.5 below.

The model has positive and significant impact of residual income and expenditures on IC on company's stock price as it was expected. Coefficients in front of book value and lagged IE variables are positive but insignificant on the conventional 5% level of significance.

The coefficients obtained are then used in calculation of accumulation and depreciation rates. Due to insignificance, coefficients A_1 and A_4 are assumed to be equal to zero for the purposes of α and δ estimation.[7]

R^2 within		0.3664		
R^2 between		0.0833		
R^2 overall		0.1016		
F(10,1622)		27.5		
Prob>F		0		
corr(u_i, Xb)		-0.2494		
sprice		Coef.	t	P>|t|
sbv_share		0.42911	1.72	0.086
sRI_share		3.7928	**2.31**	0.021
sIE_share		2.83428	**2.46**	0.014
sIE_share_lag		1.05983	0.82	0.414
year				
	2007	1.27579	**2.29**	0.022
	2008	-1.8494	**-3.57**	0
	2009	-0.2647	-0.5	0.616
	2010	-0.2978	-0.57	0.571
	2011	-2.0679	**-3.99**	0
	2012	-2.3091	**-4.27**	0
_cons		3.38089	**5.9**	0
sigma_u		2.93366		
sigma_e		1.66283		
rho		0.75684	(fraction of variance due to u_i)	

Table 3.5: estimation results of two-way fixed effects model; adjusted RIM evaluation.

The accumulation and depreciation rates were calculated according to the formulas (2.10). Accumulation rate α occurred to be the same for all countries and years and equal to 0.74. This means that, on average, 74% of the expenditures on intellectual capital are capitalized in the company and further used as intellectual capital. The similar results are found by Sydler et al. (2014) - 84% for IC-intensive UK companies. The results of δ calculation are showed in table 3.6.

[7] The IC estimation without restricting the coefficients to zero provides similar results.

	Russia	China	Brazil	India	South Africa
2006	.	-0.03	-0.13	-0.08	-0.08
2007	-0.07	-0.05	-0.13	-0.08	-0.09
2008	-0.08	-0.03	-0.13	-0.06	-0.07
2009	-0.10	-0.04	-0.13	-0.08	-0.09
2010	-0.08	-0.04	-0.12	-0.08	-0.08
2011	-0.08	-0.04	-0.11	-0.09	-0.08
2012	-0.08	-0.04	-0.09	-0.08	-0.06

Table 3.6: results of depreciation rate δ calculation.

Depreciation rate occurred to be negative for all countries and years. This is different from Sydler et al. (2014) findings,[8] and indicates the situation when IC gains value in the course of time. This could be possible when expenditures on IC are deployed in a lagged manner. Such a lagged deployment can also take place when expenditures on IC are done step-by-step: each year only part of components is covered, and the whole effect accumulates once every part of IC component is upgraded. For example, a company can invest in purchasing new software for employees, but the full effect of this investment occurs later in time as the employees need time to learn the software and use it to their full advantage. Thus, the case of negative depreciation rate potentially could be justified, but it requires further confirmations to be claimed robust.

2nd step: calculation of IC

Employing obtained values for α and δ IC is calculated. Due to imperfect nature of the proxy for IC some observations appeared to be negative. These values were replaced by zero, the percentage of such values made up approx. 3.3%. IC per share has an asymmetric distribution with long right tail and high peak. For the purposes of further analysis it was also winsorized to reduce the distortion due to extreme outliers.

4.1.2 VAIC calculation

[8] They find the depreciation rate to be equal to 0.64 or 64% of IC is amortized every year. Ballester et al. (2002), (2003) obtain depreciation rate of 34% for HC only, 12-14% for SC.

Following Pulic (2000) procedure VAIC and its components were calculated. Value added was approximated as the sum of operating income, total expenditures on wages and depreciation and amortization. Descriptive statistics of VAIC and its components can be found in table 3.7. As it follows from obtained values, efficiency of intellectual resources employment significantly exceeds the efficiency of physical capital employed, which is in line with findings of Zeghal and Maaloul (2010) on UK market. The set of VAIC variables is a unitless measure; high values of VAIC are associated with higher efficiency of intellectual and physical capital employment in the company.

Variable	Obs	Mean	Std. Dev.	Min	Max
VA	5600	181.301	495.046	-52.52	7915.29
VACA	5600	0.12547	0.10842	-0.0469	2.08609
VAIN	5600	6.93605	7.12152	-8.9957	46.0751
VAIC	5600	7.06205	7.12444	-9.0078	46.1891

Table 3.7: descriptive statistics of VAIC and its components.

