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ISSUES OF INTELLECTUAL CAPITAL EVALUATION IN AN ENTERPRISE IN RELATION TO THE METHOD BASING ON THE DIFFERENCE BETWEEN ITS MARKET AND BOOK VALUE

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Purpose: The main goal of the article was to present the issues of the practical application of the method of measuring intellectual capital based on the difference between the market value and book value of enterprises.
Design/methodology/approach: By comparing the relation of the market value to the book value of companies listed on the Warsaw Stock Exchange in various time dimensions with the trends in their basic economic and financial categories, such as sales revenues and total assets, it was shown when the indicated approach to measuring the intellectual capital of the enterprise makes sense, and when it may be misleading.
Findings: The conducted research allows to conclude that the considered method of measuring intellectual capital is simple, but strongly imperfect. Its main burden is the high dynamics of changes in market quotations, which often occurs in the case of listed companies, which may lead to distortions. Hence, this method is more suitable for the initial identification of entities with a potentially high level of intellectual capital than for its precise measurement.
Research limitations/implications: Research is limited to a group of 20 companies listed on WSE with the highest P/BV values. In further, more detailed studies, other approaches to the selection of companies based on the P/BV ratio and to the verification of the level of intellectual capital through the prism of trends in the economic and financial situation of the surveyed entities can be considered more broadly.
Practical implications: In order to make the results of using the market to book value difference more objective in the identification and measurement of intellectual capital in enterprises, it is worth relying on quotations or P/BV ratios of the analyzed companies, in the form of an average, or even better a median, from a longer period (preferably several years). In addition, the indications of a high level of intellectual capital of the surveyed entities should be verified based on the assessment of changes in their economic and financial situation referring to the metaphor of the "tree" (invisible resources create visible effects).
Originality/value: The article presents a proprietary approach to the application of the relationship between the market and accounting value of enterprises in terms of identifying entities with a high level of intellectual capital. The article is addressed in particular to researchers dealing with the subject of valuation and measurement of intellectual capital in an enterprise, as well as analysts and stock market investors.

Keywords: intellectual capital, intellectual capital valuation methods, market to book value.

Category of the paper: Research paper.

1. Introduction

In the knowledge-based economy, where enterprises build their basic competences on intangible assets, intellectual capital is considered a key factor in productivity and long-term growth (Sveiby, 1997; Guthrie et al., 2001). This is due to the fact that intangible assets in the information society era have grown to the rank of strategic resources, increasingly determining the ability of enterprises to generate cash flows, and their value (Bombiak, 2016).

Intellectual capital is identified primarily with the knowledge used by the organization as a lever in the exchange of intangible assets for value-creating assets (Kianto, 2007). Previous research on intellectual capital shows, inter alia, that it positively influences the achieved economic results of enterprises (Menor et al., 2007; Hussinki et al., 2017), it is as important in an enterprise as material capital (Samul, 2013), or it is a key factor of innovation (Subramaniam, Youndt, 2005; Rossi et al., 2016).

The importance of intellectual capital in recent years has also been noticed by both investors and listed companies themselves. Investors realized that non-financial information, including in particular those related to the elements of intellectual capital, presents factors determining the competitiveness and development of enterprises in the future, and thus may constitute the basis for investment decisions (Michalak, 2017). On the other hand, listed companies, or rather their management boards, in a way responding to the growing information needs of investors, began to include non-financial information in the published reports to a much greater extent, wanting to present their situation in a more credible way (Bagieńska, Burchart, 2018). It should be noted, however, that despite the growing importance of this category of capital in the literature, there is still considerable variation in its definition, identification and measurement (Jardon, Martinez-Cobas, 2021).

Although the first mentions of intellectual capital date back to the 1930s (Chamberlin, 1939), and later to the end of the 1950s in the context of the resource theory of the enterprise (Penrose, 1959), this category gained more popularity in scientific research only at the end of the 20th century. One of the reasons for this interest was the observation of the deepening disproportions between the market and book value of companies listed on world stock exchanges (Ujwary-Gil, 2009; Bombiak, 2016), especially in the late 1990s during the so-called "dotcom" boom.

At the same time, the aforementioned difference between the market value, identified with the company's quotations on the capital market, and the book value, resulting from the balance sheet (the value of the so-called net assets, i.e. equity), remains, despite the passage of time, one of the basic and more popular general measures of intellectual capital of enterprises. Although from the conceptual point of view it is difficult to question it (the company's balance sheet does not include all resources at its disposal, in particular those intangible ones that determine the amount of intellectual capital), and its additional advantage is its simplicity and

ease of use, at the same time this measure cannot be used without reflection because stock quotes also have their own specificity, which may distort the results of measuring intellectual capital.

