

HUMAN CAPITAL AND ITS EFFICIENCY ON THE EXAMPLE OF INDUSTRIAL AND NEW TECHNOLOGIES COMPANIES

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Purpose: Comparative analysis of human capital and its efficiency in enterprises with various business profiles, especially the so-called old and new economy.

Design/methodology/approach: The analysis was carried out on the example of companies listed on the Warsaw Stock Exchange operating in the industrial and high-technology sectors. For its purposes, indicators based on financial data and used, among others in the method of assessing the efficiency of intellectual capital – VAIC.

Findings: The obtained results allow to conclude that the situation in terms of human capital level and its efficiency, including labour efficiency, in the analysed enterprises is highly diversified. These differences not only exist between companies from different sectors, but also within individual sectors, industrial as well as high-tech. Companies from high-tech sectors are generally characterized by a higher human capital level, as well as its efficiency, which is particularly distinguished by the sector Video Games Developers.

Research limitations/implications: Due to the limited quantitative research sample, compared to the total number of companies listed on the Warsaw Stock Exchange and the industries and sectors they represent, the results obtained and the conclusions drawn on their basis can be treated as preliminary and contributing to further broader research.

Practical implications: As the results of the analysis show how individual industrial and high technology companies compare to the competition in terms of the level and efficiency of human capital, it may be an indication for their management boards of the need for actions aimed at improving the efficiency of human capital.

Social implications: As the subject of the analysis is human capital in an enterprise, its results may contribute to changes in the field of corporate social responsibility in the analysed enterprises in the area of employees.

Originality/value: The topic of the article is not new, but in the literature there are hardly any studies on the assessment of the efficiency of human capital in the intersectoral approach.

Keywords: human capital, efficiency, comparative analysis, listed companies.

Category of the paper: Research paper.

1. Introduction

The increasingly frequent and dynamic global transformations we have been witnessing in recent decades, have posed particular tasks for managers of enterprises and force them to change the perception of factors influencing success in the long-term strategy of their development. Thus, intangible resources increasingly often constitute a competitive advantage of contemporary enterprises, pushing traditional tangible resources, associated mainly with fixed assets, into the background (Barney, 1991, DeNisi et al., 2003, Szwajca, 2012). At this point, attention should be paid to the important role of a human being (employee), which is one of the possible intangible resources, which started to be perceived as a component of various aggregate values concerning the company – intellectual capital, innovation, competitiveness or finally value (Schultz, 1961; Becker, 1962; Dobija, 2005; Nawrocki, 2012). Only a few decades ago, the common opinion was that remuneration is only a payment for work done by employees and the value of the company is increased only by investments in fixed assets. Nowadays, which has been greatly influenced by the development of the resources-based view (RBV), whose precursor is considered to be E. Penrose (1959), it is obvious that the employee is not only a labour force, but one of the most valuable resources that the company has. It is necessary for its proper functioning, and having a certain value, verified on the market, it constitutes the economic potential of a given entity and allows building its competitive advantage (Szopik-Depczyńska, Korzeniewicz, 2011) and improving the efficiency of its operations (Berk et al., 2010; Wang et al., 2014; Asare et al., 2017; Nawaz, 2019). The significant importance of human resources stems directly from their characteristics – they are developmental, creative assets that have the capacity for continuous improvement (Gorczyńska, 2009). Therefore, more than other resources, they contribute to the creation of additional value for the company (Wyrzykowska, 2008). To reflect these characteristics of human resources, it has become accepted in the literature to refer to them as human capital (Haq, 2016).

With the growing scientific interest in the importance of employees for the development of enterprises and the improvement of their performance, the term "human capital" has lived to see many interpretations and measurement concepts. As a result, currently we can meet with numerous approaches to this issue, which are very diverse in terms of detail and recommended assessment criteria. At the same time, a question arises here about the applicability of particular criteria of human capital measurement and the universality of their interpretation from the point of view of sector specificity and corporate information policy. Therefore, as the main objective of this article it was assumed to carry out a comparative analysis of human capital and its efficiency in enterprises of different business profiles, especially the so-called old and new economy.