4.2 Valuation of Zeghal and Maaloul (2010) Model

The impact of IC on company's performance is estimated based on the approach proposed by Zeghal and Maaloul (2010). The authors measure the performance of a company on three-dimensional space. In line with this methodology we also distinguish between three dimensions but in contrast to above mentioned paper we include additional regressors into each dimentsion in order to obtain a more comprehensive picture of the impact of IC on the performance. On the first dimension there is economic performance of the company, measured by operational margin and ratio of net income to operational profit. The second dimension investigates financial performance and consists of rate of assets (ROA), economic value added (EVA) and residual income (RI). The third dimension considers stock market performance and the measures are book-to-market ratio and risk premium. The latter is defined as the product of country risk premium and company's beta. All the equation can be found in section 2.1.3.

The estimation procedure is different from the previous section. In this part we do not apply the fixed effects model as in the previous section, but stay with pooled OLS. This is done for several reasons. Firstly, the fixed effects together with IC variable produce very high multicollinearity, creating difficulties for statistical and economic inferences (VIFs around 43 and 55 for IC and size variables). Analyzing the effect of intellectual capital on company's performance we care about significance of the variables, hence the absence of high correlation between explanatory variables becomes crucial. The dummies, implied by the fixed effects estimator, correlate with IC term as well as with size variable, which is now included into the model as the control variable. Moreover, fixed effects may capture some of the impact of IC on the dependent variable, since IC is, by definition, unobservable and intangible - a latent and unique for each firm variable. Dummies for objects in fixed effects models are usually introduced exactly for the purpose of capturing the unobservable and unique to each object component. Hence, in the case of intellectual capital the inclusion of fixed effects might be detrimental for the evaluation of the IC term.

Therefore, for the above named reasons we employ the pooled OLS models to evaluate the impact of IC on the performance measures. Zeghal and Maaloul (2010) also use pooled OLS estimator, however, they do not provide any motivation for it. Contrary to the original paper, we also extend our model with time dummies to capture the crisis, and we follow Lev et al. (2012) in including the industry fixed effects into the model as well. To better understand the effect of IC on the company's performance, we split the sample every year into IC-intensive firms and IC-non-intensive firms as described in section 3.2. Consequently, further we present results for 3 samples - pooled, IC-intensive and IC-non-intensive.

As already mentioned in the previous section, IC variable is winsorized in order to reduce the distortion due to extreme outliers. This, however, still preserves high variability in the distribution. In order to reduce the heteroscedasticity induced by this variability and to scale down IC, which is measured in mln USD, we apply the logarithmic transformation, as we do with size variable which is the logarithm of total assets, a proxy used in Zeghal and Maaloul (2010).

4.2.1 Impact of IC on financial performance

Table 3.8 presents the results of the first regression using the return on assets as the measure of financial performance. The table reports six regression estimates: first three using Sydler et al. (2014)'s proxy for IC (pooled, IC-non-intensive and IC-intensive samples), and the other three regressions using VAIC measure. For each regression coefficients estimates are reported along with their robust t-statistics. Below the regression estimates several summary statistics are reported, namely, the number of observations used in the regression, its adjusted R-squared and F-statistic. In the second panel of the table we report the difference in coefficient estimates of IC or VAIN variables between IC-intensive sample and IC-non-intensive sample together with a test on whether these two estimates are statistically different from each other. Significant coefficient estimates are in bold. Note also that although not presented, the year and industry dummies are present in each of the models below.

	ROA											
	Pooled		**Non intensive**		**Intensive**		**Pooled**		**Non intensive**		**Intensive**	
Parameters	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat
IC	0.0083	**6.22**	0.0021	1.16	0.0143	**4.78**						
VAIN							0.0019	**13.44**	0.0018	**10.74**	0.0041	**7.89**
VACA							0.2949	**9.11**	0.2163	**5.56**	0.3987	**17.25**
size	-0.002	-1.4	0.0033	1.74	-0.0083	**-2.53**	0.0007	0.84	-0.0002	-0.21	0.0009	0.8
lev	-0.0261	**-19.86**	-0.0229	**-15.73**	-0.0308	**-13.28**	-0.0178	**-9.71**	-0.0154	**-6.84**	-0.0177	**-9.66**
Intercept	0.0581	**3.6**	0.0603	**2.53**	0.0511	**2.4**	0.0058	0.35	0.0287	1.26	-0.0438	**-2.23**
N	5419		2620		2799		5601		2802		2799	
adj. R-sq	0.2173		0.2054		0.2008		0.4628		0.4187		0.5515	
F-stat	37.709		23.907		15.993		50.651		30.382		53.253	
Coefficient comparison between intensive and non-intensive groups												
	diff	p-value						diff	p-value			
IC	0.0122	0.0005					VAIN	0.0023	0			

Table 3.8: The effect of IC and VAIN on ROA

Looking first at the regressions with Sydler et al. (2014) proxy (IC), we observe that in the pooled regression IC has a significantly positive impact on the return. The regression itself is significant as well - F-statistics of 37.7 together with R-squared of 21%. The non-intensive sample displays insignificant IC coefficient in contrast to positive and significant coefficient estimate obtained in intensive sample. The relative difference is also significant. Comparing the results with VAIN measure of intellectual capital provides us with the same results, except that VAIN is significant even in non-intensive sample, although having lower coefficient estimate. All regressions are significant, R-squared ranges from around 20% for Sydler's proxy to 42-55% for VAIN proxy.

