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INTELLECTUAL CAPITAL INVESTMENTS: EVIDENCE FROM PANEL VAR ANALYSIS

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INTELLECTUAL CAPITAL INVESTMENTS: EVIDENCE FROM PANEL VAR ANALYSIS

It is believed that investments in intellectual capital enable a company to create a competitive advantage that results in the ability to earn economic profits and increase company value. However, this influence is reciprocal: Companies that generate more money can invest more funds in intellectual capital. The aim of this study is to use vector autoregression (VAR) to analyze the return on investments for companies in tangible and intellectual assets. This instrument allows us to take into account both the lag effect and the mutual influence of intellectual capital components.

JEL Classification: C22, C33, G30, O30

Keywords: vector autoregression, intellectual capital, return on assets, economic value added, investments, panel data

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1. Introduction and literature review

Nowadays the fact that the intellectual resources of companies are increasing in importance is confirmed by empirical studies and is recognized in the business world (Lev, 1999). Consequently, the financial performance of a company and its equity attractiveness for potential shareholders are also largely driven by intellectual capital. However, the means by which investment in intellectual capital actually allows companies to achieve success is a debatable question.

Intellectual capital theory considers such key companies' resources as employee knowledge, information systems, relationships with suppliers and customers, and management. It combines existing achievements in different areas, such as intangible asset evaluation, theory of competitive advantage and strategic management of resources (resource-based approach to the theory of the firm), and human capital. It also disseminated approaches to human capital analysis to other types of intellectual capital. There are three levels of intellectual capital analysis – macro level, sectorial level and micro level – and in this paper we consider intellectual capital at the company level.

A company's intellectual capital is heterogeneous and is usually divided into several components. Most authors identify three main structural components of intellectual capital: Human capital, structural capital, and relational capital (Bontis, Chua, & Richardson, 2000; Bontis, 1996, 1998, 1999; Roos et al., 1998; Stewart, 1991, 1997; Sveiby, 1997b, Edvinsson and Malone, 1997; Edvinsson, Sullivan, 1996; Moon, Kym, 2006; Nazari, 2010).

- **Human** capital. In the concept of intellectual capital, human capital is treated as knowledge that belongs to employees, for example skills, abilities, and experience (Stewart, 1997; Lee, 2011).
- **Structural** capital is defined as “the knowledge that doesn't go home at night” (Stewart, 1997). Although it is created by employees, it can also be separated from them. First of all, structural capital includes organizational procedures, strategies, patents, manuals, and databases (Nazari, 2010). In other words, structural capital is determined by human capital, but at the same time it is independent.
- **Relational** capital is a company's ability to interact successfully with its external stakeholders in order to develop the potential of value-creation by enhancing human and structural capital.

Nowadays, the role of intellectual capital in corporate management is being actively investigated. A number of empirical studies show that the contribution of intellectual resources in a company's value is significant (Bontis, 2000; Chen, Zhu, Xie, 2004; Tseng, Goo, 2005; Huang, Hsueh, 2007; Kamukama, Ahiauzu, Ntayi, 2010; Chang, Hsieh, 2011).

One of the important properties inherent to investments in intellectual capital is the effect of time delay (Tseng, Goo, 2005). This means that investments in human, relational, and structural capital take time to be fully implemented: There is a certain inertia which delays total and immediate use of benefits derived from these investments. In general, this property is common to all types of investment, but taking it into consideration, it shows the need to consider the return on investment in human capital with a certain lag. Norton and Kaplan emphasize this feature in the construction of the Balanced Scorecard (Kaplan, Norton, 1992). They call operational indicators, such as customer satisfaction and relationships with suppliers leading or factors of activity, while they consider financial indicators to be lag indicators. Norton and Kaplan noted that the management based on financial measures provides only short-term results, while non-financial performance indicators are leading and are better for long-term efficiency.

Thus, researchers recognize a company's intellectual resources as being crucial for survival and for successful competition in the knowledge economy. Yet most of these studies are based on the assumption that the impact is completely exhausted in one period, while theoretical assumptions run contrary. Moreover, these studies ignore the following inverse relationship: The result of a company's activity (the value of equity and economic profit) is closely connected with a company's ability to invest, which in turn causes the growth of intellectual resources. Consequently, in models that do not take into account the reverse effect, there is some endogeneity, which biases the model's evaluation results towards a higher importance of intellectual capital. In this paper we try to solve this problem as reasonable as possible, and also we try to take into account the mutual influence of intellectual resources and their relationship with a company's tangible resources.

2. Data and the methodology

In order to evaluate the impact of intellectual capital on a company's performance, it is necessary to determine an indicator for each intellectual capital component. At the same time, since we want to take into account the delayed impact of investment in intellectual capital, we need indicators available in dynamics. To measure human capital (HC), the number of company employees is used (Scandia Navigator, 1997; Baiburina, Golovko, 2008; Garanina, 2009;

Sullivan, 2000; Wang, Chang, 2005; Zickgraf, Merton et al., 2007). This indicator characterizes the number of “carriers” of this component of intellectual capital and it is available for external investors. On the other hand, this indicator has a disadvantage in that it ignores differences in employee knowledge that depend on their position in the company.

The proxy indicator of a company’s structural capital (SC) can be represented by the value of its intangible assets (Shakina, 2011; Shakina, Barajas Alonso, 2012), since this value is an estimate of patents and licenses value. In this case, intangible asset value does not include many elements of structural capital, such as manuals, know-how, and corporate culture because the information about it is available only to internal stakeholders. However, we can assume that the intensity of use for these structural capital elements is proportional to the intangible asset value, as specified in the balance sheet. In this case, the intangible asset value can be a proxy indicator for structural capital owned by the company.

Relational capital (RC) in empirical studies is usually measured by an indicator calculated on the basis of a company’s revenue (Van Buren, 1999; Brennan, Connell, 2000; Tsan, 2004; Chen, 2004; Marr, Adams, 2004) or advertising expenditures (Edvinsson, Malone, 1997; Tsan, 2004; Wu, 2004; Chen, 2004). However, these indicators characterize a company’s relationship only with customers and do not reflect a company’s value creation through relationships with suppliers. A company’s contribution to the development of relational capital can be estimated as the excess of accounts receivable over accounts payable. The larger this value is, the greater deferral a company offers to its clients and the quicker it pays for supplier goods and services.

Also it is necessary to consider that tangible assets (TA) are required for a company’s activity and may affect financial performance.

In order to make a cross-industry comparison, we selected a group of major industries that play an important role in the US economy. Each industry can be characterized by some specific features that are related to the role of intellectual capital.

