

Empirical Paper

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Efficiency of human capital in Poland in terms of sectors and industries

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Abstract:

The article aims to examine the impact of selected factors on wage differentiation. The research question is formulated as follows: “Do human capital efficiency and tangible fixed assets efficiency explain inter-sectoral and inter-industry differences in wages in Poland?” Verification of the hypotheses was made based on financial statements, management reports, and non-financial information reports published by companies listed on the Warsaw Stock Exchange. In addition to analyzing arithmetic means and variability ranges of selected values the correlation and determination between the analyzed data and the indicators built on their basis were calculated. The research results allow for a positive verification of the hypotheses, i.e., inter-sectoral and inter-industry differences in wages and benefits are related to the efficiency of human capital and tangible fixed assets. The originality of the article lies in the analysis of human capital efficiency and its connection with the amount of wages and benefits in Polish companies.

Keywords: human capital efficiency, inter-sectoral and inter-industry differentiation of wages and benefits, tangible fixed assets, value added

JEL Classification: E24, J21, J24, J31, M12, M52, M54

1 Introduction

Considerations about the human capital available to an enterprise focus on determining its value and effectiveness. The value of an individual employee’s human capital is reflected in the remuneration they receive for performing work. The competitive labor market model assumes that wages are equal to the marginal productivity of employees, and the balance of supply and demand determines the level of wages.

Apart from the human capital of individual employees, the value of human capital for an enterprise is determined by a number of factors, starting from the workplace equipment, through the conditions and organization of the workplace, to the synergistic effects resulting from the cooperation of staff. Employers support the internal dynamics of creation, development, and use of skills and knowledge within the adopted technical and organizational solutions [Antonelli et al., 2010].

The article examines the impact of selected factors on wage differentiation from the inter-sectoral and inter-industry perspectives. The research question is: “Do human capital efficiency and tangible fixed assets efficiency explain inter-sectoral and inter-industry differences in wages in Poland?”

For the article, the quotient of added value, generated by the company and its human capital (identified with total wages and benefits of employees), was adopted as a representation of the efficiency of human capital, according to Pulic [Pulic, 1998]. Pulic emphasizes that value added is an objective indicator of business success and the coefficient shows the actual productivity of the company’s staff (the value that the company obtains from investing one monetary unit in its staff) [Pulic, 2000, 2004].

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The article's contribution to considerations on the value and efficiency of human capital is the analysis of these values in a sectoral and industry approach in the Polish economy, based on data published by companies listed on the Warsaw Stock Exchange. The article allows us to answer the question: "Do human capital efficiency and tangible fixed assets efficiency explain inter-sectoral and inter-industry differences in wages in Poland?"

The theoretical introduction includes a literature review on the topic, taking into consideration published research results. Then, the adopted methodology and research results were presented. The article ends with a conclusions section.

2 Review of literature

Human capital related to an individual employee is treated as individual characteristics in the form of education, work experience, skills acquired at school, on-the-job training and other forms (independent further education, public training on the labor market, intergenerational transfer of human capital in the family), skills, teamwork, etc. [Kicker, 1966; Hanushek, 1996; Hanushek and Woessmann, 2008; Antonelli et al., 2010; Goldin, 2016; Flabbi and Gatti, 2018; Sasso and Ritzen, 2019; Goczek et al., 2022].

For an enterprise, human capital is higher than the simple sum of individual human capital of all employees. People are co-creators of processes, practices, norms, and standards, they build social relationships and organizational systems, creating values for both the company and themselves. By reacting to environmental changes and influencing them, they improve individual knowledge, as well as shape skills and attitudes [Habib et al., 2019; Rosińska-Bukowska, 2020].

According to the "canonical" model, the subject of transactions in the labor market are the skills offered by employees [Acemoglu and Autor, 2011]. Wage levels are determined solely based on observable and unobservable skills, taking into account the supply and demand for particular skills. Based on comparative advantage, employees are assigned to perform tasks according to their skills [Fortin and Lemieux, 2016; Sheveleva et al., 2023]. This model, which can be treated as a starting point for the analysis of the return on skills, does not fully explain the actual wage ranges and their evolution in the form of non-monotonous changes in wages in various segments of the labor market, the increase in employment in high-skilled and low-skilled occupations, compared to medium qualifications ("polarization" of professions). Explaining the above phenomena requires supplementing the model with interactions between employees' skills and professional tasks, technological progress, globalization, as well as related offshoring and institutional conditions [Goos et al., 2010; Acemoglu and Autor, 2011; Klimek, 2021].