To confirm the finding above we use another proxy for financial performance - EVA. Particularly, we employ EVA spread which is defined as the return on invested capital minus the weighted cost of capital. The results presented in table 3.9 show similar patterns - despite of the way IC is approximated, it has a significantly positive impact on the company's economic value added. It is interesting to point out that the impact of IC differs significantly between intensive and non-intensive samples. Although the overall impact is still significant, this distinction points at broad structural differences between intensive and non-intensive firms. To find out whether this is true indeed we check this hypothesis for other measures of company's performance.

	EVA spread											
	Pooled		**Non intensive**		**Intensive**		**Pooled**		**Non intensive**		**Intensive**	
Parameters	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat
IC	0.0118	**6.61**	0.0022	0.88	0.022	**5.55**						
VAIN							0.0018	**9.58**	0.0018	**9.02**	0.0043	**6.06**
VACA							0.2737	**6.77**	0.1519	**3.65**	0.4328	**9.63**
size	0.0022	1.15	0.0095	**3.45**	-0.0069	-1.75	0.0083	**6.09**	0.0077	**4.45**	0.0092	**4.7**
lev	-0.0063	**-3.48**	-0.0041	**-2.16**	-0.0092	**-2.89**	-0.0018	-0.62	-0.003	-0.76	0.0048	1.6
Intercept	-0.0296	-1.23	0.0206	0.48	-0.0526	-1.7	-0.0608	**-2.51**	0.0039	0.11	-0.1437	**-5.3**
N	5419		2620		2799		5601		2802		2799	
adj. R-sq	0.1587		0.1662		0.1597		0.273		0.2494		0.3652	
F-stat	21.504		15.779		13.839		27.976		23.96		23.289	
	Coefficient comparison between intensive and non-intensive groups											
	diff	p-value						diff	p-value			
IC	0.0198	0					VAIN	0.0025	0.0004			

Table 3.9: The effect of IC and VAIN on EVA

Table 3.10 reports the results for the last measure of the financial performance - residual income per share. As opposed to EVA spread measure, which comes from Bloomberg database, residual income is calculated manually according to the formula:

$$RI\ per\ share_t = EPS_t - r_e * BV\ per\ share_{t-1}$$

The results are again consistent with those obtained with ROA and EVA. Thus, we can confirm the second hypothesis (H2) - IC has a positive and significant impact on financial performance of the company, irrelevant of the proxy used.

Residual Income												
	Pooled		**Non intensive**		**Intensive**		**Pooled**		**Non intensive**		**Intensive**	
Parameters	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat
IC	0.0156	**2.44**	-0.0004	-0.14	0.0329	**2.02**						
VAIN							0.0017	**2.79**	0.0018	**2.08**	0.0034	**2.18**
VACA							0.5135	**4.16**	0.5158	**2.82**	0.4797	**3.64**
size	-0.0042	-0.93	0.006	1.73	-0.017	-1.36	-0.0007	-0.16	-0.0087	-1.22	0.0088	**2.97**
lev	-0.0156	**-5.11**	-0.0104	**-4.62**	-0.0217	**-3.72**	-0.0072	-1.68	-0.0041	-0.56	-0.0059	-1.3
Intercept	-0.0611	-1.33	0.0123	0.66	-0.1629	-1.79	-0.1974	**-2.44**	-0.2525	-1.3	-0.2568	**-2.79**
N	2764		1252		1512		2874		1362		1512	
adj. R-sq	0.1498		0.1293		0.1847		0.1094		0.0787		0.3567	
F-stat	12.394		10.826		5.845		10.938		6.8075		16.559	
Coefficient comparison between intensive and non-intensive groups												
	diff	p-value						diff	p-value			
IC	0.0333	0.0427					VAIN	0.0016	0.3473			