- The pharmaceutical industry is mainly characterized by significant structural capital value, which is represented by licenses and patents.
- Consulting and educational services were attributed to the service industry. Thus, the key resource for this industry is human capital and established relationships with customers.
- The steel industry is generally classified as one of the traditional industries. Consequently, steel companies have minor amounts of intellectual capital.

- The retail industry is characterized by small amounts of tangible assets. The most important role here is the attraction of customers, which is considered relational capital.
- The telecommunications industry, as well as retail trade, is mostly focused on the attraction and retention of customers. Furthermore, the development of communication facilities and customer databases requires investments in structural capital.

Table 1 contains information on the value of different components of intellectual capital relative to tangible assets. Selected proxy indicators reflect the expected economic characteristics of the various industries.

Table 1. A comparison of industries on the relative size of intellectual capital components.

	Number of observations	HC/TA	SC/TA	RC/TA
Pharmaceutical	1035	0.09	10.47	-7.20
Retail	1080	0.06	1.82	-1.68
Services	1222	0.36	6.82	-6.85
Steel industry	390	0.02	0.28	-0.50
Telecommunications	1727	0.04	3.33	-1.19

Empirical studies regarding the influence of intellectual capital on a company's activity use different measures of performance. Short-term indicators measure performance over one period, such as return on assets (Firer, Williams, 2003; Chen et al., 2005; Shiu, 2006; Ting, Lean, 2009), return on equity (Chen et al., 2005), operating profit, or EVA (Huang, Wang, 2008). Long-term measures are based on a firm's value and can be absolute, such as market value of equity (Tseng, Goo, 2005; Diez et al, 2010; Brynjolfsson et al., 2002), or relative, such as the market-to-book value ratio (Firer, Williams, 2003; Chen et al., 2005; Shiu, 2006; Chang, Hiesh, 2011). But when we use a company's market value as the target indicator for performance, we lose information about companies whose equity isn't traded on the stock market. Also, the market value of equity is exposed to the influence of stock market tendencies. Thus, we chose short-run indicators of company performance. Firstly, we use one of the traditional measures – net operating profit (NOPAT) – that could be derived directly from a company's reports. Secondly, following the value-based management concept, we use economic profit (EVA), which takes into account not only explicit costs, but also opportunity costs.

It is difficult to estimate the relationship between components of intellectual capital and a company's performance measures (NOPAT, EVA) because selected variables may simultaneously affect each other. Thus, it is difficult to mark out the impact of one selected factor over another, abstracting from the effects of other variables.

In our research we use VAR (vector autoregression) for this purpose. The use of orthogonal response functions (impulse response function, hereinafter IRF) allows us to solve the problem described above: We can evaluate the reaction of one variable (for example, NOPAT) to the shock in the other variable (for example, HC), leaving all other variables of our structural model constant and without considering their changes (shocks).

We estimate a panel VAR (panel vector autoregression, hereinafter pVAR). It allows us to combine the advantages of VAR described above and the advantages of using panel data, allowing us to take into account the individual heterogeneity of companies (Love, Ziccino, 2006).

We use pVAR of a second order:

$$z_{i,t} = \alpha + \beta_1 \cdot z_{i,t-1} + \beta_2 \cdot z_{i,t-2} + f_i + e_i, \quad (1)$$

where $z_{i,t}$ is a vector of four variables {NOPAT, hc, rc, sc}. We also use another specification where $z_{i,t} = \{EVA, hc, rc, sc\}$ in order to consider the differences in the relationships between different types of capital and accounting (NOPAT) and economic (EVA) indicators; f_i is a company's individual features (see below); hc is the increase in the number of employees, measured in thousands; rc is the increase of the difference between accounts receivable and accounts payable, measured in millions of US dollars; sc is the increase in the value of intangible assets, also measured in millions of US dollars; and NOPAT is the net operating profit, calculated on the basis of a company's effective tax rate.

$$EVA_{i,t} = NOPAT_{i,t} - WACC_{i,t} \cdot IC_{i,t-1}, \quad (2)$$

where $IC_{i,t-1}$ is the sum of the book values of equity and long-term debt capital, and $WACC_{i,t}$ is the weighted average cost of capital:

$$WACC_{i,t} = k_{ei,t} \cdot \frac{E_{i,t}}{V_{i,t}} + k_{di,t} \cdot \frac{D_{i,t}}{V_{i,t}} \cdot (1 - tax_{i,t}), \quad (3)$$

where $D_{i,t}$ is the book value of long-term debt; $E_{i,t}$ is the book value of equity, $tax_{i,t}$ is an effective tax rate of the company; $k_{di,t}$ is the cost of debt determined based on the company's synthetic credit rating as the sum of the risk-free rate and the default spread (found according to S&P ratings); and $k_{ei,t}$ is the cost of equity:

$$k_{e,i,t} = RF_t + RP_t \cdot \beta_{i,t} \quad (4)$$

RF_t is the risk-free rate, calculated as the geometric mean of the yield of U.S. Treasury bills for 30 years (the data on yield were taken from the site of Damodaran www.damodaran.com). RP_t is the risk premium associated with changes in the stock market. It is calculated as the difference between the geometric mean for the stock returns in the U.S. stock market for 40 years and risk-free rate. $\beta_{i,t}$ is the beta coefficient characterizing company's risks associated with whole economy risks (systematic risks). The unlevered beta coefficient ($\beta_{u,i,t}$) is determined by the Damodaran database and then adjusted according the Hamada formula (Damodaran, 2004):

$$\beta_{i,t} = \beta_{u,i,t} \cdot \left(1 + \frac{D_{i,t}}{E_{i,t}} \cdot (1 - tax_{i,t}) \right), \quad (5)$$

We analyzed *orthogonal* IRF, focusing on how a shocked variable impacts another variable, keeping other shocks constant. However, since the empirical variance-covariance matrix is diagonal, in order to isolate shocks it is necessary to decompose residuals in the model so that they will be orthogonal.

Using VAR for panel data, it is necessary to set a limit on the data structure: The same (or random – the so-called “random-effect model”) structure of cross-sectional data is assumed. This assumption is not consistent with the empirical data: Companies are heterogeneous; each has its own features. Thus, for a correct analysis, it is necessary to allow for individual heterogeneity within a cross-section, i.e., to use a statistic model with “fixed effects” (fixed object model).