For this reason, the main aim of the article was to present the issues of the practical application of the method of measuring intellectual capital based on the difference between market and book value of enterprises. By comparing the relationship of the market value to the book value of companies listed on the Warsaw Stock Exchange in various time dimensions with the trends in their basic economic and financial categories, it was shown when the indicated approach to measuring the intellectual capital of an enterprise makes sense and when it can be misleading.

2. The concept of intellectual capital and methods of its evaluation

2.1. The concept and elements of intellectual capital

As noted in the introduction, the concept of intellectual capital appeared in the literature many years ago, but only the popularization of the resource theory of E. Penrose and the dynamic development of economies based on intangible assets in the 1980s and 1990s contributed to the increased interest in this category (Pirogova et al., 2020). At the same time, due to the dynamic nature of intellectual capital, no comprehensive, universally recognized definition of it has yet been developed (Buenechea-Elberdin, 2017). Thus, both in the literature and in economic practice, there are various approaches to defining this category (Table 1), and in research on the nature of intellectual capital, a certain terminological heterogeneity can be noticed. Most often it is identified with intangible assets, hidden assets, invisible assets, non-financial assets, intellectual resources, intangible resources, knowledge capital or intellectual matter. In this context, the specificity of intellectual capital is well reflected by the "iceberg" model and the "tree" metaphor. The "iceberg" model presents the company's resources broken down into tangible (e.g. land, buildings, equipment, stocks, securities) and intangible (e.g. employee competences, management philosophy, organizational culture, reputation, customer loyalty, brand), where it indicates that the latter, unlike the former, are less visible to the environment and more difficult to evaluate, but at the same time have a greater ability to generate added value for the enterprise (Dobiegała-Korona, Herman, 2006). In turn, the metaphor of "tree" indicates that what is visible to the environment (the crown, i.e. the trunk and leaves) is the so-called external image of the company, which is the effect of invisible, hidden values inside the company equated with intellectual capital (tree roots). Which leads to the conclusion that when the roots of a tree no longer fulfill their functions well, the entire tree will be destroyed (Adamska, 2015).

Table 1.
Selected definitions of intellectual capital

Author	Definition
L. Edvinsson M.S. Malone	Intellectual capital is a hidden asset that reflects the gap between a company's market value and book value.
M. Bratnicki	Intellectual capital is the sum of the knowledge possessed by people who make up the enterprise community and the practical transformation of this knowledge into components of the company's value.
D. Dobija	Intellectual capital is a source of financing the company's intangible resources contributing to the generation of future benefits, and thus significantly influencing the process of creating the company's value.
G. Urbanek	Intellectual capital is an invisible resource of an enterprise that creates visible effects. It is both knowledge in itself and the result of its transformation into intangible assets.
Słownik języka polskiego PWN	Intellectual capital is wealth created, resulting from the knowledge of employees of the enterprise engaged in the constant process of increasing its value.
G. Roos, J. Roos	Intellectual capital is the sum of hidden assets not included in the financial statements, including both what is in the minds of employees and what remains in the company after they go home.
L. Prusak	Intellectual capital is intellectual matter that has been materialized, captured and used to create high-value assets.
T. Steward	Intellectual capital is intellectual material that has been formalized, captured and forced to act to create wealth of greater value.
J. Fitz-Enz	Intellectual capital is the intellectual property of the company and a complex combination of processes and culture connected with a network of various types of relationships and human capital.
E. Skrzypek	Intellectual capital is intellectual assets that are the sum of the knowledge of individual employees and teams of employees. These resources are subject to constant changes resulting from the learning process of the organization.
M. Mroziewski	Intellectual capital is the concept of the company's and its employees' ability to generate income and build the potential of future competitiveness, in particular based on intellectual assets and social relations, focused on the search for knowledge, its processing, enrichment and transfer to stakeholders in the form of artifacts that generate various benefits and socio-economic progress.
A. Brooking	Intellectual capital covers four areas: – market power - sales markets, customer loyalty, – intellectual properties such as patents, brand value, – internal aspects, such as corporate culture, management, processes, systems, – properties that come from the company's employees, such as competencies related to work, know-how, knowledge, abilities, connections.
K.-E. Sveiby	The intellectual capital of the company consists of elements that make up the external structure, internal structure and employees' competences.
K.M. Wiig	Intellectual capital consists of assets created as a result of intellectual activities, ranging from the acquisition of new knowledge (learning) through invention to the formation of valuable relationships with others.
M. Marcinkowska	Intellectual capital is the knowledge of employees and management, which is a resource of strategic importance influencing the competitive position and market potential of the enterprise. It is a resource that is very difficult to value and protect against loss.

Source: own work based on: Bombiak, 2016, pp. 105-119; Śledzik, 2011.