Table 3.10: The effect of IC and VAIN on RI

One of the interesting hypotheses stemming from the above obtained result is that firms earn positive EVA if and only if they invest in intellectual capital. Of 182 cases with zero intellectual capital in our sample 111 firms or 61% have negative EVA spread, whereas 71 cases (39%) actually do have positive EVA spread. Thus, our data do not support this hypothesis. This might be not surprising because of the market structure in emerging countries. Imperfect competition together with unsatisfied demand in such markets creates opportunities for companies to earn abnormal earnings by means of active marketing, aggressive pricing policy, geographical channels, etc. without actually making significant R&D investments. However, there might be a positive association between those firms who actively invest in R&D and those who achieve positive economic value added. To test this milder hypothesis we perform a contingency analysis. For this purpose a dummy variable dumEVA taking value of 1 if the firm displays positive EVA spread, and zero otherwise is created. We further classify all the observations in the data sample between four cases - negative EVA and non-intensive group, positive EVA and non-intensive group, negative EVA and intensive group, and positive EVA and intensive group. We then test the strength of association between columns and rows to figure out if intensive firms have higher chances of achieving a positive EVA than non-intensive firms and the other way round. Table 3.11 reports the results of this exercise.

Contingency analysis

	dumIC		
dumEVA	0	1	Total
0	2363	2122	4485
	84.33%	75.84%	80.09%
1	439	676	1115
	15.67%	24.16%	19.91%
Total	2802	2798	5600
	100%	100%	100%

Pearson chi2(1) = 63.3230 Pr = 0.000
Cramér's V = 0.1063

Table 3.11: The relationship between positive EVA and IC intensive firms

We observe that in the group of non-intensive firms 15.7% hit a positive EVA, whereas in the group of intensive companies the percentage of those who report positive EVA increases to 24%. Consequently, if a company actively invests in IC then the chances that it will not reach positive EVA decrease from 84% to 75%, other things being equal. Pearson's chi statistics of this association is significant given any level of confidence. Cramer's V which measures the strength of the relationship and varies between 0 (no association) and 1 (for two identical variables) equal 0.1 meaning that the association is modest.

Thus, we can conclude that active investment in IC does in fact lead to higher chances of hitting a positive EVA, but this relationship is quite moderate. As mentioned above, in emerging markets there are, probably, more easy ways of delivering a positive EVA other than risky R&D investments.

4.2.2 Impact of IC on economic performance

Since IC has a positive impact on the firm's return on asset as well as its economic value added, it might be interesting to look at where the benefits come from. Thus, we look at economic aspect of the company and split the production cycle into two stages - manufacturing and corporate governance, spelled out in section 2.1.3. We first present the results in table 3.12 for the production stage - EBIT/Sales.

EBIT/Sales												
	Pooled		**Non intensive**		**Intensive**		**Pooled**		**Non intensive**		**Intensive**	
Parameters	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat
IC	-0.0111	**-2.77**	-0.0216	**-2.17**	0.003	0.51						
VAIN							0.0079	**15.94**	0.0071	**12.24**	0.011	**7.58**
VACA							0.5401	**9.12**	0.4773	**5.58**	0.6737	**12.96**
size	0.0279	**6.72**	0.0437	**4.55**	0.0075	1.35	0.0098	**3.97**	0.0131	**3.68**	0.0021	0.66
lev	-0.0433	**-11.93**	-0.0452	**-9.9**	-0.0468	**-8.68**	-0.0245	**-5.97**	-0.0246	**-4.22**	-0.022	**-5.03**
Intercept	0.0676	**2.18**	-0.0211	-0.39	0.0988	**2.31**	-0.0816	**-2.68**	-0.0911	**-2.19**	-0.1125	**-2.71**
N	5419		2620		2799		5601		2802		2799	
adj. R-sq	0.0971		0.1053		0.1152		0.3213		0.2927		0.4135	
F-stat	14.167		11.086		10.736		33.736		23.588		25.398	
Coefficient comparison between intensive and non-intensive groups												
	diff	p-value						diff	p-value			
IC	0.0246	0.0337					VAIN	0.0039	0.0112			

Table 3.12: The effect of IC and VAIN on operational margin

Looking first at pooled regression we note that IC has a significantly negative impact on operational margin, given the significance of the regression on the whole. This is surprising keeping in mind the results in the previous section. It might be that negative estimator is driven by the non-intensive observations. This hypothesis is confirmed with negative coefficient of IC, but for the intensive sample the estimator is insignificantly different from zero. Comparing the results with another proxy for IC shows that in the case of VAIN there is a significantly positive impact of IC on the operational margin with a significant difference between intensive and non-intensive sample estimates. Thus, it can be concluded in this particular aspect the two proxies provide counter to each other’s results. It might be the case that the results differ since the proxies for IC have different interpretation. While Sydler’s proxy is a direct measure of intellectual capital, VAIN stands for the efficiency of IC employment, and might be closer connected to the operational margin, which is another form of company’s efficiency. Alternatively, Sydler’s proxy is a new measure of IC and is complicated to calculate as opposed to VAIC, which has longer history of successful applications in the research. It might be suggestive to investigate Sydler’s proxy in a more throughout way. But for the purposes of this research, we leave this suggestion for future research.