Since fixed effects are correlated with dependent variables (the problem arises because of the usage of lags), we cannot use mean-differencing. To solve the problem of endogeneity, we use the Helmert procedure. This procedure removes the average value, calculated on future values, and allows us to preserve the orthogonality of transformed and lagged regressors. Thus, we can use them as tools in evaluating the resulting system of equations using the method of moments. In our case, the model is not super-identified, so using the method of moments is equivalent to using the two-step OLS. To analyze IRF, it is necessary to assess confidence intervals. Since the IRF matrix is based on estimated pVAR coefficients, it is necessary to take into account standard errors. We use a Monte Carlo simulation in order to generate confidence intervals and a distribution of standard errors is not parameterized. A bootstrap approach is used to approximate the distribution empirically.

Finally, we also make a variance decomposition, which shows what percentage of variance (accumulated over time) of one variable is explained by shocks in other variables.

We used data from Compustat Database about American companies working in pharmaceutical, retail, steel, telecommunications, and service industries for the period from 2001 to 2010. The choice of U.S. companies is explained by the fact that the role of intellectual capital in this country is significant, according to the Knowledge Economy Index of the World Bank and the National Intellectual Capital Model (Lin, Edvinsson, 2008), which estimate the overall level of a country's development and the efficiency of its use of knowledge.

3. Results

Pharmaceutical companies have a fairly stable financial result, but their economic profit has no clear relation to the previous values (Figure 1.). Investments in intellectual capital affect investments in tangible assets. The relationship between capital investments and operating profit is explained by the fact that capital investments respond to shocks in operating profit. Thus, in the pharmaceutical industry, an investment strategy whereby companies consistently invest a certain amount of operating profit into tangible assets can be noted. Also, an additional increase of capital expenditures is related to the increase of human capital or the reduction of structural capital. Consequently, structural capital and tangible assets are substitutes for the company, to some extent. In this case, no positive return on investment in tangible assets is observed.

However, if we consider economic profit, then, as we can see in the graph, it is negatively related to the increase in human capital (Figure 2). The negative relationship with capital investments is explained by the fact that investments are rising, but there is no return on these investments during the analyzed period.

Thus, we can assume that, in the pharmaceutical industry, investments in tangible and intellectual assets (human and structural capital) have a return only within a period longer than four years. However, consideration of a model with longer time intervals requires consideration of more factors.

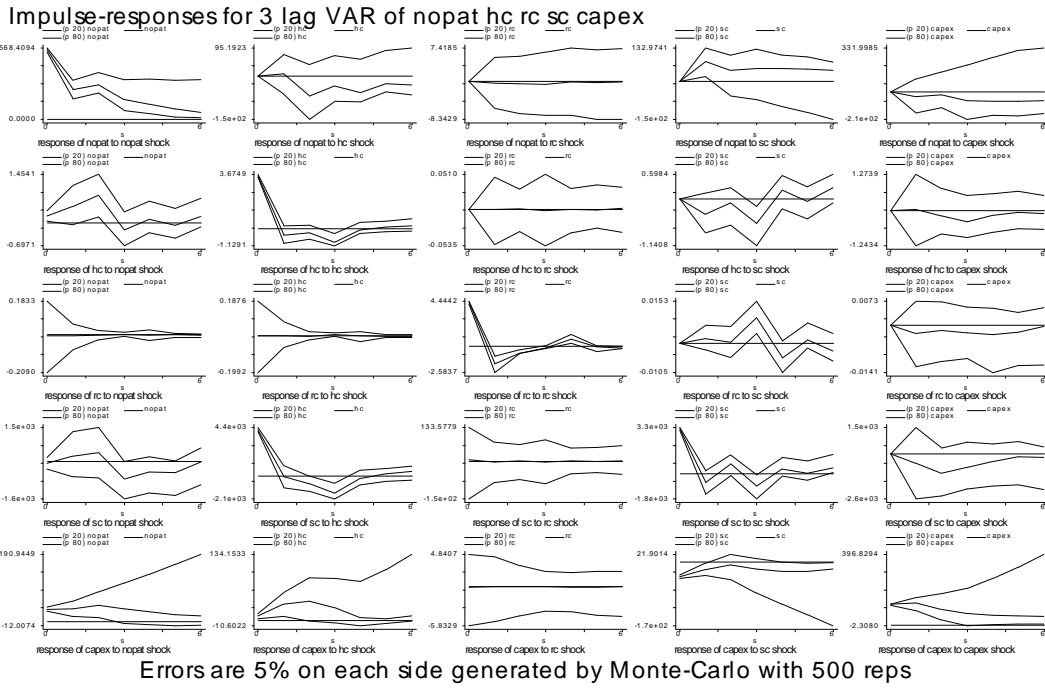


Fig. 1. Impulse responses for 2 lag VAR of NOPAT, human, relational, structural capital and tangible assets for pharmaceutical companies.

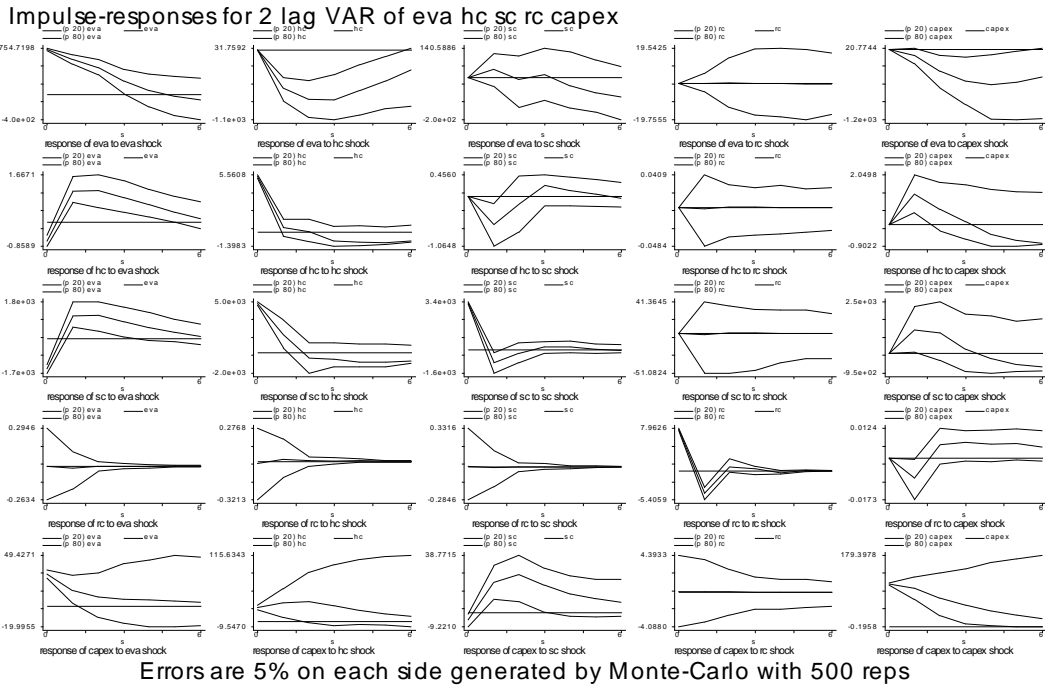


Fig. 2. Impulse responses for 2 lag VAR of EVA, human, relational, structural capital and tangible assets for pharmaceutical companies.