2. The concept of human capital and how it can be assessed

Although the very idea of human capital dates back to the seventeenth century and is associated with economic and financial researchers (e.g. William Petty, Adam Smith, William Farr), the origins of human capital theory as an organised discipline of knowledge date back to the late 1950s and early 1960s (Kiker, 1996). It was then that some scholars concluded that a person's knowledge, education, skills and health status have productive potential (Mincer, 1958; Schultz, 1961; Becker, 1962).

Human capital can be classified as a concept that is difficult to define. There are many definitions of it in literature, depending on the perspective of consideration (Jabłoński, 2021). For the purpose of this article, it has been assumed that human capital is a resource of knowledge, skills, abilities, qualifications, attitudes, motivation and health of employees, which has significant meaning in economic activity and, therefore, is a source of future earnings (OECD, 1998, Fischer et al., 2006, Łukasiewicz, 2009).

The concept of human capital can be considered from a macroeconomic and microeconomic perspective. In the macroeconomic perspective, human capital is characterised as one of the basic resources remaining in the economy, which determines economic growth. In microeconomic terms, on the other hand, the concept of human capital refers to an individual employee (worker) and is treated as an element of intangible resources of an enterprise (Kucharcikova, 2011).

A company can seek competitive advantage based on properly prepared, highly motivated and loyal personnel (Noe et al., 2006; Bloisi, 2007; Gabcanova, 2011). Activities aimed at increasing the value of human capital consist of (Nellis and Parker, 2006; Ackroyd et al., 2005; Zieliński, 2006):

- acquiring human capital (by employing suitably prepared staff, replacing staff),
- retention of human capital remaining in the company (by means of an appropriate motivational system and creating development opportunities),
- development of human capital within the company (training).

Some authors divide human capital into general capital and specific capital. General (universal) capital, can be used in all types of economic activity, while specific capital (qualifications gained in practice), determines productivity in a given enterprise (McConnell, Brue, 1986).

From a corporate perspective, human capital is a component of intangible resources. According to Edvinsson and Malone (2001), it is a component of intellectual capital. Intellectual capital includes: knowledge, experience, technology, customer relationships and professional skills that are a source of competitive advantage for the organisation. Intellectual capital, apart from human capital, also includes structural capital, which is defined as everything

that supports employee productivity, in particular organizational infrastructure, including organizational systems, management tools and philosophy as well as innovative capital.

Human capital, apart from the features an employee brings to the organisation (skills, knowledge, experience, health, attitudes, professed values, etc.), also includes the employees' ability to learn, motivation (e.g. to share information and knowledge), striving to achieve goals, or ability to work in a team. It should also be noted that apart from the individual human capital of each employee, the human capital of an enterprise also includes the creativity and innovativeness of employee teams (Czechowska-Świtaj, 2005; Król, 2006; Sokołowska, 2005). What is important, all the issues mentioned above are particularly important from the point of view of the Industry 4.0 concept popularised in the recent years, where one of the key conditions for its implementation is the acquisition of appropriate education and skills by employees (Flores et al., 2020; Singh et al., 2021).

Attempts to measure human capital are generally based on treating employees as assets of the firm and measuring changes in their value. Many authors raise doubts about the possibility of measuring human capital, which revolve around the questions: can human capital be treated as a business asset at all?, what human capital costs should be capitalised? how reliable are the methods of determining the value of human capital and their links to costs? At the same time, the most frequently used methods of human resources valuation are those based on costs related to personnel policy or income achieved, or earned, by the employee (Phillips et al., 2003).