Generally speaking, it can be said that the definitions of intellectual capital consider this category either as a factor that creates the value of an enterprise and strengthens its competitive advantage – (i), or the sum of its components, in particular such as: human capital, structural (internal) capital and relational (external) capital – (ii). Human capital includes the intellectual potential of employees (i.e. their knowledge, skills, abilities, experience, predispositions, personality traits, etc.) and the possibilities of using it determined by their motivation. Structural

(organizational) capital includes, among others: organizational culture, systems, methods and processes as well as organizational and information infrastructure facilitating the flow of knowledge within the organization and the use of human potential. On the other hand, relational capital (network architecture) concerns all connections with external stakeholders (investors, suppliers, customers), as well as the reputation resulting from these relations (Sydler et al., 2014; Bombiak, 2016; Hussinki et al., 2017).

At the same time, with regard to the second of the mentioned approaches, the literature indicates that the impact of individual components of intellectual capital on the market value of the enterprise is not immediate. Structural and relational capital positively affects the performance of enterprises only in the long term (Sardo, Serrasqueiro, 2017). At the same time, it is emphasized that the size of the enterprise or the period of its operation on the market does not affect the level of intellectual capital (Forte et al., 2017).

Numerous studies also show that there are multidirectional dependencies between the individual dimensions (components) of intellectual capital. It is noted, inter alia, that structural capital, by facilitating the sharing of uncoded knowledge between employees, affects their job satisfaction and encourages them to stay in the organization. Human capital has a positive effect on both structural and relational capital (Hsu, Fang, 2009). In addition, human capital along with relational capital significantly affects structural capital – investments made by an enterprise in human and relational capital significantly affect the accumulation of structural capital (Johnson, 1999). As noted by Staniewski and Szczepankowski (2012), such a broad influence of human capital makes it the main dimension (component) of intellectual capital.

It is also worth noting that some researchers question the ability of the tripartite model to recognize and measure the diverse nature of organizations. Therefore, human, structural and relational capital is supplemented with such dimensions as: renewal capital, trust capital, entrepreneurial capital, with a proposal to include them in the components of intellectual capital (Inkinen et al., 2017; Buenechea-Elberdin et al., 2017, 2018).

Summing up the deliberations on the concept of intellectual capital, it can be stated that it is undoubtedly a complex category, developed on the basis of the most valuable resource of modern organizations, which is knowledge (both hidden, accumulated in the minds of employees, as well as codified and preserved in the company's documents), which is foundation for the creation of various intangible assets. This knowledge is therefore not only an ingredient, but also the basis for the creation of this capital. The process of its generation is equally complex, carried out through complex interactions involving not only various assets, but also various groups of the company's stakeholders (investors, employees, suppliers, customers). As noted by E. Bombiak (2016), the difficulty in developing a uniform approach and a consistent definition of intellectual capital is primarily due to the fact that we are dealing with a complex and unique resource. In each enterprise, it is created by a specific configuration of intangible assets related to each other and complementing each other. This uniqueness, on the one hand, is an important advantage of this capital, as it enables building a permanent

competitive advantage of the organization, and on the other hand, it is a source of problems related to determining its value.

2.2. Methods of intellectual capital evaluation

The need to measure intellectual capital results directly from the needs of the process of managing it and the entire enterprise. Measuring intellectual capital is the starting point for taking steps to evaluate, develop, increase and communicate it. At the same time, however, the measurement and valuation of intellectual capital is extremely complicated. This is mainly due to the fact that the elements that make up intellectual capital are often difficult to identify, not always clearly defined, often function in close connection with other elements, and their isolation is impossible or changes their value. Moreover, most often the value of intellectual capital depends on the quality of its components, and not on their quantity. It is also often difficult to express in money the values that define intellectual capital, as they are usually descriptive (qualitative).

When classifying models and methods of measurement and valuation of intellectual capital in the literature, one can see their general division into two groups (Fijałkowska, 2012; Jardon, Martinez-Cobas, 2021):

- Internal-analytical, components, measures of intellectual capital, i.e. measures of the micro level, created mainly to support the decision-making process of the management board and for reporting purposes. Such a measurement is expected to provide detailed information, based on several measures or a set of indicators. These measures concern the quantification of individual components of intellectual capital on the basis of monetary units, but also percentage or natural units. Typically, the result of a measurement is a set of indicators and non-sumable values. In order to calculate these measures, it is most often necessary to obtain additional information from the enterprise, which is not presented in the financial statements, which makes it impossible to calculate these measures for external users of information published by enterprises. These measures are very useful for company management, if the company decides to disclose them, they can also be very useful for external stakeholders of the company. The measures of this group include, among others: Monitor of intangible assets, Navigator Skandia, Strategic scorecard.
- Synthetic, holistic, economic valuation measures that lead to a single overall quantity representing the value of intellectual capital in monetary units. They do not refer to individual elements of intellectual capital, have a high level of aggregation and usually try to assign a value to the total intellectual capital resources by determining their share in the total value of the enterprise. Examples include the Tobin Q index, the difference between market and book value, or the calculated value of an intangible asset CIV.