In the retail industry, we can observe a relationship between current indicators of performance and their previous values as measured by net operating profit and economic value added (Figures 3 and 4). As in the pharmaceutical industry, the most endogenous variable is capital investment value. It is influenced by the shocks in structural and human capital and

shocks in operating profit. Investments in structural capital and tangible assets are interrelated positively. In the retail industry they are probably complementary resources for a company.

The direct influence of intellectual capital on financial performance was not observed. However, investments in structural capital lead to a decrease in economic value added.

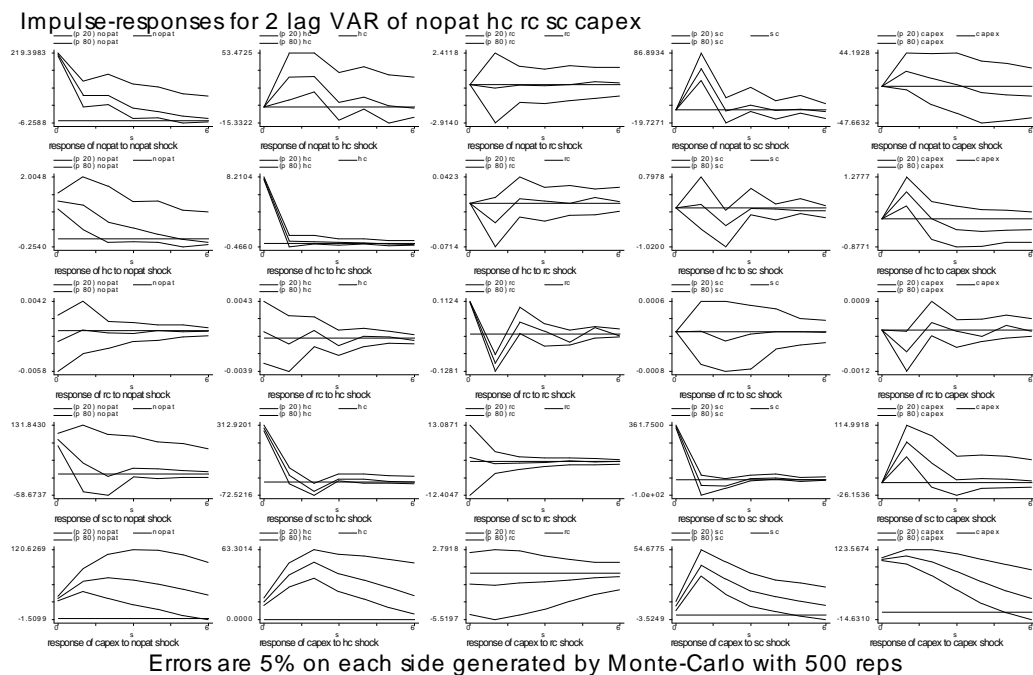


Fig. 3. Impulse responses for 2 lag VAR of NOPAT, human, relational, structural capital and tangible assets for retail companies.

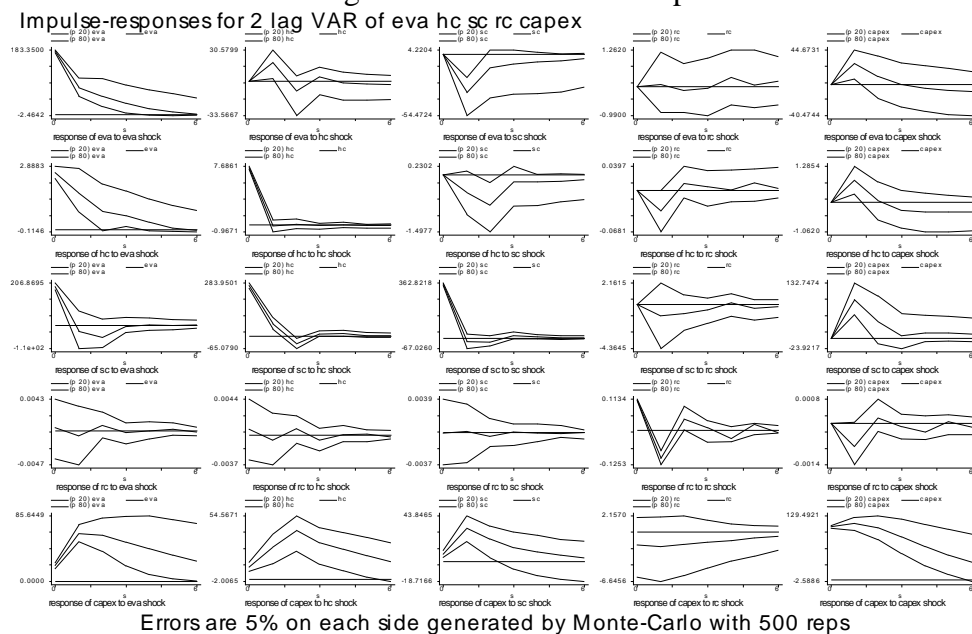


Fig. 4. Impulse responses for 2 lag VAR of EVA, human, relational, structural capital and tangible assets for retail companies.

For the telecommunications industry, a positive impact of investments on the human and structural components of intellectual capital and investments in tangible assets on economic value added is typical (Figure 6). Also, it should be noted that investments in intellectual capital

favor investments in tangible assets. The value of net operating profit has no linear relationship to intellectual capital (Figure 5).