In the case of estimating the value of human capital according to the "cost" approach, the concepts most frequently recommended in the literature are: the historical cost method and the replacement cost method. In the first one the value of human capital is illustrated by the expenditures incurred for the acquisition and further training of an employee. The latter assumes that human capital is worth as much as the company would have to spend to replace the currently employed worker. The main measures to estimate the value of human capital in the case of the historical cost method are: recruitment and selection costs and training costs. For the replacement cost method, the main measures are: the cost of recruiting, selecting and training a new employee and the cost of leaving an existing employee (Samul, 2011). The disadvantages of cost-based methods for determining the value of human capital include: the lack of an unambiguous link between the cost of producing a good and its economic value, the difficulty in distinguishing between investment and consumption expenditure, the lack of taking into account the biological and moral degradation of human capital over time (e.g. the obsolescence of knowledge), and the difficulty in isolating costs in relation to individual units. On the other hand, the advantages of cost methods include the possibility to use real data published in statistical yearbooks, published compilations and analyses (Łukasiewicz, 2009; Czajkowski, 2012). In general, however, given the differences in the openness of the information policy of companies (Nawrocki and Zieliński, 2013), the practical application of the mentioned cost concepts of estimating the value of human capital is quite difficult, mainly due to the problematic access to the required data. Therefore, often for the

purposes of research a simplified approach is used, in which the value of human capital is taken as the data disclosed in the financial statements of companies about the amount of wages and benefits for employees – such an approach was used, for example, in the framework of the value-added coefficient of intellectual capital VAIC (Pulic, 2004).

Estimating the value of human capital using the income approach assumes that it is equal to the present value of future receipts per employee. Estimates using the income method are hampered by changing tangible (raw materials, technology) and intangible (organisation and management) assets, as these changes cannot be predicted over several decades (when attempting to estimate the expected income earned over an employee's entire working life), and they significantly affect employee productivity (King, 2006). Besides, calculations based on the income approach are based on assumptions or probabilities of changes in wages over the entire working life, the degree of work activity and the health of the employee. On the other hand, the advantage of income-based estimations is their market nature, i.e. taking into account employers' preferences regarding the level of education, professional experience, taking into account employers' reactions to changes in the economic situation and changes in the labour market situation, which translate into establishing the level of wages, constituting a valuation of human capital of individual employees (Łukasiewicz, 2009).

Difficulties in the valuation of human capital are also related to changes in the employment structure and staff rotation. A departing employee may take with him/her experience related to the mechanisms of operation, informal ties with customers, suppliers, other employees (Sokołowska, 2005), which entails disruptions in the functioning of the organisation (Probst et al., 2004). The higher the position of the departing employee in the organisation's hierarchy, the more knowledge he/she possesses and the more difficult it will be to replace him/her. Therefore, it is necessary to monitor the structure of redundancies in terms of the share of those leaving at their own request, the structure of those leaving by seniority, the share of the most productive employees among those leaving (King, 2006). It should be emphasised that human capital is in practice the property of employees, therefore staff fluctuations may in a short period of time very seriously change its valuation (Zieliński, 2008).

In order to gain an insight into the area of human capital in the company, and especially into the changes occurring in it, a number of measures can also be used. The number of employees participating in projects, the number of employees with a planned career path, work efficiency, expenditure on health care, the number of sick days, accidents at work, etc. (Łukasiewicz, 2009).

Although it is difficult to determine the objective value of human capital on the basis of the above-mentioned measures, they illustrate changes in the personnel policy of an enterprise and may be used to assess its development prospects.

3. Basic assumptions and research methodology

Due to the ease of access to data resulting from the disclosure obligations of securities issuers, a comparative analysis of human capital and its efficiency was carried out for selected companies listed on the Warsaw Stock Exchange. The selection of individual entities for the study was deliberate. First, the affiliation of the analysed companies to industrial (so-called traditional) and high-tech sectors of the economy was taken into account, and second, the availability of their annual reports for 2016-2020 as well as their size and market value. The research sample obtained in this way is presented in Table 1.