Another, more developed, approach to the classification of intellectual capital measurement and valuation methods is that proposed by Sveiby (2010), where four groups of methods are distinguished: direct measurement methods, market capitalization methods, return on assets methods, and scorecard methods. This division, along with the characteristics of individual groups of methods, is presented in Table 2.

Table 2.
Methods of classification, measurement and valuation of intellectual capital according to K.E. Sveiby

Direct Intellectual Capital methods (DIC): estimate the money-value of intangible assets by identifying its various components. Once these components are identified, they can be directly evaluated, either individually or as an aggregated coefficient.	– Citation – Weighted Patents – Total Value Creation (TVC) – Inclusive Valuation Methodology – The Value Explorer – Technology Broker – Intellectual Asset Valuation
Market Capitalization methods (MC): calculate the difference between a company's market capitalization and its stockholders' equity as the value of its intellectual capital or intangible assets.	– Market-to-Book Value – Q-Tobin's Indicator – Investor Assigned Market Value
Return on Assets methods (ROA): average pre-tax earnings of a company for a period of time are divided by the average tangible assets of the company. The result is a company ROA that is then compared with its industry average. The difference is multiplied by the company's average tangible assets to calculate an average annual earnings from the Intangibles. Dividing the above average earnings by the company's average cost of capital or an interest rate, one can derive an estimate of the value of its intangible assets or intellectual capital.	– Economic Value Added (EVA) – Human Resources Costing & Accounting – Calculated Intangible Value (CIV) – Knowledge Capital Earnings – Value Added Intellectual Coefficient (VAIC)
Scorecard methods (SC): the various components of intangible assets or intellectual capital are identified, and indicators and indices are generated and reported in scorecards or as graphs. SC methods are similar to DIC methods, expect that no estimate is made of the money-value of the intangible assets. A composite index may or may not be produced.	– Human Capital Intelligence – Skandia's Navigator – Value Chain Scoreboard – IC-Index – Intangible Asset Monitor – Strategic Scorecard – IC-Rating

Source: own work based on: Sveiby.

It should be emphasized at this point that no measure of intellectual capital has so far been considered ideal, as each of the methods of measurement and valuation has certain advantages, but also some weaknesses. Usually, the desired simplicity of calculations, meaning lower costs of calculation and easier access to data, is associated with the consent to some simplifications in defining intellectual capital and the omission of many of its important elements, or possibly including components that do not affect its value.

Component methods have been criticized in the literature because they present contradictory aspects. Users of these methods believe that the interactions of individual components of intellectual capital make a significant contribution to the value of intellectual capital (van der Meer-Kooistra, Zijlstra, 2001), but they are ignored in the focus on measuring individual components (Mouritsen, 2009). In addition, it is difficult to obtain financial information on the individual components, and only component aspects that are measurable are

considered, but there are likely to be many other aspects that cannot be accurately measured (Goebel, 2015).

In turn, holistic methods are criticized because they are too general and identify the monetary value of intellectual capital with the value generated also by other types of capital in the enterprise (Jardon, Martinez-Cobas, 2021).

The further part of the article focuses on the problem of applying one of the simpler and more popular methods of measuring and valuing intellectual capital, which is the difference between market and book value of an enterprise.

3. Research methodology

The main aim of the article was to present the issues of the practical application of the method of measuring intellectual capital based on the difference between market and book value of enterprises. Due to the use of the same variables, this method is inextricably linked with one of the basic stock exchange indicators, i.e. P/BV. This ratio, which is the relation of the market price of the company's shares (P, market value) to equity per share (BV, book value), shows how much the market overvalues (P/BV > 1) or undervalues (P/BV < 1) shares of a given entity in relation to its book value, or balance sheet value (the so-called net assets being the difference between total assets and total liabilities).

In the context of intellectual capital valuation, particular attention is paid to situations in which listed companies are characterized by a P/BV ratio above 1, especially definitely above 1. Despite the fact that from an investment point of view, such cases are usually not treated as investment opportunities (Haugen, 1999), in the sciences of management, as already indicated in the previous paragraphs, the higher market value in relation to the book value is justified by the presence of intangible assets (human capital, structural capital, relational capital), which have not been fully included in the traditional balance sheet of the company, prepared in accordance with the applicable accounting standards.

At the same time, however, it should be borne in mind that the share price of companies on the stock exchange market is not influenced solely by objective and fundamental factors, but to a large extent is the result of investors' emotions on various information and related expectations (Zaremba-Śmietański, 2013). Hence, especially in short time ranges, it may be subject to rapid changes (both up and down), which may distort the result of the enterprise's intellectual capital valuation using the considered method..

For this reason, considering the issue of the application of the method of intellectual capital valuation, based on the difference between market and book value of an enterprise, it was decided to analyze its effectiveness in identifying entities with a high level of intellectual capital

depending on the application of various approaches to their selection using the P/BV ratio, and then subjecting selected companies to verification for the actual presence of intellectual capital.