Table 3.13 presents the results for the second stage of the economic performance aspect - NI/EBIT. Here the results get particularly interesting.

NI/EBIT												
	Pooled		**Non intensive**		**Intensive**		**Pooled**		**Non intensive**		**Intensive**	
Parameters	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat
IC	0.2839	1.19	1.8171	1.55	0.6332	1.22						
VAIN							-0.0263	-0.52	-0.0648	-0.96	0.0515	0.79
VACA							-0.8019	-0.37	-2.6373	-0.94	3.1367	0.82
size	-0.2771	-1.72	-1.4736	-1.68	-0.8611	-1.14	-0.0253	-0.13	0.2158	0.83	-0.2972	-0.93
lev	-0.2037	-0.59	-0.544	-1.02	0.1555	0.4	-0.2488	-0.71	-0.6369	-1.24	0.2418	0.48
Intercept	0.8231	0.67	-1.2206	-0.61	1.3977	**2.01**	1.3532	**1.96**	-0.734	-0.55	1.5172	**2.81**
N	5419		2620		2799		5601		2802		2799	
adj. R-sq	-0.0005		-0.0009		-0.003		-0.0008		-0.0022		-0.0034	
F-stat	1.0002		0.8739		0.9484		0.8048		0.7538		0.883	
Coefficient comparison between intensive and non-intensive groups												
	diff	p-value						diff	p-value			
IC	-1.1839	0.3537					VAIN	0.1163	0.2127			

Table 3.13: The effect of IC and VAIN on NI/EBIT

Before looking at the coefficient estimates we note that all the regressions are, in fact, insignificant. In other words, a simple straight line would fit the data with the same level of goodness. A quick conclusion could be made - none of the variables included in the model has any explanatory power for the dependent variable, NI/EBIT. Thus, it seems that higher IC does not lead to lower borrowing costs or better optimized taxation plans. What is also interesting, size and leverage also has no influence on the ratio NI/EBIT. This means that bigger companies are in fact in the same borrowing conditions as smaller companies. More leveraged companies have same access to capital market as less leveraged companies - both observations are quite doubtful. Unfortunately, up to our knowledge we do not have any evidence of such analysis for other emerging or developed markets. Consequently, this direction could be interesting for future research both for emerging and developed markets.

4.2.3 Impact of IC on stock market performance

The stock market aspect of the company's performance is split into two parts: analyzing the book-to-market ratio and firm's cost of equity. Both these relationships depend on how the market evaluates the company and its intellectual capital. It is important to emphasize that if investors recognize and value intellectual capital, it should increase the market value of a firm, other things being equal. Therefore, book-to-market ratio should decrease as IC is not acknowledged as an asset and does not participate in book value calculation according to the accounting standards.

Table 3.14 presents the results for book-to-market ratio.

	B/M											
	Pooled		**Non intensive**		**Intensive**		**Pooled**		**Non intensive**		**Intensive**	
Parameters	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat
IC	0.0216	**1.98**	-0.0129	-0.65	0.0076	0.35						
VAIN							-0.0042	**-3.28**	-0.0044	**-3.24**	-0.0047	-1.19
VACA							-0.2346	**-2.23**	-0.2114	-1.49	-0.4471	**-2.93**
size	0.0172	1.27	0.1061	**6.27**	-0.0071	-0.31	0.031	**2.81**	0.0683	**5.3**	0.0051	0.37
lev	0.0336	1.15	-0.0165	-0.56	0.0627	1.73	0.0263	1.03	-0.0026	-0.11	0.0468	1.31
Intercept	0.5901	**4.04**	0.1011	0.81	0.8874	**3.88**	0.73	**4.81**	0.3803	**2.41**	1.0363	**4.5**
N	5419		2620		2799		5601		2802		2799	
adj. R-sq	0.0805		0.117		0.0818		0.0964		0.1225		0.0881	
F-stat	21.928		21.551		10.579		20.662		17.752		10.748	
Coefficient comparison between intensive and non-intensive groups												
	diff	p-value						diff	p-value			
IC	0.0205	0.4347					VAIN	-0.0003	0.9393			

Table 3.14: The effect of IC and VAIN on B/M ratio

First of all, we note that R-squared are uniformly low for both proxies. This means that it is difficult to explain the market value of the firms given their balance figures. This is not a new observation, however, a similar regression in Zeghal and Maaloul (2010) explained roughly from 30 to 60% of the sample variation in the UK market.[9]

The results for Sydler's proxy are again less clear cut as compared to VAIN proxy. Particularly, IC has a positive impact on book-to-market ratio in pooled sample, which is counter to our expectation. Segmenting between non-intensive and intensive firms does not make things more clear. Moving to VAIN proxy, we observe a negative and significant coefficient in pooled and non-intensive samples, but negative and insignificant in intensive sample.