Table 1.
Research sample

Industry (Old Economy)		High-tech (New Economy)	
Fuel and Energy: <ul style="list-style-type: none"> ▪ PKN Orlen ▪ PGNiG ▪ Lotos ▪ PGE ▪ Tauron PE 	Construction: <ul style="list-style-type: none"> ▪ Budimex ▪ Mirbud ▪ Unibep ▪ Polimex MS ▪ Erbud 	Video Games Developers: <ul style="list-style-type: none"> ▪ CD Projekt ▪ Boombit ▪ Ten Square Games ▪ CI Games ▪ 11 bit 	Information Technology: <ul style="list-style-type: none"> ▪ Wasko ▪ Asseco Poland ▪ Comarch ▪ Sygnity ▪ Atende
Chemical: <ul style="list-style-type: none"> ▪ Grupa Azoty ▪ Ciech ▪ PCC Rokita ▪ PCC Exol 	Electromechanical: <ul style="list-style-type: none"> ▪ Apator ▪ ZPUE ▪ Aplisens ▪ Sonel ▪ Lena Lightning 	Production of Drugs, Materials and Medical Equipment: <ul style="list-style-type: none"> ▪ Celon Pharma ▪ PZ Cormay ▪ Bioton ▪ Mercator Medical ▪ Voxel 	Media: <ul style="list-style-type: none"> ▪ ATM Grupa ▪ Kino Polska ▪ Agora ▪ Wirtualna Polska ▪ Comperia
Polwax Mining and Steel Industry: <ul style="list-style-type: none"> ▪ JSW ▪ Bogdanka ▪ KGHM ▪ Stalprodukt ▪ Kęty 		Biotechnology: <ul style="list-style-type: none"> ▪ Selvita ▪ Synektik ▪ PBKM ▪ Pure ▪ Onco Arendi Therapeutics 	

Source: Own work based on www.gpw.pl, 29.03.2022.

Taking into consideration the possibility of access to the required data for the needs of human capital estimation and its efficiency in the companies accepted for the research, in reference to the first of the mentioned categories it was decided to apply a simplified cost criterion in the form of the value of remuneration and employee benefits. In order to neutralise a possible distortion connected with the size of the analysed entities, the value of salaries and employee benefits was related to the average size of employment in the financial year, which can be expressed by the formula:

$$HC_P = \frac{S\&B}{\bar{L}} \quad (1)$$

where:

HC_P – valuation of human capital per employee,

$S\&B$ – value of salaries and benefits for employees in the financial year,

\bar{L} – average employment during the financial year.

It should be noted that the above approach to human capital valuation may be in a way distorted by the employment structure (e.g. if a small number of employees received significantly higher salaries and benefits than the rest). At the same time it is difficult to neutralise this shortcoming as only nearly 30% of companies listed on the Warsaw Stock Exchange provide more detailed information on the employment structure, and in most cases it concerns a division into white-collar and blue-collar workers (Nawrocki, Zieliński, 2013).

On the other hand, for the purposes of comparison, within the second of the distinguished categories, the human capital efficiency coefficient from the VAIC – intellectual capital value added model (Pulic, 2004) and a simplified labour productivity coefficient, based not on production, but on sales revenues, were adopted, which was expressed by the formulas:

$$HCE = \frac{VA}{S\&B} \quad (2)$$

where:

HCE – human capital efficiency,

VA – value added (difference between sales revenues and operating costs excluding salaries and benefits of employees),

$S\&B$ – value of salaries and benefits for employees in the financial year.

$$WE = \frac{S}{\bar{L}} \quad (3)$$

where:

WE – work efficiency,

S – sales revenue for the financial year,

\bar{L} – average employment during the financial year.

A comparative analysis using the criteria highlighted above was carried out using data from the annual financial statements of the companies under study for the period from 2016 to 2020 year.

In addition, in order to determine the range of variation in the level and efficiency of human capital in the analysed entities, representing at the same time specific sectors of the economy, with reference to the assessment criteria distinguished above, an analysis was conducted based on basic statistical characteristics, i.e. the expected value and standard deviation, given by the formulas:

$$R = \frac{1}{n} \sum_{t=1}^n r_t \quad (4)$$

$$s = \sqrt{\frac{\sum_{t=1}^n (r_t - R)^2}{n - 1}} \quad (5)$$

$$TIV \in (R - s, R + s) \quad (6)$$

where:

R – expected value of a variable on an arithmetic mean basis,

n – the number of periods (cases) from which the data originate,

r_t – value of the variable at t -th period (case),

s – standard deviation of the variable,

TIV – typical interval of variation.

The main goal of the research is a comparative analysis of human capital and its efficiency, as well as work efficiency, in traditional and high-tech industries exemplified by the Polish economy. Additionally, in the course of the conducted analyses, answers to the following research problems are sought:

R1: Are enterprises operating in high-tech industries associated with a higher human capital level?