Changes in the remuneration structure within and between professions are related to the type of tasks performed, differentiating wages among employees with identical formal qualifications [Dunne et al., 2004]. Pay ranges increase as the share of bonuses, commissions, or piece rates (pay for performance) increases [Sheveleva et al., 2023].

In the 1980s, there was a shift from a proportional wage increase for all qualification groups to a model of employment polarization. The phenomenon of increasing employment and wages in the group of highly paid specialists and managers, as well as in the group of low-paid service staff, was accompanied by a decreasing share of production and office workers [Autor et al., 2006; Goos et al., 2010]. These trends have been observed in studies on the USA, the European Union, OECD countries [Guy et al., 2014], and Asian countries [Mehta et al., 2013].

The leading explanation for the polarization of occupations is the routinization hypothesis, indicating that professions with a high level of automation/routine usually experience a decline in both the level and dispersion of wages [Fortin and Lemieux, 2016; Blundell, 2022]. These processes are deepened by technological changes, which reduce the demand for medium skills and increase the demand for high qualifications [Autor et al., 2003; Autor et al., 2008; Goos and Manning, 2007; Bárány and Siegel, 2018; Feng and Graetz, 2020; Schultheiss et al., 2023].

Another factor influencing the wage range and strengthening the impact of technical progress is globalization. The increase in international trade turnover and the related possibilities of expanding by

offshoring (transferring some tasks abroad) led to the evolution of wages and employment in professions affected by foreign competition. Research confirms the impact of offshoring on the polarization of the labor market, although it is much smaller than the effects of absorption of technological changes [Goos et al., 2010; Dygas, 2020].

The level of polarization is also influenced by institutional factors such as legislation on minimum wages, collective bargaining, and unionization of individual sectors, industries, and enterprises [Acemoglu and Autor, 2011; Próchniak, 2013; Adermon and Gustavsson, 2015; Cortes, 2016]. Rent-sharing mechanisms may explain differences in wages, especially in industries with collective agreements and wage negotiations at the company level [Song et al., 2019]. In addition, political decisions can affect the wages in sectors dominated by state ownership. Examples in Poland include sectors undergoing energy transformation, which involves a gradual departure from non-renewable energy sources. The transformation program includes regulating energy prices, and protecting employment and income of employees in mining and energy sectors [Zieliński and Jonek-Kowalska, 2021].

Numerous studies indicate statistically significant inter-industry differences in remuneration, but their interpretation remains controversial [Mehta et al., 2013]. It is indicated that changes in wages are related to changes in the valuation of skills, which evolve over time. In addition to general and formal skills, wage changes are influenced by the tasks performed and the above-mentioned technological changes, as well as offshoring [Acemoglu and Autor, 2011; Fortin and Lemieux, 2016]. Polarization of job positions occurs both between sectors (industries) and within industries (in individual enterprises) [Goos et al., 2014; Grzywińska-Rapca et al., 2023]. High-wage sectors employ workers with high skills (observable and unobservable ones), obtaining a high return on employee skills [Gibbons et al., 2005; Juchniewicz and Łada, 2022]. Trends in wage dispersion track trends in productivity dispersion across industries and workplaces [Abowd et al., 1999; Dunne et al., 2004; Faggio et al., 2010; Barth et al., 2016].

Higher wages usually occur in capital-intensive industries, where enterprises have greater material resources [Card et al., 2023] and acquire qualified employees performing unusual tasks, while unskilled employees performing routine tasks are pushed to capital-efficient sectors. In industries that absorb new technologies the fastest, there is the most rapid increase in demand for the best-educated employees and the quickest decline in demand for employees with an average level of education [Goos et al., 2014; Guy et al., 2014]. Consequently, more qualified employees benefit from relatively better physical capital than less qualified employees, which leads to an increase in the dispersion of wages and productivity in individual plants. Enterprises are segmented into well-paying leading companies and lower-paying suppliers and service providers [Song et al., 2019; Bormans and Theodorakopoulos, 2023]. Differences in productivity and wage levels by sector may vary in different countries [Sampson, 2016], depending on comparative advantages.

Trends in the dispersion of productivity-based wages occur not only between industries, but also between enterprises and workplaces. This is related to differences in employee skills and productivity, combined with the pace of absorption of technical changes [Dunne et al., 2004; Juchniewicz and Łada, 2020]. Much of the wage inequality between companies is linked to their financial performance, resulting from employee productivity. According to the research of Card et al. [2018], a 10% increase in value added per employee leads to a 1.5% wage increase.