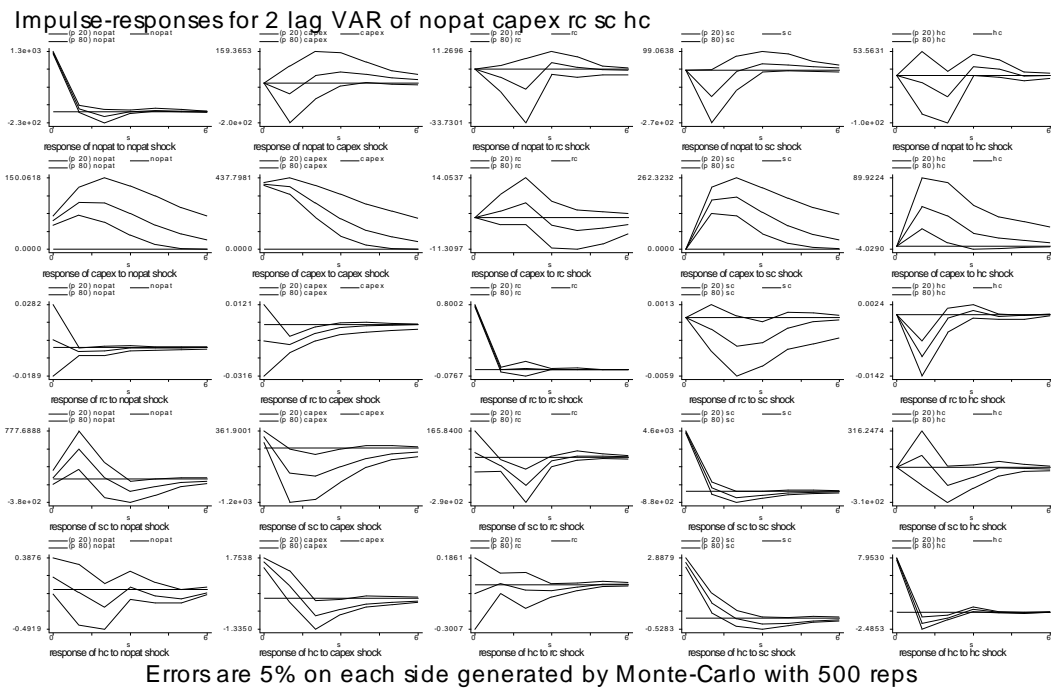


Fig. 5. Impulse responses for 2 lag VAR of NOPAT, human, relational, structural capital and tangible assets for telecommunications companies.

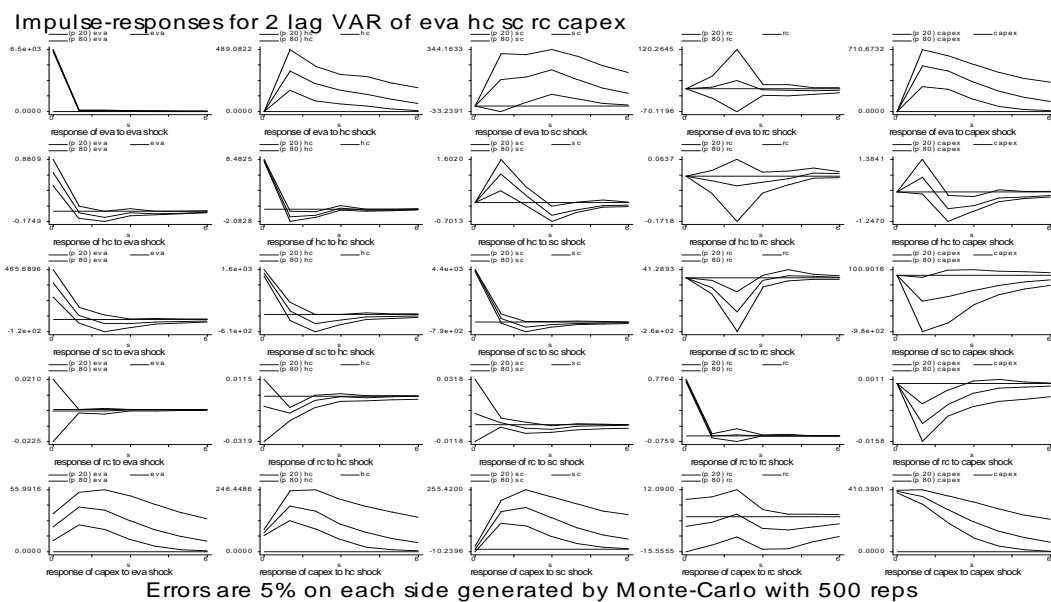


Fig. 6. Impulse responses for 2 lag VAR of EVA, human, relational, structural capital and tangible assets for telecommunications companies.

Consulting and educational services have no clear linear relationship between investments in tangible and intellectual assets and a company's financial results (Figure 7-8). In this case, making a profit does not increase investments. We can assume that the relationships

between assets and a company's activity in the process of value creation are more complex than a simple linear relationship.

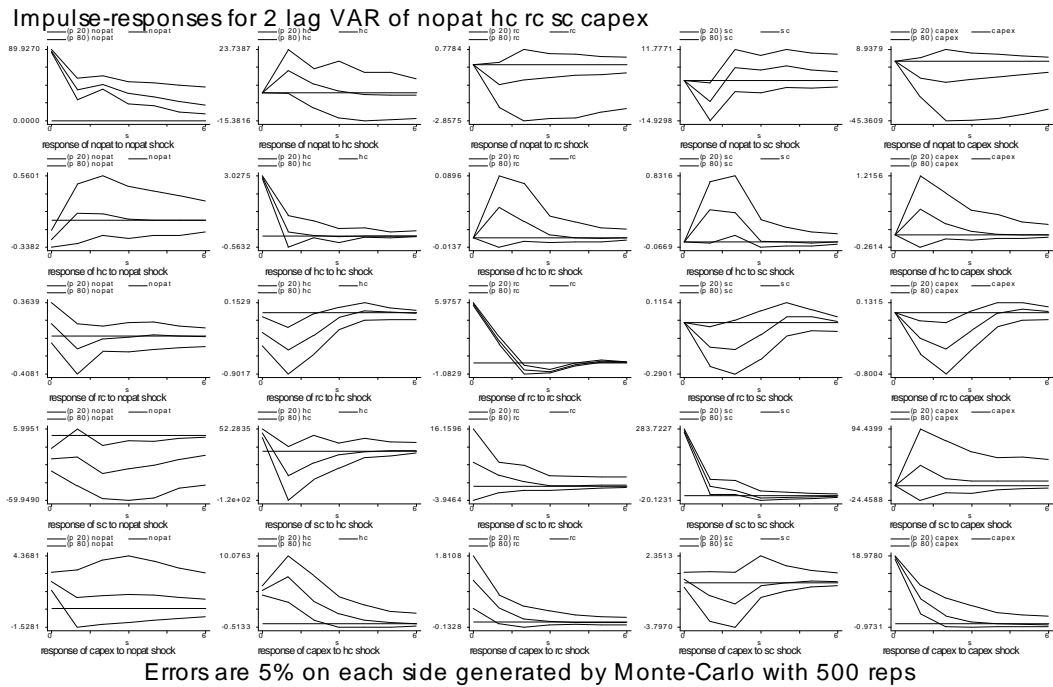


Fig. 7. Impulse responses for 2 lag VAR of NOPAT, human, relational, structural capital and tangible assets for service companies.