In general, it looks like the market valuation of a firm is not closely related to its balance figures, at least based on our data sample. We obtain mixed results from both proxies, although VAIN seems to be more predictable. It might be the case that market valuation of a particular firm is affected by stochastic market, political, social and other factors, which drive the market price away from its fundamental value. Such deviations could become long lasting

[9] Zeghal and Maaloul (2010) estimated the regression without time and industry dummies.

and even non-reversal in sub- or inefficient emerging financial markets. In such cases the market value could be above or below fundamental for quite a long time, thus, explaining low explanatory power of the model based on accounting figures.

Table 3.15 presents the results for cost of equity regressions. To remind, according to several papers including Lev (2004) high investments in IC could increase the risk of a firm. More specifically, Lev et al. (2012) found out that R&D investments actually decrease the risk associated with competition and operations, but increase disruptive technology risk, associated with the volatility of special items. The latter include restructuring expenses, goodwill impairment, write-offs from mergers and acquisition, etc. The overall effect therefore depends on the profile of R&D expenditures for each firm.

Cost of equity												
	Pooled		**Non intensive**		**Intensive**		**Pooled**		**Non intensive**		**Intensive**	
Parameters	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat
IC	-0.0032	**-6.79**	0.0004	0.43	-0.0065	**-6.75**						
VAIN							0.0001	1.54	0	-0.02	0.0002	1.37
VACA							-0.0302	**-4.65**	-0.0118	-1.7	-0.051	**-5.8**
size	0.003	**5.73**	0.0001	0.05	0.0056	**5.56**	0.0008	2.38	0.0012	**2.61**	-0.0001	-0.29
lev	0.0008	1.88	0.0006	0.98	0.0011	1.87	0.0003	0.6	0.0001	0.23	0	-0.07
Intercept	0.0813	**17.59**	0.0652	**8.73**	0.0956	**16.18**	0.081	**17.36**	0.0686	**10.96**	0.0972	**15.76**
N	5418		2620		2798		5600		2802		2798	
adj. R-sq	0.4141		0.3926		0.4261		0.4135		0.3992		0.4309	
F-stat	195.09		95.972		105.44		165.11		81.92		92.463	
Coefficient comparison between intensive and non-intensive groups												
	diff	p-value						diff	p-value			
IC	-0.0069	0					VAIN	0.0002	0.2104			

Table 3.15: The effect of IC and VAIN on cost of equity

As it can be seen from the table, all regressions are significant with relatively high R-squared. Looking first at Sydler's proxy, IC has highly significant negative impact on the cost of equity. Segmenting this impact between non-intensive and intensive samples provides additional insights - a significant reduction in cost of equity occurs for IC intensive firms, whereas for non-intensive companies such effect is absent. It means that those firms, who seriously and actively invest in intellectual capital benefit from reduced operational and competition risk.

The results for VAIN proxy are insignificant in both three samples with the coefficients close to zero in absolute value. Again, the difference might be driven by the relative difference between two proxies - Sydler's proxy directly estimates intellectual capital whereas VAIN provides a measure of the efficiency of IC usage.

4.2.4 Summary

Here we briefly summarize the main conclusions derived from the analysis above.

- Intellectual capital has a positive impact on financial performance of the company measured by ROA, EVA or Residual Income. The influence is statistically significant irrelevant of whether Sydler's proxy or more traditional VAIN measure is used.
- The impact of intellectual capital on economic performance measured by operational margin delivers less clear cut results. It is significantly positive for VAIN proxy, which is what we expected, but significantly negative for pooled and non-intensive sample for Sydler's proxy. The NI/EBIT regression appeared to be insignificant for both proxies, implying that IC is not relevant for explaining NI/EBIT ratio.
- Investigating the stock market performance measured by book-to-market ratio resulted in mixed evidence. Sydler's proxy revealed positive impact of IC on B/M ratio for pooled sample, whereas VAIN proxy resulted in significantly negative impact for pooled and non-intensive samples, which is what we intuitively expected. Regressing cost of equity revealed a significantly negative impact of IC on the overall level of firm's risk in the case of Sydler's proxy, and insignificant impact in case of VAIN measure.
- The difference in results obtained using the two proxies for IC could lie in the different aspects approximated by these proxies. While Sydler's proxy is a direct estimate of IC, VAIN is a measure of the intellectual capital's usage efficiency. This might have led to VAIN being more relevant for explaining operational margin and Sydler's proxy being more relevant for cost of equity and book-to-market analysis as it approximates the intellectual capital itself, which is what market is trying to evaluate.
- Comparing the intellectual capital intensive and non-intensive firms we find that IC intensive companies display significantly better financial performance in terms of ROA, EVA and Residual Income. It looks like IC intensive firms