Differences in remuneration and working conditions result in staff allocation. Consequently, there are changes in the structure of personnel in individual sectors, affecting the level of remuneration in the industry (enterprise), treated as the value of human capital [Sampson, 2016; Bárány and Siegel, 2018]. Allocation causes a change in the average quality of employees and, consequently, in wage differences [Song et al., 2019; Cavaglia and Etheridge, 2020].

The allocation scale between sectors, enterprises, and professions also depends on employees' decisions. They consider not only the income offered but also the non-wage value of work, for which they can sacrifice higher wages. They differ in their assessment of the non-wage characteristics of the employment offered to them [Card et al., 2018], which include benefits, travel time, hours, flexibility, job security, required level of effort, company size, and promotion prospects [Sorkin, 2018; Dženopoljac et al.,

2023]. The differences in wages between sectors (industries, enterprises, professions) are, therefore, partly due to the result of compensation for non-wage features of the job (employees expect higher wages for unfavorable working conditions) [Clark et al., 2024].

Based on the literature review presented above, the article aims to answer the question of whether inter-sectoral and inter-industry wage differences in Poland can be explained by the efficiency of human capital and the efficiency of tangible fixed assets. The adopted goal results in two hypotheses:

H1: Inter-sectoral and inter-industry wage differences in Poland can be explained to a large extent by the efficiency of human capital in individual sectors and industries.

H2: Inter-sectoral and inter-industry wage differences in Poland can be explained mainly by the efficiency of tangible fixed assets in individual sectors and industries.

3 Methodology

For the article, data for 2023 was used, coming from companies from 19 industries, forming four sectors: Finance, Consumer goods, Industry, and New technologies (classification according to the Warsaw Stock Exchange). The study included five companies from each industry with the highest capitalization on the WSE as of the study date. Ten companies were eliminated from the research sample, as they significantly differed from comparable entities in their industries in terms of the value of remuneration and benefits per employee (ambiguities in providing the employment level) or showed negative value added, which made it impossible to calculate the human capital efficiency index according to the Pulic's model (value added/salaries and employee benefits). Therefore, the final research sample consisted of 85 companies.

The analysis included data on revenues, employment, remuneration and employee benefits, value added (net result on sales + depreciation + remuneration and employee benefits), and tangible fixed assets. Data for calculations were obtained mainly from the financial statements of the analyzed companies, published as part of the annual reports for 2023. These data were then used to calculate the following additional indicators:

- Human capital efficiency:
 - Sales revenues/Number of employees [thousands PLN per employee]
 - Sales revenues/Salaries and employee benefits [without unit; PLN/PLN]
 - Value added/Number of employees [thousands PLN per employee]
 - Value added/Salaries and employee benefits [without unit; PLN/PLN]
- Technical equipment:
 - Tangible fixed assets/Number of employees [thousands PLN per employee]
 - Tangible fixed assets/Salaries and employee benefits [without unit; PLN/PLN]
- Human capital per employee:
 - Salaries and employee benefits/Number of employees [thousands PLN per employee]
- Tangible fixed assets efficiency:
 - Value added/Tangible fixed assets [without unit; PLN/PLN]

The situation of companies from individual industries in terms of the above indicators is presented in the form of charts, including arithmetic averages and their range of variability from the lowest readings (min) to the highest (max).

The hypotheses were verified based on the correlation and determination between the value of human capital (Salaries and employee benefits/Number of employees) and indicators of human capital efficiency, technical equipment of work, and tangible fixed assets efficiency.

4 Results

When we consider the amount of remuneration and benefits as the value of human capital, then it turns out that the industries employing employees with the highest human capital in Poland are “Capital market,” “Video games developers,” and “Sale and rental of real estate” (Figure 1). The lowest level of human capital measured by wages and benefits is characteristic of the “Wholesale trade and retail chains” and “Sale of clothing and footwear” industries. By far, the largest differences in the amount of remuneration and benefits occur in the “Sale and rental of real estate” industry. Looking from a sectoral perspective, the largest wage and benefit disparities are in the “Finance” and “New technologies” sectors, while the smallest are in the “Consumer goods and trade and services” sector.

The hierarchy of remuneration is only partially justified when sales revenues are compared in terms of remuneration and employee benefits as well as employment (Figure 2).