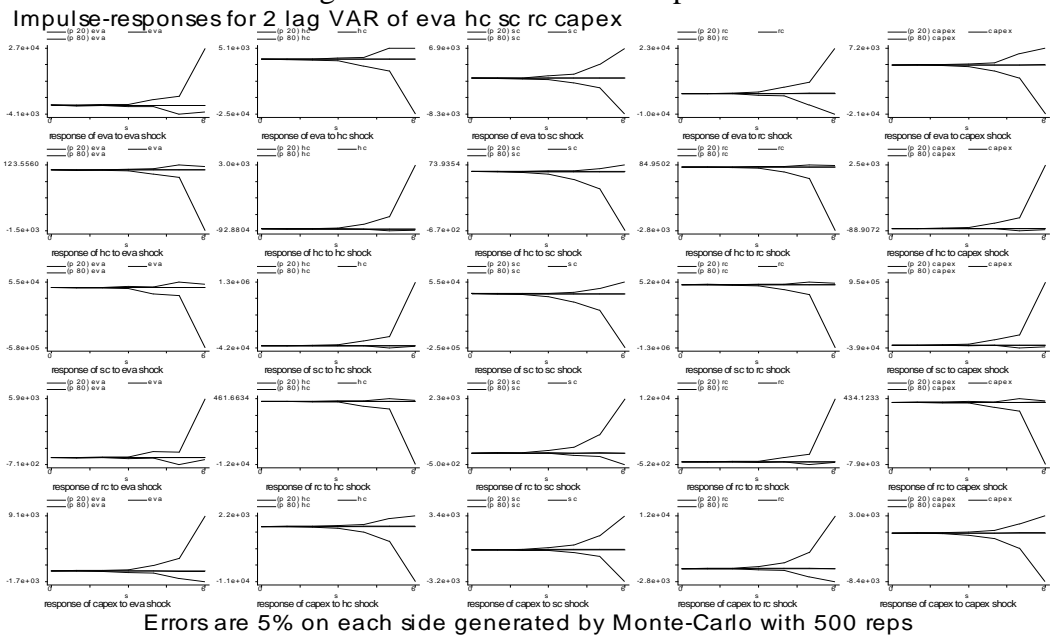


Fig. 8. Impulse responses for 2 lag VAR of EVA, human, relational, structural capital and tangible assets for service companies.

In the steel industry, the key factors of value increase are human capital and tangible assets (Figures 9-10). It also should be noted that, in the steel industry, investments have a weak impact on financial performance. Also, in contrast to previously observed industries where capital investment was the most endogenous variable, in the steel industry, on the contrary, capital investments depend only on the value of capital investments in previous periods.

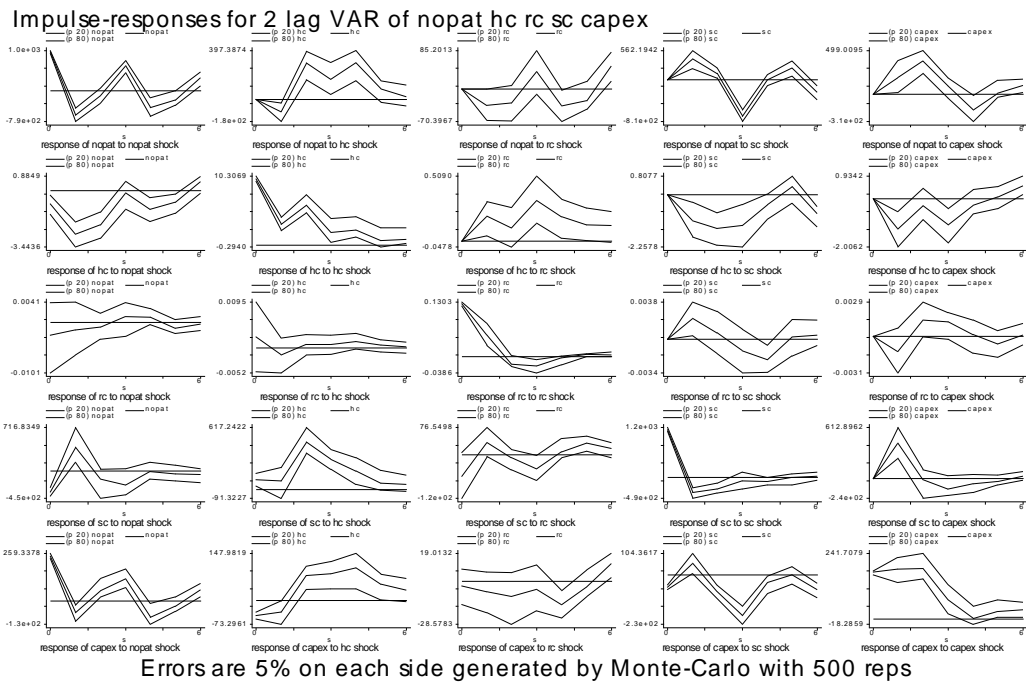


Fig. 9. Impulse responses for 2 lag VAR of NOPAT, human, relational, structural capital and tangible assets for steel companies.