R2: Are enterprises operating in high-tech industries associated with a higher human capital efficiency, including work efficiency?

4. Research results

The results of the conducted analysis were presented in two approaches. In the first one, based on the average values of the criteria for assessing human capital and its efficiency from 2016-2020, the analysed companies were compared within two sectoral groups of the economy and their selected subsectors (Table 2). In turn, the second focuses on the overall comparison of human capital and its efficiency in the main sectors and their selected subsectors, based on the average values of the assessment criteria of their representatives and taking into account the range of variability of these values (Figures 1-4).

Table 2.

Human Capital (HCp), Human Capital Efficiency (HCE) and Work Efficiency (WE) in analysed companies from Old and New Economy sectors (Average values from 2006-2020)

Old Economy Industrial sectors & companies		HCp	HCE	WE	New Economy High-tech sectors & companies		HCp	HCE	WE
Fuel and Energy	PKN ORLEN	128	4,08	4,45	Video Games Developers	CD PROJEKT	397	4,57	2,84
	PGNIG	118	3,40	1,54		BOOMBIT	213	3,05	1,21
	LOTOS	159	4,40	4,96		TEN SQUARE GAMES	200	5,52	2,71
	PGE	121	2,35	0,79		CI GAMES	38	8,10	0,59
	TAURON PE	107	1,73	0,72		11 BIT	61	6,57	0,49
Chemical	GRUPA AZOTY	104	1,77	0,68	Production of Drugs, Materials and Medical Equipment	CELON PHARMA	67	2,86	0,43
	CIECH	91	3,02	0,89		PZ CORMAY	86	1,00	0,31
	PCC ROKITA	98	2,64	0,80		BIOTON	105	1,56	0,39
	PCC EXOL	157	2,12	2,25		MERCATOR	45	4,23	0,60
	POLWAX	69	2,04	0,94		VOXEL	109	2,35	0,60
Mining and Steel Industry	JSW	134	1,49	0,29	Biotechnology	SELVITA	109	1,22	0,21
	BOGDANKA	120	2,09	0,35		SYNEKTIK	98	2,12	0,84
	KGHM	155	1,90	0,63		PBKM	118	1,73	0,40
	STALPROD	90	1,82	0,57		PURE	95	1,07	0,10
	KĘTY	84	2,23	0,59		ONCO ARENDI THERAPEUTICS	39	0,94	0,30
Construction	BUDIMEX	147	1,57	1,06	Information Technology	WASKO	97	1,23	0,28
	MIRBUD	96	1,85	1,40		ASSECO POLAND	190	1,29	0,39
	UNIBEP	108	1,43	1,13		COMARCH	129	1,26	0,23
	POLIMEX MS	86	1,15	0,44		SYGNITY	121	1,06	0,29
	ERBUD	125	1,20	0,93		ATENDE	130	1,56	0,72
Electro- -mechanical	APATOR	80	1,60	0,34	Media	ATM GRUPA	721	2,34	4,60
	ZPUE	65	1,34	0,27		KINO POLSKA	149	4,25	1,22
	APLISENS	66	1,80	0,23		AGORA	116	1,35	0,40
	SONEL	90	1,59	0,32		WIRTUALNA POLSKA	158	2,08	0,54
	LENA LIGHTNING	95	1,99	0,84		COMPERIA	84	0,70	0,37

Source: Own work based on data from Notoria Serwis.



Figure 1. Human Capital (HCp), Human Capital Efficiency (HCE) and Work Efficiency (WE) in Old and New Economy sectors. Source: Own work based on data from Notoria Serwis.