It is true that the “Sale and rental of real estate” industry appeared among the leaders in the ranking, but other sectors with the highest salaries and benefits per employee took lower positions in the ranking. Additionally, among industries with a relatively high level of human capital efficiency, given by relation of sales revenues to number of employees, there was “Wholesale trade and retail chains,” which also ranks last in the level of remuneration and benefits per employee. Notably, the analyzed indicator varies greatly in the “Fuels and energy” industry and is significant in the “Sale and rental of real estate” industry. Referring to the observed ranges, indicators using revenues concerning employment give an approximate picture of the value of human capital engaged in particular industries. Still, they may “overestimate” its value in cases, where a significant part of the company’s revenues constitutes commercial activities not related to processing (providing value added). In the case of this indicator, the “Industry” and “Finance” sectors have the largest differences.

The indicators of technical equipment (Tangible fixed assets to Salaries and employee benefits and Tangible fixed assets to Number of employees) allow us to distinguish the leading industries: “Fuels and energy,” “Chemistry,” “Production of medicines,” and “Mining and metallurgy” (Figure 3). Other type of industries have similar values of the analyzed indicators.

By far, the largest range of indicators occurs in the following industries: “Fuels and energy,” “Chemistry,” and “Production of medicines.” The hierarchy of industries according to the values of the considered indicators of technical work equipment is, therefore, clearly divergent from the hierarchy of

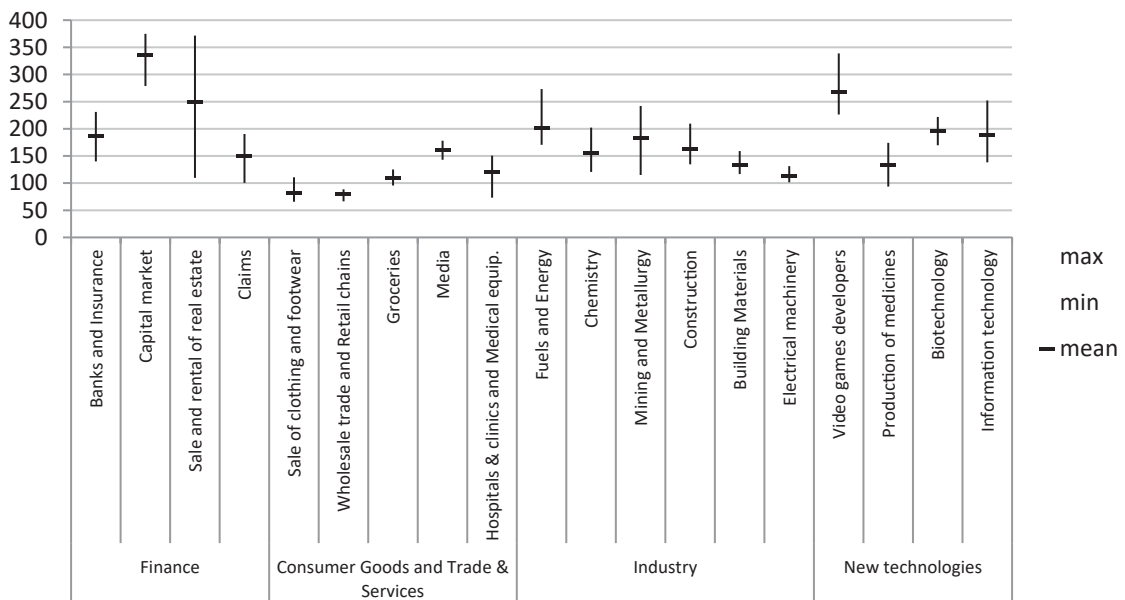


Figure 1. Intellectual capital per employee (Salaries and employee benefits/Number of employees) by sector and industry [thousands PLN per employee].

Source: Own work based on reports of analyzed companies listed on the WSE.



Figure 2. Human capital efficiency (Sales revenues to Salaries and employee benefits [without unit] and Sales revenues to Number of employees [thousands PLN per employee]) by sector and industry.

Source: Own work based on reports of analyzed companies listed on the WSE.