on the emerging markets invest in IC in order to increase its operational efficiency by means of, for example, reducing its operational costs, optimizing the production cycle, etc. Moreover, the investments of IC intensive firms lower the cost of equity for such firms, as also evidenced by Lev et al. (2012).

- We also find some evidence concerning the low relation between market evaluation of the firm and its fundamental value. It might be the case that the prices in the emerging stock markets are driven by other non-fundamental factors, for example, political situation, business climate. Moreover, firms in emerging economies have various opportunities to achieve positive EVA other than investing in intellectual capital, which characterizes such markets with imperfect competition and unsatisfied demand.

Conclusion and discussion

This research deals with a couple of important topics in the area of intellectual capital: IC estimation and evaluation of the effect of IC on corporate performance. Estimation of IC is a vital topic since the notion of IC is vague in itself. Intangible nature together with absence of accounting standards regulating the IC reporting makes the task of IC estimation a tough challenge to accomplish. Evaluation of the IC effect on company's performance is another key topic because it allows companies to evaluate the efficiency of their spending on IC components, regulatory institutes to develop a system of accounting rules in order to decrease the information asymmetry which exists in the market. Lev (2004) in his motivating article calls for the increased attention to the intellectual capital phenomenon. He argues that there still remain two actions to be done by companies and regulatory institutes: regular ROI calculation of R&D investments and recognition of R&D as an asset rather than a cost. This should solve the problem of underinvestment in R&D projects and increase the current level of R&D investments, which he estimates to be one third of the optimal level.[10] Intellectual capital is often associated with the difference in market and book value which market assigns to the intangible quality of management, professional practices, patented software, licenses, know how, etc. In the conditions of a new knowledge economy, traditional production resources - physical capital and labour - merely become commodities. It means that these

[10] For the US economy.

resources generate some standard level of profit, theoretically, equal for all firms in a given industry. What differentiates the firms is the level of intellectual capital, and increasing the quality and efficiency if IC usage enhances profitability of a firm.

In the course of the study three problems were solved. Firstly, Sydler's proxy was estimated on the five biggest emerging markets. We obtained a dollar estimate of each firm's intellectual capital. However, this measure displays high variation and is subject to a number of assumptions. In some instances in the subsequent analysis it provided distinctly different results compared to VAIN proxy and hence should be treated with caution.

Secondly, using two proxies for IC an analysis of the impact of IC on three aspects of company's performance was performed. It was revealed that IC has a positive and significant influence on ROA, EVA and residual income. Although the hypothesis that firms which do not invest in IC cannot reach positive EVA was rejected, a contingency analysis confirmed positive and significant association between intensive investing in IC and delivering positive EVA. Further based on the results from the analysis we may suggest that firms in the emerging countries invest mostly in increasing the operational efficiency by means of cutting production costs, developing better practices and etc. Although not confirmed by Sydler's proxy, a positive and significant impact of IC on operational margin is found in regressions with VAIN. More evidence in favor of this suggestion is found in cost of equity regressions: IC has a negative impact on the risk of the company, leading, as postulated by Lev et al. (2012) to decrease in competition and operations risks. Based on the stock market aspect of company's performance, we find low evidence of the market valuating intellectual capital. The reason might be that in the emerging financial markets prices might deviate from their fundamental values for quite a long time due to the impact of other factors, for example, political or social.

Thirdly, comparing the intellectual capital intensive and non-intensive firms we find that IC intensive companies display significantly better financial performance in terms of ROA, EVA and residual income. Moreover, the investments of IC intensive firms lower the cost of equity for such firms. IC non-intensive firms merely try to mimic the behavior of IC intensive firms and follow after them in introduction of new products, new production schemes, cutting cost programs, etc. This, however, lead to lower economic returns associated with such behavior as compared with intensive firms.

The present study has also a number of limitations. Firstly, the share of missing data implies some structure, making the missing data nonrandom and leading to, possibly, a bias. For the full representativeness it is necessary to model the missing data generating process and try to recover the part of the distribution which we did not have in the present data. Secondly, in the course of the analysis we ran into a puzzle with NI/EBIT regression. According to the results obtained, neither IC, nor size and leverage affect the dependent variable. NI/EBIT accounts for the debt raising capability of a firm, realizing in a high or low interest rate, and for taxation plans. The capability of a firm to raise debt under a certain interest rate should, in principle, depend on the size of the firm (small firms do not have access to stock markets) and on the leverage (highly leveraged firms are restricted in new borrowings). Thus, the insignificance of the regression containing NI/EBIT should be verified in future research.