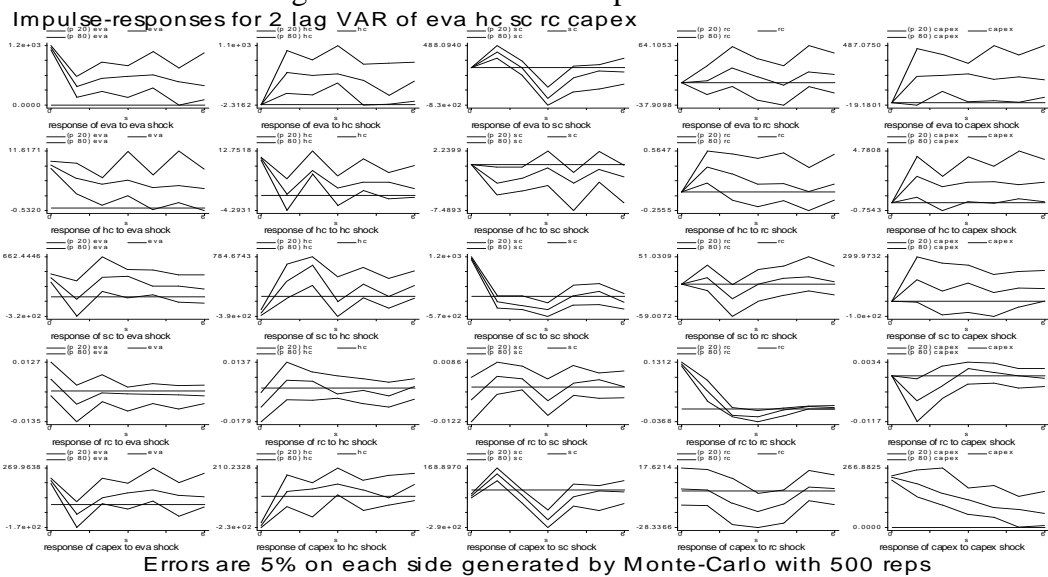


Fig. 10. Impulse responses for 2 lag VAR of EVA, human, relational, structural capital and tangible assets for steel companies.

4. Conclusion.

In this paper, we analyzed the mutual influence of investments on different types of intellectual capital and company performance using panel VAR. The results suggest that there is a relationship between investments in intellectual assets and financial performance. There is also a reverse relationship. The significance of shocks in the impact of financial performance on

investments in intellectual assets indicates the need of taking this into account in future research about the contribution of intellectual capital to company performance.

In addition, we identified a number of sectorial peculiarities regarding the relationship between intellectual capital and company performance.

- In industries with long production cycles, such as pharmaceuticals, investments in human and tangible resources could have a positive return after a long period of time, such as five years and more. For short-term investments, it is advisable to select companies with less current investments in tangible assets and human capital.
- In the retail industry, major investments in structural capital often do not lead to corresponding increases in operating profit, meaning that economic value added decreases.
- In the telecommunications industry, investments in human and structural capital and tangible assets contribute to the creation of economic value added. In this case, the most important roles are played by investments in human capital and tangible resources of the previous year, and, as for structural capital, investments from the two previous years. Relational capital has no direct effect on the company performance. Consequently, the efficiency of this type of capital is determined by the efficiency of other resources. Thus, telecommunication companies with large investments in human, structural, and tangible assets should be treated as more preferred objects for investing.
- In the steel industry, investments in human capital and tangible resources play the most significant role. And their positive impact on value created remains during a long period of time with no significant weakening. Thus, the choice of the investment object should be based on a maximum amount of investments accumulated over time.
- Value creation in companies providing consulting and educational services is a less definite process. To analyze the efficiency of investments in this industry, more detailed proxy-indicators of investments or an individual study of every company from this sector is necessary.

Thus, our research proves that there is a mutual relationship between investments in the components of intellectual capital and company performance. We consider the chosen methodology (orthogonal response functions) to be suitable for the analysis of such a complex process as the transformation of intellectual capital into value. That this relationship has been identified serves as an incentive for further research in this area of corporate finance.

Literature

- Damodaran A. (2004), Investment Valuation: Tools and Techniques for Determining the Value of Any Asset, Moscow, Alpina Business Books, 2004 [in Russian], p.1342
- Bajburina J. R., Golovko T.V. (2006). Empirical Study of the intellectual value of large Russian companies and the factors of its growth // *EJournal of Corporate Finance*, 6, c. 56-78
- Garanina T.A. (2009) The role of intangible assets in value creation of the company: the theoretical and practical aspects // *EJournal of Corporate Finance*, 4 (12), 79-96
- Damodaran's official site www.damodaran.com
- Bontis N. (1996). There's a price on your head: managing intellectual capital strategically" // *Business Quarterly*, 60(4), 40–47.
- Bontis N. (1998). Intellectual Capital: An exploratory study that develops measures and models// *Management Decision*, 36, 2, 63-76.
- Bontis N. (1999). Managing Organizational Knowledge by Diagnosing Intellectual Capital: Framing and advancing the state of the field // *International Journal of Technology Management*, 18, 5/6/7/8, 433-462.
- Bontis N., Chua W., Richardson S. (2000). Intellectual capital and business performance in Malaysian industries // *Journal of Intellectual Capital*, 1, 1, 85-100.
- Brennan N., Connell B., (2000). Intellectual capital: current issues and policy implications // *Journal of Intellectual Capital*, Vol. 1 Iss: 3, pp.206 - 240
- Chang W.S. Hiesh J.J. (2011). Exploring A Human Capital Driven Intellectual Capital Framework: Evidence from Information Technology Industry in Taiwan // *European Journal of Social Sciences*, 21, 3, pp. 392 – 404.
- Chen M.C. (2004). Intellectual capital and competitive advantages: the case of TTY, *Journal of Business Chemistry*, Vol. 1 No. 1, pp. 14-20.
- Chen J., Zhu Z., Xie H.Y., (2004). Measuring intellectual capital: a new model and empirical study // *Journal of Intellectual Capital*, Vol. 5 Iss: 1, pp.195 - 212
- Edvinsson L., Malone M. (1997). Intellectual Capital: Realising Your Company's True Value by Finding its Hidden Brainpower // *Harper Collins*, New York, NY, 1997.
- Edvinsson L., Sullivan P. (1996). Developing a model for management intellectual capital // *European Management Journal*, 14(4), 187-199.
- Huang C.F. and Hsueh S.L (2007). A study on the relationship between intellectual capital and business performance in the engineering consulting industry: A path analysis approach // *Journal of Civil Engineering and Management*, 13(4): 265-271.
- Kamukama N., Ahiauzu A., Ntayi J.M., (2010). Intellectual capital and performance: testing interaction effects // *Journal of Intellectual Capital*, Vol. 11 Iss: 4, pp.554 - 574
- Kaplan, R.S., Norton, D.P. (1992). The Balanced Scorecard – Measures that Drive Performance // *Harvard Business Review* 70 (1)
- Lee J.Y. (2011). Incremental innovation and radical innovation: the impacts of human, structural, social, and relational capital elements // *Doctor of Philosophy Dissertation*. Michigan State University.
- Lev B. (1999). Seeing is Believing - A Better Approach To Estimating Knowledge Capital // *CFO magazine*, February, pp. 29-37
- Lin Y.Y., Edvinsson L. (2008). National intellectual capital: Comparison of the Nordic Countries // *Journal of Intellectual Capital*, 9(4), 525-545.
- Love I., Zicchino L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR // *The Quarterly Review of Economics and Finance*, Elsevier, vol. 46(2), pages 190-210, May
- Marr B., Adams C. (2004). The balanced scorecard and intangible assets: similar ideas, unaligned concepts // *Measuring Business Excellence*, Vol. 8 Iss: 3 pp. 18 - 27
- Viedma-Marti J.M. (2001). ICBS – intellectual capital benchmarking system // *Journal of Intellectual Capital*, Vol. 2 No.2, pp.148-64.