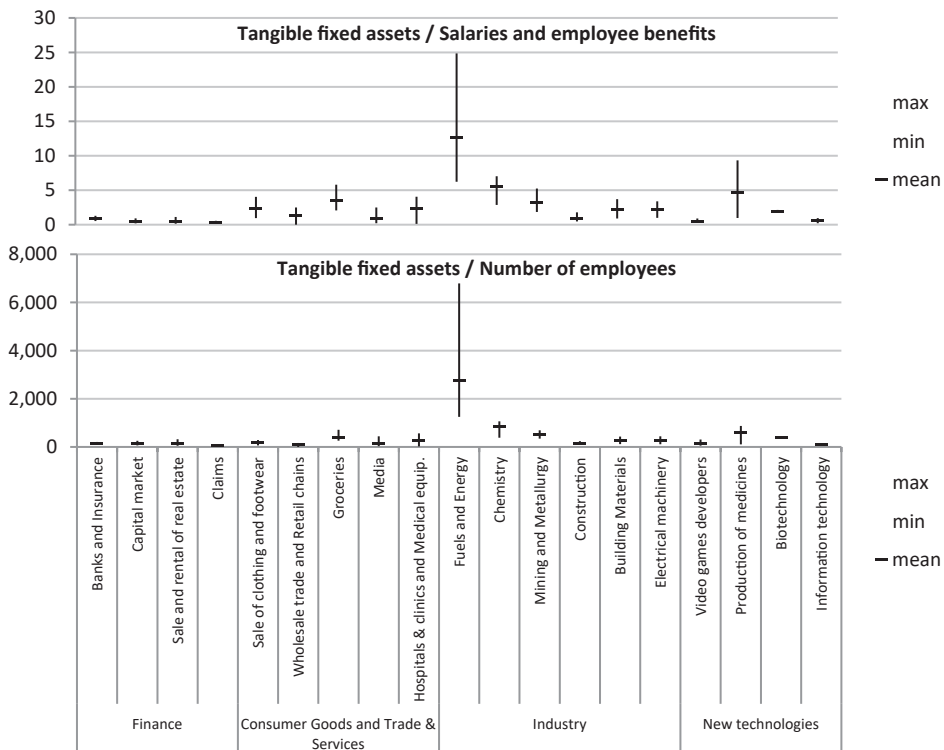


Figure 3. Technical equipment (Tangible fixed assets to Salaries and employee benefits [without unit] and Tangible fixed assets to Number of employees [thousands PLN per employee]) by sector and industry.

Source: Own work based on reports of analyzed companies listed on the WSE.

remuneration and employee benefits per employee. The industry sector is characterized by the largest ranges in the revenue/employment ratio.

The hierarchy of labor productivity indicators based on value added has a much better fit to the hierarchy of labor costs (Figure 4).

Of the seven industries with the highest salaries and benefits per employee, six are also among the seven industries with the highest Value added to Number of employees indicator (the exception is “IT”), and four with the highest Value added to Salaries and employee benefits indicator (“Sale and rental of real estate,” “Banks and insurance,” “Fuels and energy,” and “Video games developers”). The industries with the lowest level in terms of both labor and human capital efficiency indicators considered included “Wholesale trade and retail chains,” “Hospitals, clinics and medical equipment,” “Chemistry,” and “Production of medicines.” At the same time, it should be noted that relatively larger ranges characterize industries with higher values of human capital efficiency indicators. Regarding remuneration and employee benefits per employee, the largest ranges in labor productivity indicators, based on value added, occurred in the “Finance” sector. Significant differences also characterize the “New technologies” and “Industry” sectors (mainly due to the “Fuels and energy” industry).

Since the indicators of technical equipment do not indicate a strong relationship with the value of human capital (Salaries and employee benefits/Number of employees), it should be examined, whether such a relationship occurs, taking into account the efficiency of using tangible fixed assets. The summary of the Value added to Tangible fixed assets indicator is presented in Figure 5. Out of seven industries with the highest salaries and benefits per employee, five are also among the seven industries with the highest value of the analyzed indicator. The exceptions are the following industries: “Biotechnology,” which took tenth place, and “Fuels and energy,” which took eighteenth place (only ahead of the “Chemistry” industry).