In the context of selecting companies, three approaches were considered:

i. the P/BV value on a given day,
ii. average P/BV value for 12 quarters (P/BV taken at the end of each quarter),
iii. median P/BV for 12 quarters (P/BV taken at the end of each quarter).

The indicated selection of approaches will allow to determine whether there are significant differences in the selection of companies between the short and long term (i. vs. ii. and iii.) and due to one-off high P/BV readings (i and ii. vs. iii.).

On the other hand, the verification for the presence of intellectual capital was based on the aforementioned "tree" metaphor, according to which the intellectual capital hidden in assets invisible in the traditional balance sheet of an enterprise gives visible effects in the form of its stable or improving financial and results condition. For this purpose, two simple criteria were used, referring to two basic economic and financial categories of enterprises, which are sales revenues and total assets:

- the average annual growth rate of revenues from sales and total assets, calculated as the arithmetic mean of their annual changes over the last 5 years – AAG,
- number of years with a year-on-year increase in sales revenues and total assets in the last 5 years – NoY.

For the purposes of the analysis, the verification was assumed to be carried out in relation to 20 companies with the highest P/BV selected under each of the three approaches indicated above. Enterprises with actual intellectual capital should be characterized by relatively higher values of the average annual growth rate of revenues from sales and total assets in the period under consideration and, in fact, their systematic growth (high number of years indicating improvement).

The companies listed on the Warsaw Stock Exchange were selected as the subjects of the analysis, and the data needed to conduct the analysis were obtained from the website of the WSE – www.gpw.pl (P/BV ratios) and the biznesradar website – www.biznesradar.pl (sales revenues and total assets).

4. Research results

The analysis of the effectiveness in identifying enterprises with high intellectual capital value based on the P/BV ratio was carried out in accordance with the methodology outlined in the previous section for companies listed on the Warsaw Stock Exchange. In the first approach to selecting companies (i.), i.e. for a given date, P/BV data as of June 17-th 2022 were taken into account, in the second (ii.) and the third approach (iii.), the average (avg.) and respectively

median (med.) P/BV assuming the values of the ratio from June 17-th 2022 and at the end of 11 previous quarters (from Q1 2022 to Q3 2019). In turn, the data on sales revenues, needed to verify intellectual capital, was adopted for the period from 2016 to 2022, and due to the fact that 2022 was "in progress", the data for this year constituted the sum of sales revenues for the last four quarters, i.e. Q2, Q3 and Q4 2021 and Q1 2022. The 20 companies with the highest P/BV values selected under each of the three approaches are listed in descending order in Table 3, in each case also taking into account the P/BV values for the other two approaches.

Table 3.
P/BV values for the 20 *companies with the highest readings (decreasing order) under each of the three approaches to selecting entities with a potentially high level of intellectual capital*

	P/BV sort by 17-06-2022				P/BV sort by average from 12 quarters				P/BV sort by median from 12 quarters			
No.	Company	17.06. 2022	avg. from 12 quart.	med. from 12 quart.	Company	17.06. 2022	avg. from 12 quart.	med. from 12 quart.	Company	17.06. 2022	avg. from 12 quart.	med. from 12 quart.
1	ADIUVO	59.23	9.93	2.76	GROCLIN	1.65	51.53	1.14	ZYWIEC	20.70	36.54	25.91
2	XTPL	26.10	21.26	17.48	ZYWIEC	20.70	36.54	25.91	LIVECHAT	16.99	24.13	22.82
3	ZYWIEC	20.70	36.54	25.91	DATAWALK	8.71	28.77	16.34	CDPROJEKT	4.65	19.10	21.14
4	ENTER	19.45	4.33	2.53	LIVECHAT	16.99	24.13	22.82	TSGAMES	2.06	17.86	18.09
5	LIVECHAT	16.99	24.13	22.82	XTPL	26.10	21.26	17.48	XTPL	26.10	21.26	17.48
6	IFIRMA	10.62	6.47	4.72	CDPROJEKT	4.65	19.10	21.14	DATAWALK	8.71	28.77	16.34
7	BRASTER	10.02	2.49	1.25	TSGAMES	2.06	17.86	18.09	PLAYWAY	4.24	10.87	11.51
8	DATAWALK	8.71	28.77	16.34	BIOMEDLUB	2.66	11.22	7.78	DINOPL	8.70	11.19	11.35
9	DINOPL	8.70	11.19	11.35	DINOPL	8.70	11.19	11.35	ULTGAMES	2.10	8.53	9.25
10	VIVID	5.90	2.92	2.40	PLAYWAY	4.24	10.87	11.51	SELVITA	5.31	8.68	8.21
11	11BIT	5.51	7.40	7.24	ADIUVO	59.23	9.93	2.76	BIOMEDLUB	2.66	11.22	7.78
12	SELVITA	5.31	8.68	8.21	SELVITA	5.31	8.68	8.21	11BIT	5.51	7.40	7.24
13	INTERSPPL	5.28	4.02	2.49	ULTGAMES	2.10	8.53	9.25	MOBRUK	4.74	6.24	5.94
14	MOBRUK	4.74	6.24	5.94	11BIT	5.51	7.40	7.24	BUDIMEX	3.86	5.94	5.53
15	CDPROJEKT	4.65	19.10	21.14	IFIRMA	10.62	6.47	4.72	CCC	3.04	6.05	5.41
16	LPP	4.62	5.74	5.29	MOBRUK	4.74	6.24	5.94	LPP	4.62	5.74	5.29
17	VOTUM	4.40	2.97	2.99	CCC	3.04	6.05	5.41	MDIENERGIA	4.00	4.73	4.73
18	PLAYWAY	4.24	10.87	11.51	BUDIMEX	3.86	5.94	5.53	IFIRMA	10.62	6.47	4.72
19	MDIENERGIA	4.00	4.73	4.73	LPP	4.62	5.74	5.29	VIGOSYS	3.19	4.55	4.72
20	SUNEX	3.90	2.58	2.35	R22	2.86	5.61	4.41	WIRTUALNA	3.09	4.62	4.60