- Moon Y.J. and Kym H.G. (2006). 'A model for the value of intellectual capital // *Canadian Journal of Administrative Sciences*, Vol. 23 No. 3, pp. 253-69.
- Nazari, J.A., Herremans, I.M. (2010, March 1). Assurance Statements in Sustainability Reports: Emergence of Dual Reports. *Presented at International Association for Business and Society IABS 2010*.
- O'Donnell D., Berkery G. (2003). Human interaction: the critical source of intangible value // *Journal of Intellectual Capital*, Vol. 4 No. 1, pp. 82-99.
- Roos J., Roos G., Edvinsson L. (1998). *Intellectual Capital — Navigating the New Business Landscape*. London, UK: Macmillan Press Ltd.
- Edvinsson L., Malone M. (1997). *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower*, Harper Business: New York
- Shakina E.A. (2011). Intellectual Capital: Value Drivers and Role of the Institutions in Europe and Russia // *Conference proceedings*, Milocer: EACES,.
- Shakina E.A., Barajas Alonso A. THE RELATIONSHIP BETWEEN INTELLECTUAL CAPITAL QUALITY AND CORPORATE PERFORMANCE: AN EMPIRICAL STUDY OF RUSSIAN AND EUROPEAN COMPANIES // *Economic Annals*, 2012. № Volume LVII, No. 192 / January – March. C. 79—98
- Stewart T. A. (1991). Brainpower: intellectual capital is becoming corporate America's most valuable asset and can be its sharpest competitive weapon; the challenge is to find what you have - and use it // *Fortune*, 123(11), 44-60.
- Stewart T.A. (1997). *Intellectual Capital: The new Wealth of organization*. Nicholas Brealey, London, 1997.
- Sullivan P. H. (2000). *Value-driven Intellectual Capital. How to convert intangible corporate assets into market value*, Wiley, New York.
- Sveiby K.-E. (1997). "The "Invisible" Balance Sheet", [online] <http://www.sveiby.com/articles/InvisibleBalance.html>
- Tsan W. N. The Measurement of Intellectual Capital for IT Industry in Taiwan — System Theory Perspective // *Presented at IC Congress*. Amsterdam, 2004.
- Tseng C.-Y., Goo Y.-J.J. (2005). Intellectual capital and corporate value in an emerging economy: empirical study of Taiwanese manufacturers // *R&D Management*, vol.35, no.2, 2005, pp. 187-199
- Bassi L, van Buren M (1999). Valuing investments in intellectual capital // *International Journal of Technology Management*, Vol. 18 No.5, pp.414-32.
- Wang W.-Y., Chang C. (2005). Intellectual capital and performance in causal models. Evidence from the information technology industry in Taiwan // *Journal of Intellectual Capital*, Vol. 6 No. 2, 2005 pp. 222-236
- Wu C.C. (2004). An Empirical Examination of Relevance between Intellectual Capital and Equity Value // *Presented at IC Congress*. Amsterdam
- Zickgraf S., Mertins K., Will M., Wang W.-H., Meye, J. (2007). "C.InCaS: Intellectual Capital Statement" // *European ICS Guideline*
- Sveiby K. *Methods for Measuring Intangible Assets*. 2001 [online]: <http://www.sveiby.com.au/BookContents.html>

Appendix

Table 1. Descriptive statistics of data used.

Variable	Number of observations	Average	Standard deviation.	Min	Max
<i>Pharmaceutical industry</i>					
Investments in human capital (hc)	927	0.33	3.53	-20.66	63.35
Investments in structural capital (sc)	998	437.63	4 252.49	-8 886.00	71 206.00
Investments in relational capital (rc)	868	-0.20	15.52	-276.59	307.00
Investments in tangible assets (CAPEX)	1160	205.50	569.53	0.00	3 106.19
NOPAT	1170	763.63	2 264.92	-1 200.18	15 911.69
EVA	1162	625.09	1 977.94	-4 264.83	12 693.93
<i>Retail industry</i>					
Investments in human capital (hc)	971	0.74	8.12	-84.77	139.00
Investments in structural capital (sc)	963	9.80	424.14	-5 783.00	6 656.37
Investments in relational capital (rc)	1005	0.01	0.21	-2.74	4.17
Investments in tangible assets (CAPEX)	1128	210.47	505.32	-0.08	4 010.00
NOPAT	1131	214.36	569.24	-3 590.83	5 986.91
EVA	1121	150.00	480.40	-3 419.14	5 550.54
<i>Service industry</i>					
Investments in human capital (hc)	1189	0.55	3.38	-35.00	32.00
Investments in structural capital (sc)	1327	33.52	217.84	-990.70	4 337.70
Investments in relational capital (rc)	1117	0.20	20.02	-327.10	351.60
Investments in tangible assets (CAPEX)	1515	24.55	65.22	0.00	1 342.00
NOPAT	1515	67.84	218.21	-1 384.12	2 524.13
EVA	1125	42.04	166.77	-395.96	2 524.13
<i>Steel industry</i>					
Investments in human capital (hc)	351	1.10	10.50	-37.88	149.19
Investments in structural capital (sc)	400	128.27	1 017.72	-6 249.43	13 463.59
Investments in relational capital (rc)	404	-0.01	3.87	-64.71	31.43
Investments in tangible assets (CAPEX)	457	344.75	1 179.32	0.00	14 157.90
NOPAT	460	500.65	1 718.62	-1 427.34	19 800.47
EVA	459	336.05	1 349.93	-3 057.31	17 030.97
<i>Telecommunications</i>					
Investments in human capital (hc)	1519	0.55	9.78	-99.49	196.91
Investments in structural capital (sc)	1625	305.99	4 538.37	-37 429.86	104 839.00
Investments in relational capital (rc)	1664	0.25	8.25	-40.05	317.76
Investments in tangible assets (CAPEX)	1896	1 074.78	2 616.27	0.00	20 478.00
NOPAT	1904	845.28	2 538.20	-14 961.28	32 009.89
EVA	1892	318.85	2 224.89	-27 376.30	31 227.48

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