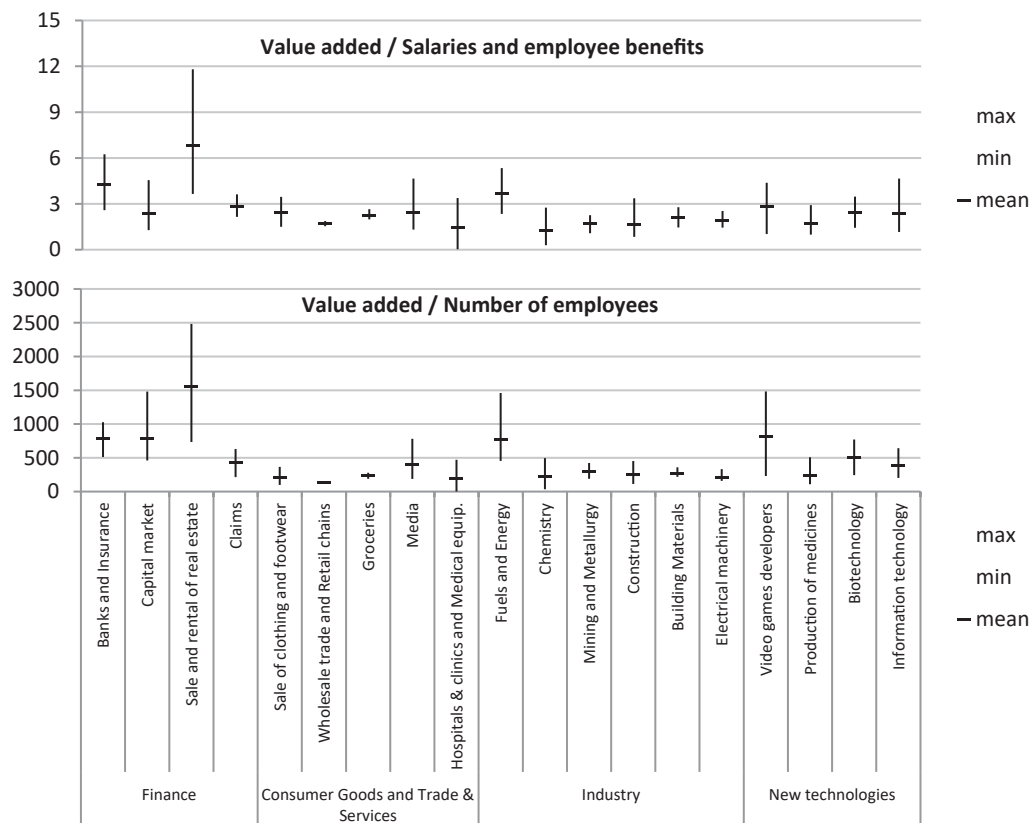


Figure 4. Human capital efficiency (Value added to Salaries and employee benefits [without unit] and Value added to Number of employees indicators [thousands PLN per employee]) by sector and industry.

Source: Own work based on reports of analyzed companies listed on the WSE.

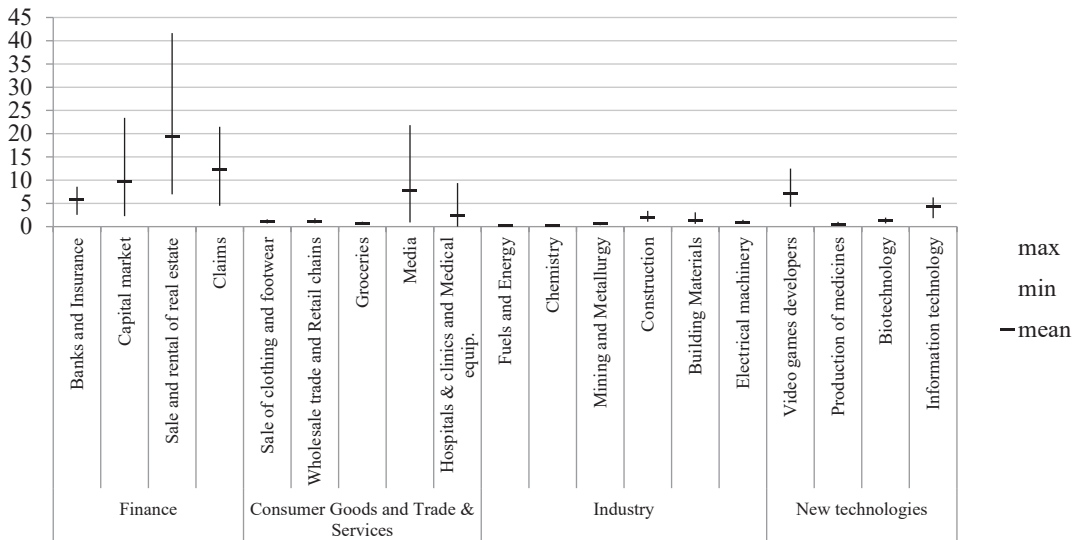


Figure 5. Tangible fixed assets efficiency (Value added to Tangible fixed assets indicator [without unit]) by sector and industry.
Source: Own work based on reports of analyzed companies listed on the WSE.