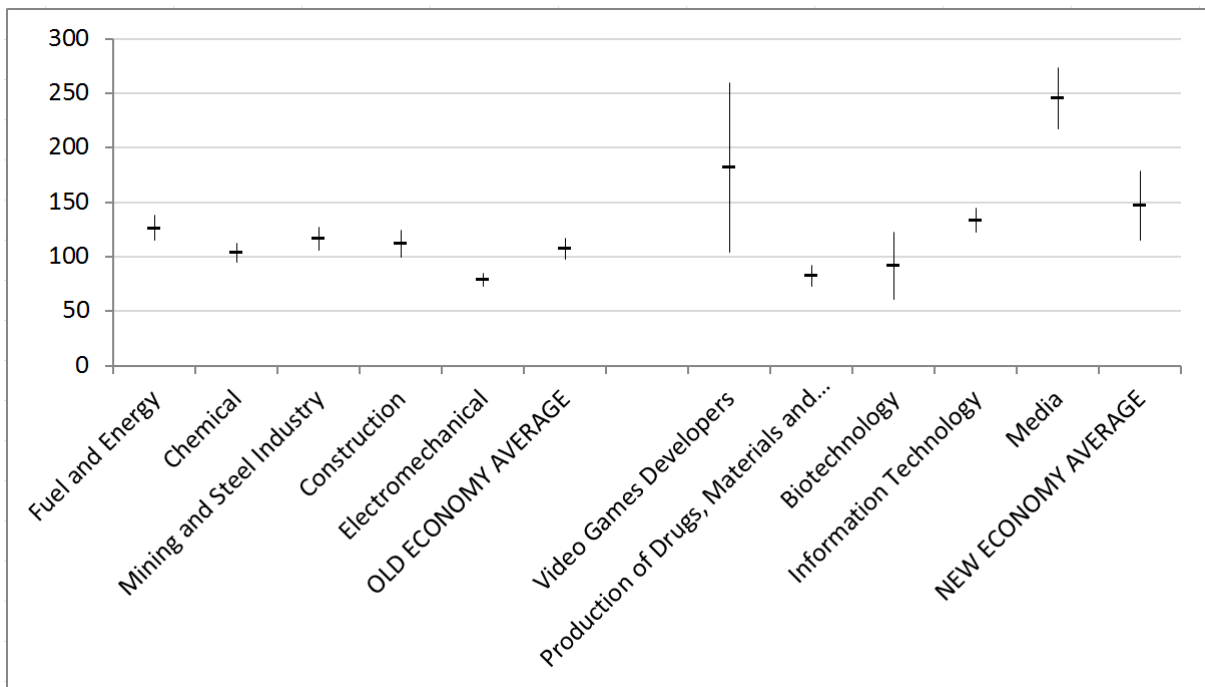


Figure 2. Typical Interval of Variation (TIV) and Expected Value (R) of Human Capital (HCp) in Old and New Economy sectors [thou. PLN/employee]. Source: Own work based on data from Notoria Serwis.