Source: own work based on data from the website www.gpw.pl.

At this stage, the first differences between the various approaches to the selection of companies can already be identified. Compared to the P/BV approach for a given day (i.). The 12-quarter average approach (ii.) was indicated by seven other companies (instead of ENTER, BRASTER, VIVID, INTERSPPL, VOTUM, MDIENERGIA and SUNEX appeared GROCLIN, TSGAMES, BIOMEDLUB, ULTGAMES, CCC, BUDIMEX and R22). On the other hand, in the case of selection by the 12-quarter median (iii), ZYWIEC was the new company compared to the two previous approaches.

For a better understanding of the selected companies, Table 4 presents their activity profiles in a shortened manner. Out of 29 entities (a lot of entities repeated under individual approaches to selection based on P/BV), the largest representation can be found in relation to game developers (6 – 11BIT, CDPROJEKT, PLAYWAY, TSGAMES, ULTGAMES, VIVID), and then related entities with broadly understood activities in the field of health protection (4 – ADIUVO, BRASTER, BIOMEDLUB, SELVITA), IT activities in the field of software (3 – DATAWALK, IFIRMA, LIVECHAT), new technologies (3 – R22, VIGOSYS, XTPL) as well as clothing and footwear (3 – CCC, INTERSPPL, LPP).

Table 4.
Characteristics of the activities of the analysed companies

Company	Activity profile
11BIT	Developer of multiplatform games sold all over the world.
ADIUVO	The company focuses on the selection, development, financing and commercialization of innovative projects.
BIOMEDLUB	It deals with the production of medicinal preparations, medical devices and laboratory reagents.
BRASTER	The company has developed a breakthrough method of using liquid crystals in cancer diagnostics.
BUDIMEX	One of the largest construction companies on the Polish market.
CCC	One of the largest European companies in the footwear segment.
CDPROJEKT	The group operates in the dynamically developing industry of electronic entertainment - video games.
DATAWALK	The company deals with technologically advanced solutions for data analysis.
DINOPL	One of the largest chains of medium-sized supermarkets in Poland.
ENTER	Polish charter airline. It serves all the largest charter markets in Europe.
GROCLIN	The Group produces and sells car equipment and accessories (car seat covers).
IFIRMA	The company creates software, recruits IT staff and runs the ifirma.pl online accounting service.
INTERSPPL	The company deals with retail sale of branded sports equipment.
LIVECHAT	An IT company operating on the global market and offering services supporting sales and customer service.
LPP	It deals with the design, production and distribution of clothing.
MDIENERGIA	Specializes in the implementation of wind farm projects, biogas plants and photovoltaic installations.
MOBRUK	The company specializes in waste disposal, alternative fuels and concrete surfaces.
PLAYWAY	One of the leading producers and publishers of computer and mobile games.
R22	Holding of technology companies, offering, among others hosting services and domain sale.
SELVITA	He provides laboratory research and development services commissioned by pharmaceutical companies.
SUNEX	Producer of innovative solutions based on renewable energy sources.
TSGAMES	Producer and publisher of free to play games for mobile devices.
ULTGAMES	A producer of games for desktop computers and mobile devices.
VIGOSYS	A world leader in the production of uncooled, infrared photon detectors.
VIVID	A development studio dealing with the design, production and publishing of video games.
VOTUM	Comprehensive assistance in the field of their representation in personal injury cases and redress.
WIRTUALNA	The owner of one of the two most popular horizontal web portals in Poland - wp.pl.
XTPL	Commercialization of R&D works in order to develop the technology of ultra-precise printing of nanomaterials.
ZYWIEC	A beer producer from the Heineken group with the most diverse product portfolio on the Polish market.