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Appendix

Appendix A

Table A.1: description of main variables used in the paper

Variable	Decipher	Description	Units	Ticker in Bloomberg
bv	Book value	Value of common equity reflected on balance sheet: A measure used by owners of common shares in a firm to determine the level of safety associated with each individual share after all debts are paid accordingly.	$ mln	BOOK_VAL
bv_share	Book value per share	Book value divided by the number of shares outstanding.	$	BOOK_VAL_PER_SH
depr_amort	Depreciation and amortization	Includes all depreciation and amortization expenses included as a part Operating Expenses.	$ mln	CF_DEPR_AMORT

cost_eq	Cost of equity	Cost of Equity = Risk-free Rate + [Beta x Country Risk Premium]	%	WACC_COST_EQUITY
eps	Earnings per share	Trailing 12-month diluting net income per share.	$	TRAIL_12M_EPS
EVA	Economic value added	The after-tax profits generated in excess of the cost of capital deployed to generate those profits.	$ mln	WACC_ECON_VALUE_ADDED
eps_spread	Spread of economic value added	WACC Return on Invested Capital - Weighted Average Cost of Capital	%	WACC_EVA_SPREAD
intang	Intangible assets	The total amount of Intangible Assets as disclosed in the financial reports.	$ mln	BS_DISCLOSED_INTANGIBLES
lev	Total debt to total equity ratio - company's leverage	Calculation: the sum pf short-term and long-term debt devided by total common equity and multiplied by 100.	%	TOT_DEBT_TO_COM_EQY
ni	Net income	Net income of the company as disclosed in the financial reports.	$ mln	NET_INCOME
risk_prem	Risk premium	Risk premium is the product of Country Risk - Premium (VM109, COUNTRY_RISK_PREMIUM) and applied beta.	%	RISK_PREMIUM
num_shares	Number of shares	Weighted average number of shares outstanding during the period, excluding the effect of convertibles.	mln	IS_AVG_NUM_SH_FOR_EPS
oi	Operating income	Operating income of the company as it is disclosed in the financial reports. Calculation formula depends on the industry.	$ mln	IS_OPER_INC

price	Price of company's share	Last price of company's shares in the considering period.	$	PX_LAST
roa	Return on assets	Return on assets. Calculated as the trailing 12-month net incom divided by average total assets and multiplied by 100.	%	RETURN_ON_ASSET
sales	Revenue on sales	Gross income of the copany before any adjustments.	$ mln	SALES_REV_TURN
Tot_cap_inv	Total capital invested	Total Debt + Total Shareholders' Equity + Allowance for Doubtful Accounts + Deferred Tax Liabilities + Accrued Income Taxes	$ mln	TOTAL_INVESTED_ CAPITAL
ta	Total assets	The value of total assets as it is reported in the balance sheet.	$ mln	BS_TOT_ASSET
wacc	Weighted average cost of capital	The average cost of the capital firm deploys for generating revenues.	%	WACC

Table A.2: description of additional variables used in the paper

Variable	Description	Units	Ticker in Bloomberg
Total expenditures on employees	Includes wages and salaries, social security, pension, profit-sharing expenses and other benefits related to personnel.	mln	IS_PERSONNEL_EXP
Expenditures on R&D	Total research and development expenditures incurred which includes R&D in profit and loss account and capitalized R&D during the period.	mln	IS_RD_EXPEND

Expenditures on marketing and advertising	Reported expenses on marketing and advertising.	mln	ARD_SALES_MKT_ ADVERTISING_EXP

Table A.3: distribution of missing values in initial sample

Number of missings	Frequency	Percent	Cumulative Percent
0	5604	9.6	9.6
1	6694	11.46	21.06
2	13008	22.28	43.33
3	6041	10.34	53.68
4	3197	5.47	59.15
5	1473	2.52	61.68
6	819	1.4	63.08
7	1889	3.23	66.31
8	2406	4.12	70.43
9	1146	1.96	72.4
10	541	0.93	73.32
11	222	0.38	73.7
12	119	0.2	73.91
13	138	0.24	74.14
14	1201	2.06	76.2
15	4578	7.84	84.04
16	374	0.64	84.68
17	129	0.22	84.9
18	18	0.03	84.93
19	10	0.02	84.95
20	1436	2.46	87.41
21	7354	12.59	100
Total	51 672	100	