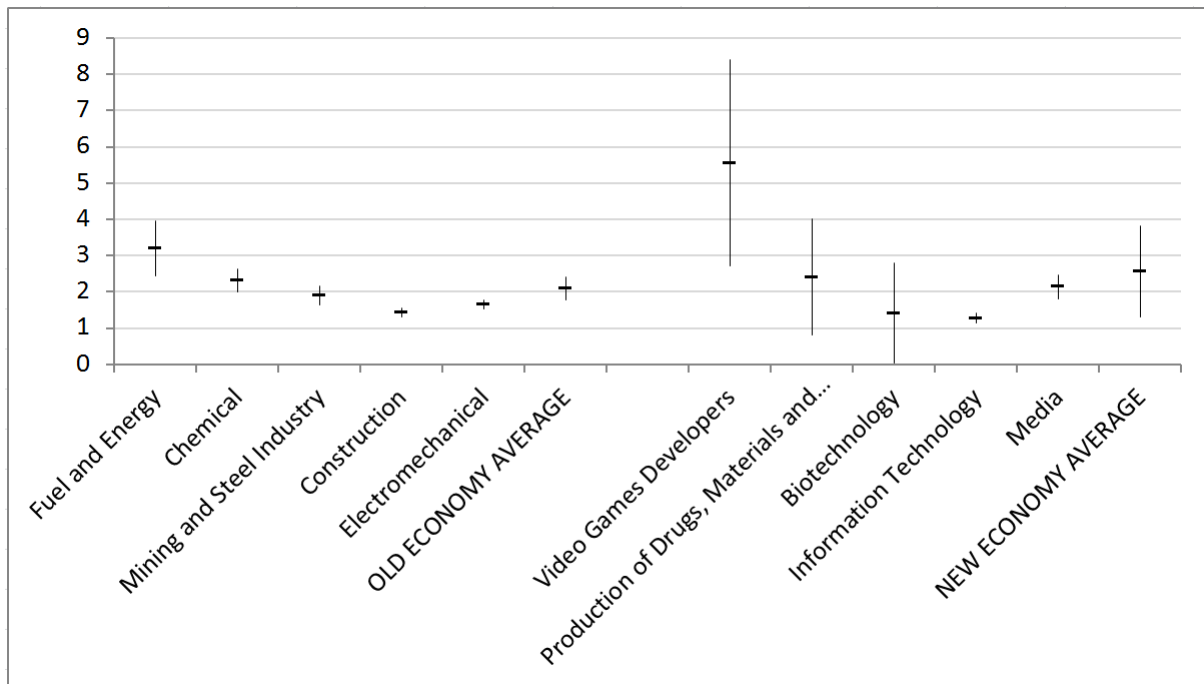


Figure 3. Typical Interval of Variation (*TIV*) and Expected Value (*R*) of Human Capital Efficiency (*HCE*) in Old and New Economy sectors [thou. PLN/thou. PLN]. Source: Own work based on data from Notoria Serwis.

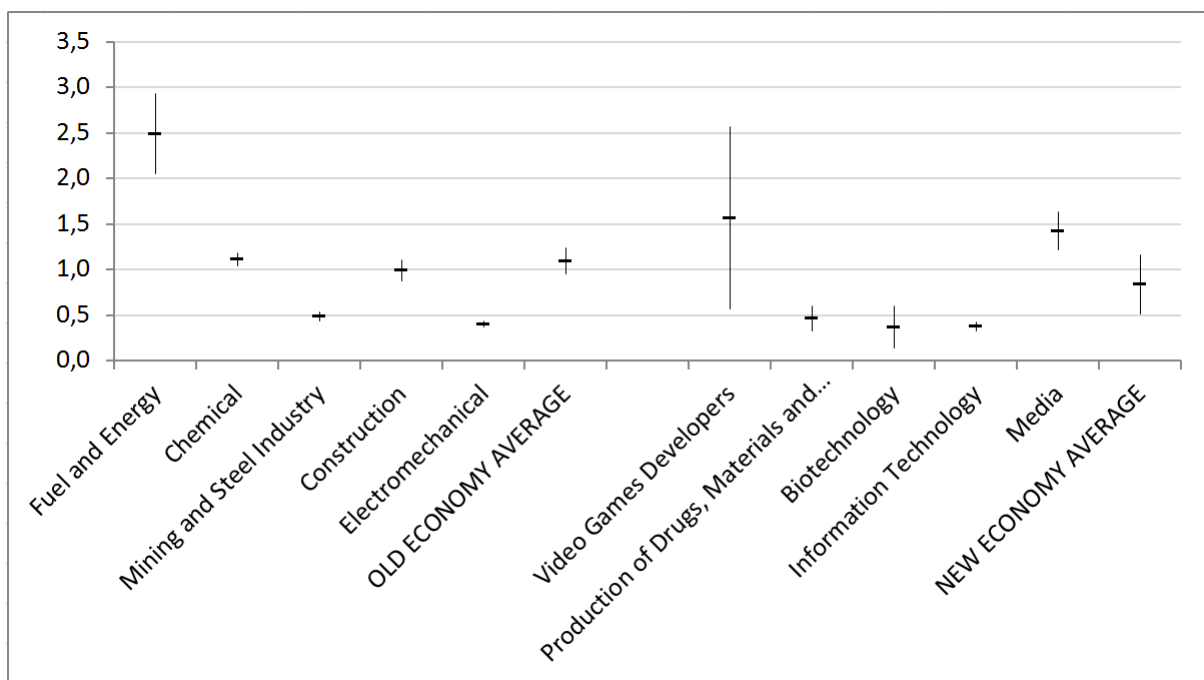


Figure 4. Typical Interval of Variation (*TIV*) and Expected Value (*R*) of Work Efficiency (*WE*) in Old and New Economy sectors [mln PLN/employee]. Source: Own work based on data from Notoria Serwis.