Source: own work based on www.bankier.pl.

Subsequently, the selected companies were verified using the criteria for changes in sales revenues and total assets – average annual growth over a 5-year period (AAG) and the number of years showing improvement over a 5-year period (NoY). The obtained values of the above-mentioned criteria together with the annual changes in sales revenues and total assets for the analyzed companies are presented in Table 5.

Table 5.
Results of verification of the intellectual capital level in the analysed companies based on changes in sales revenues and total assets

Company	Sales revenues							Total assets						
	2018	2019	2020	2021	2022	AAG	NoY	2018	2019	2020	2021	2022	AAG	NoY
11BIT	328%	-13%	22%	-19%	4%	64%	3/5	125%	42%	20%	18%	3%	42%	5/5
ADIUVO	-52%	-36%	-47%	70%	-4%	-14%	1/5	24%	-8%	-6%	-20%	4%	-1%	2/5
BIOMEDLUB	3%	21%	3%	2%	6%	7%	5/5	-29%	-6%	6%	36%	5%	2%	3/5
BRASTER	118%	-33%	-67%	128%	-21%	25%	2/5	-26%	-10%	-27%	-34%	-2%	-20%	0/5
BUDIMEX	16%	2%	11%	-6%	10%	7%	4/5	-9%	22%	12%	-8%	0%	3%	3/5
CCC	13%	24%	-4%	35%	6%	15%	4/5	100%	6%	-7%	13%	-3%	22%	3/5
CDPROJEKT	-22%	44%	310%	-58%	-10%	53%	2/5	15%	25%	106%	-25%	2%	24%	4/5
DATAWALK	-1%	103%	348%	96%	13%	112%	4/5	-55%	156%	282%	-2%	36%	83%	3/5
DINOPL	29%	31%	32%	32%	20%	29%	5/5	34%	32%	28%	29%	7%	26%	5/5
ENTER	36%	25%	-71%	138%	12%	28%	4/5	39%	45%	-1%	2%	3%	18%	4/5
GROCLIN	-21%	-49%	-72%	-100%	-1753%	-399%	0/5	-56%	-58%	-42%	-27%	-3%	-37%	0/5
IFIRMA	14%	21%	15%	38%	18%	21%	5/5	8%	16%	15%	36%	5%	16%	5/5
INTERSPPL	32%	-14%	-25%	48%	112%	31%	3/5	5%	6%	-4%	-8%	455%	91%	3/5
LIVECHAT	22%	20%	37%	24%	8%	22%	5/5	26%	42%	40%	13%	27%	30%	5/5
LPP	14%	23%	-21%	79%	5%	20%	4/5	28%	79%	8%	37%	11%	32%	5/5
MDIENERGIA	-21%	31%	44%	-2%	-6%	9%	2/5	-4%	26%	0%	7%	-7%	4%	2/5
MOBRUK	41%	41%	37%	50%	-7%	32%	4/5	4%	9%	10%	24%	-27%	4%	4/5
PLAYWAY	80%	66%	38%	29%	2%	43%	5/5	59%	74%	117%	25%	6%	56%	5/5
R22	32%	34%	62%	-6%	12%	27%	4/5	20%	23%	17%	54%	49%	33%	5/5
SELVITA	30%	48%	36%	122%	18%	51%	5/5	51%	25%	141%	113%	6%	67%	5/5
SUNEX	48%	8%	36%	54%	25%	34%	5/5	12%	33%	21%	55%	16%	28%	5/5
TSGAMES	326%	109%	140%	10%	-10%	115%	4/5	274%	95%	205%	61%	-7%	125%	4/5
ULTGAMES	259%	88%	75%	52%	-1%	95%	4/5	98%	133%	500%	2%	-9%	145%	4/5
VIGOSYS	38%	15%	25%	34%	-3%	22%	4/5	60%	42%	31%	31%	7%	34%	5/5
VIVID	-1%	13%	55%	-16%	8%	12%	3/5	-18%	13%	10%	-46%	-2%	-8%	2/5
VOTUM	12%	35%	6%	31%	7%	18%	5/5	32%	13%	7%	16%	20%	18%	5/5
WIRTUALNA	22%	25%	-11%	38%	9%	17%	4/5	19%	8%	9%	2%	11%	10%	5/5
XTPL	3%	-9%	11%	105%	20%	26%	4/5	24%	-12%	71%	-17%	-4%	12%	2/5
ZYWIEC	49%	7%	5%	-8%	5%	12%	4/5	1%	39%	0%	0%	18%	12%	4/5

Source: own calculations based on data from the website www.biznesradar.pl.

As can be seen from the obtained calculation results, the high level of intellectual capital can be negatively verified, in particular in relation to the companies ADIUVO and GROCLIN, which stand out in terms of the negative average annual growth of revenues from sales and net assets and the low number of years with an increase in the above-mentioned values in the analyzed 5 summer period. It is also worth noting here that these two companies are also characterized by the largest P/BV spread among the analyzed entities within the three analyzed approaches to selection (Fig. 1).