Table 1. Coefficients of linear correlation, determination, and the level of significance of labor costs per employee with selected values

Indicator	Linear correlation coefficient	Determination coefficient	Significance level
Sales revenues/Number of employees	0.332	0.110	$p = 0.165$
Sales revenues/Salaries and employee benefits	0.035	0.001	$p = 0.887$
Value added/Number of employees	0.745	0.556	$p < 0.001$
Value added/Salaries and employee benefits	0.439	0.193	$p = 0.060$
Tangible fixed assets/Number of employees	0.050	0.003	$p = 0.839$
Tangible fixed assets/Salaries and employee benefits	-0.124	0.015	$p = 0.613$
Value added/Tangible fixed assets	0.563	0.317	$p = 0.012$

Source: Own work based on reports of analyzed companies listed on the WSE.

In terms of sectors, the greatest diversity of the analyzed indicator is noted in the “Finance” sector, and the lowest, and at the same time least diversified, value is in the “Industry” sector. The latter observation is related to the specificity of the industrial sector, which uses tangible fixed assets of the highest value.

Pearson’s linear correlation coefficients, determination coefficients, and significance levels were calculated to determine, to what extent the considered values and indicators explain the inter-sectoral and inter-industry differences in wages (Table 1).

The analysis of the data from Table 1 allows us to conclude that taking into account only sales revenues and the value of tangible fixed assets related to both the level of employment, as well as employee salaries and benefits, does not explain the inter-sectoral and inter-industry differences in salaries and benefits (value of human capital). The strongest correlation with the level of salaries and benefits per employee is found in human capital efficiency indicators based on value added, in particular, the value added quotient per employee. This correlation is supported by a high level of determination index (Figure 6). Therefore, it can be concluded that the efficiency of human capital (labor efficiency) has a decisive impact on salaries and benefits. A slightly smaller, but also statistically significant impact on the value of human capital (level of salaries and benefits), has the efficiency of tangible fixed assets (Value added to Tangible fixed assets indicator) (Figure 7).

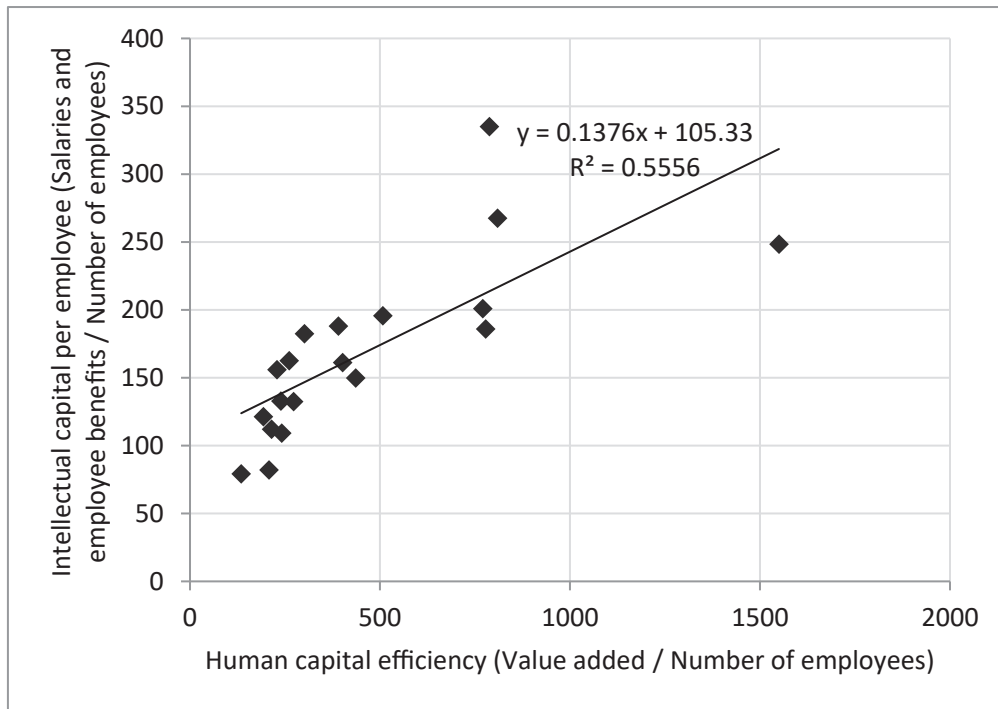


Figure 6. Relationship between the level of salaries and benefits per employee (value of human capital per employee [thousands PLN per employee]) and the efficiency of human capital (value added per employee [thousands PLN per employee]).