Taking into account the results of the analysis presented in Table 2 and Figures 1-4, the following conclusions can be drawn:

- For both high-tech and industrial companies, significant variation can be noted in the level of human capital (HCp), as well as in its efficiency (HCE) and work efficiency (WE), with generally greater variation for high-tech companies. The Video Games Developers sector in particular stands out in this regard.
- Companies from high-tech sectors are generally characterised by a higher level of human capital (HCp) as well as its efficiency (HCE); the Video Games Developers and Media sectors in particular stand out in this respect. On the other hand, industrial companies, as a group, look better in terms of work efficiency (WE), which is mainly due to fuel entities from the Fuel and Energy sector, i.e. PKN Orlen and Lotos. The above conclusions also answer research questions R1 and R2 formulated in the methodological part.
- In terms of the analysed variables, some of the high-tech sectors are at the level or even below the values characteristic for the industrial sectors; this applies in particular to the Production of Drugs, Materials and Medical Equipment as well as Biotechnology. Some explanation for this situation is the specific nature of the activities of entities in these sectors, which are often at the initial stage of development, characterised by low sales revenues and income as well as limited financial capabilities.

Irrespective of the conclusions formulated above, attention should also be drawn to certain issues related to the specificity of certain sectors, which may have slightly affected the analysis results. This concerns mainly entities from the Fuel and Energy sector (all) and Mining and Steel Industry (JSW, Bogdanka, KGHM), which, having a dominant shareholding of the State Treasury, are at the same time characterised by high labour union power. It translates into often non-market levels of salaries and employee benefits in these entities, which are the basic variables in the Human Capital Index (HCp) and somehow artificially increase its value.

Moreover, with respect to the fuel companies (PKN Orlen and Lotos), which recorded generally higher work efficiency levels for the Fuel and Energy sector and the average for the industrial sectors than the high-tech sectors, attention should be paid to the impact of the specific nature of fuel trading activities, which are mainly based on the volume of trading and to a lesser extent on its margins. For this reason, the work efficiency indicator, which is based on sales revenues, is relatively higher than in other industrial and high-tech entities, while the human capital efficiency indicator, which is based on added value (where material costs are deducted from revenue), is not, or at least not to the same extent.

5. Summary

The obtained results of the comparative analysis allow to state that the situation in terms of the level of human capital and its efficiency, including work efficiency, in the companies under study is strongly diversified. What is important, these differences occur not only between entities from different sectors, but also within individual sectors, industrial or high technology. This type of situation is a significant difficulty for more complex analyses, where human capital is only one of many assessment criteria, as it is difficult to adopt here some normative limits of the value range for individual criteria of its assessment – everything depends on the specificity of the entities included in the research sample. Nevertheless, the analysis shows that as a group the entities of the high technology sectors are more favourable in terms of the level and efficiency of human capital.

As the results of the analysis show how individual industrial and high-tech companies compare to their competitors in terms of the level and efficiency of their human capital, it may be an indication for their managements of the need for actions aimed at improving the efficiency of human capital, as well as a contribution to changes in corporate social responsibility in the analysed companies in the area of employees.

Admittedly, due to the limited quantitative research sample, compared to the total number of companies listed on the Warsaw Stock Exchange and the industries and sectors they represent, the results obtained and the conclusions drawn on their basis can be treated as preliminary and constituting the basis for further, wider research, including the relationship between the efficiency of human capital and work efficiency and the amount of salaries and employee benefits per 1 employee. On the other hand, however, it should be noted that the information policy of companies listed on the Warsaw Stock Exchange in the field of human capital is highly diversified, which will not necessarily cover all entities with extended research – e.g. about 10% of companies do not provide information about the amount of employment at all, and nearly 70% of them provide information on the employment structure in a very general or not at all (Nawrocki, Zieliński, 2013). So, in the end, a compromise is needed between the quantity of the research sample and the research methodology adopted, which determines the quality of the final results.

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