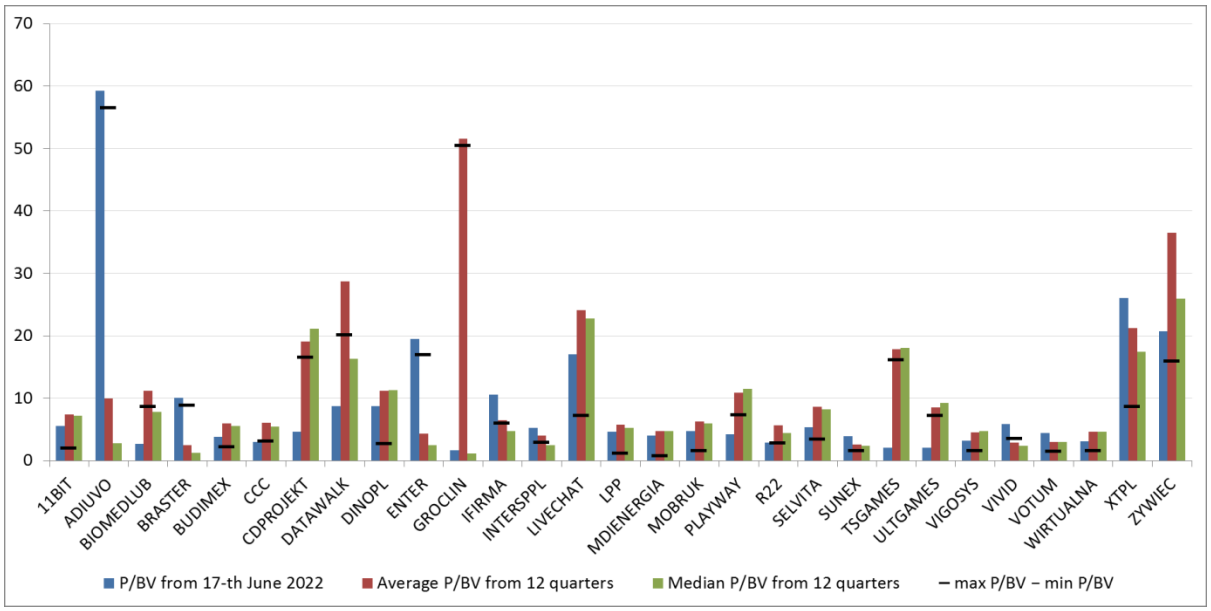

Figure 1. P/BV ratios of the analyzed companies in various perspectives (data as of the day, average and median for 12 quarters) with the difference between the highest and the lowest value.

Source: own work.

Certain objections as to the credibility of indications of a high level of intellectual capital, mainly due to changes in the scope of total assets, may also be raised in relation to BRASTER and VIVID. In the case of other entities, positive annual average increases in revenues were recorded, and in the vast majority a high or full number of years with an increase in revenues and total assets in the analyzed 5-year period. The P/BV spread under the three considered approaches to selection for these companies was also much smaller than for the two previously distinguished (ADIUVO, GROCLIN).

5. Summary

The research carried out on the application of the difference between the market value and the book value or their quotient in the form of the P/BV ratio as a measure of intellectual capital allows us to conclude that this method is simple, but strongly imperfect. Its main burden is the high dynamics of changes in their market quotations (prices), which often occurs in the case of listed companies, which may lead to distortions in the measurement or assessment of the intellectual capital level of the analyzed entities. Hence, this method is more suitable for the initial identification of entities with a potentially high level of intellectual capital than for its precise measurement.

Nevertheless, even if its application is limited to the aforementioned identification, in order to obtain more objective results, it is worth relying on quotations or P/BV ratios of the analysed companies, in the form of an average, or even better a median, from a longer period (preferably

several years). As a result, single high readings, often the result of a temporary increase in emotions among investors, will only have a limited impact on the situation of the analysed entities.

In addition, indications of a high level of intellectual capital of the surveyed entities, regardless of the approach to their identification using the P/BV ratio or the difference in market and book value (data from a given day or average or median from a longer period), it is worth verifying based on the assessment of changes in their economic and financial situation, also in a several-year time horizon, referring to the "tree" metaphor (invisible resources create visible effects). In the study carried out in this article, a simple verification, limited to the most basic financial parameters of enterprises, i.e. sales revenues and total assets, allowed to detect a few distorted cases of enterprises with an overstated level of intellectual capital..

In the course of broader, more detailed research, it is possible to expand the scope of this verification to other dimensions of the assessment of the economic and financial situation of enterprises (analysis of profitability, liquidity, debt, operational efficiency) or to test ready-made solutions, such as the F-Score model (Piotroski, 2000).

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