Source: Own work based on reports of analyzed companies listed on the WSE.

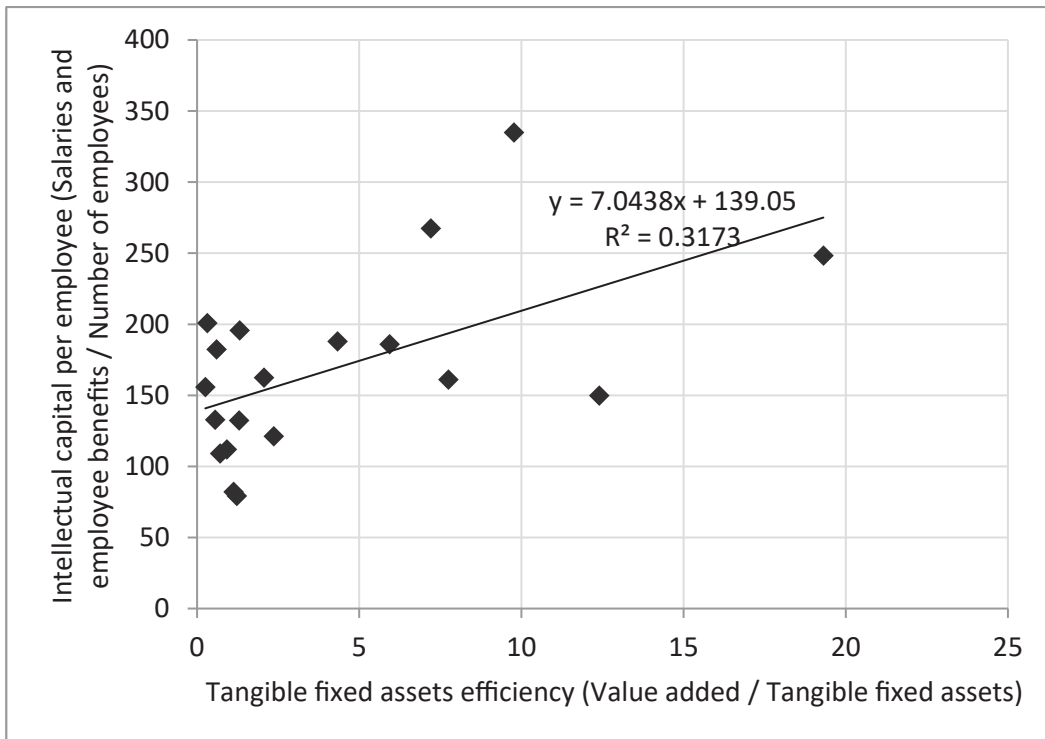


Figure 7. Relationship between the level of salaries and benefits per employee (value of human capital per employee [thousands PLN per employee]) and the efficiency of tangible fixed assets (value added to tangible fixed assets [without unit]).

Source: Own work based on reports of analyzed companies listed on the WSE.

5 Conclusions

Both research hypotheses formulated in the article were confirmed, which allowed us to achieve the aim of the article. Among the factors determining wage differentiation in the inter-sectoral and industry perspective (apart from technological progress, offshoring, political factors, bargaining power of trade unions, etc.), the efficiency of human capital and tangible fixed assets in individual sectors and industries play a significant role.

The academic implication of the article is to confirm research conducted in other economies regarding inter-sectoral and inter-industry wage differences [Abowd et al., 1999; Dunne et al., 2004; Gibbons et al., 2005; Faggio et al., 2010; Barth et al., 2016]. Companies listed on the Warsaw Stock Exchange, which belong to high-wage sectors, employ highly qualified employees, obtaining a higher return on employee skills than in the case of lower-wage sectors.

The inter-sectoral and inter-industry salary ranges occurring in Polish companies can be explained by the human capital efficiency in individual industries (sectors). In industries with the highest level of remuneration and benefits (value of human capital), there is also relatively higher labor productivity (efficiency of human capital), represented by the Value added to Number of employees ratio.

Inter-sectoral and inter-industry wage disparities also show a strong positive correlation with the efficiency of tangible fixed assets.

The practical implication of the article is the recommendation that managers when setting (negotiating with staff representatives) the level of remuneration should take into account the efficiency of the company's human capital (Value added to Number of employees ratio) and the tangible fixed assets as factors limiting the possible scale of remuneration increases.

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