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The Impact of Intangible Resources on the Financial Performance of IT Firms

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Abstract:

Purpose: *The role of intangible resources in corporate financial performance has gained increasing attention in economic research. This study examines the impact of intangible resourcese on financial performance in the technology sector, focusing on firms engaged in energy-related projects.*
Design/Methodology/Approach: *A panel data analysis of 17 IT companies listed on the Warsaw Stock Exchange (2018–2022) employs a Fixed Effects Model (FEM) to assess the relationship between intangible resources and financial indicators: Return on assets (ROA) and Return on equity (ROE).*
Findings: *The results confirm that energy engagement enhances profitability, with a statistically significant positive effect on ROA and ROE. Relational resources emerges as the strongest determinant of financial performance, highlighting the importance of business partnerships. Human resources likewise exert a positive and significant influence, emphasizing the critical role employee knowledge and skills. Structural resources, however, show an insignificant or negative impact, suggesting that infrastructure alone does not drive success.*
Practical implications: *These findings emphasize the strategic role of intangible resources and suggest that energy engagement amplifies financial benefits for IT firms. Future research should explore the synergy between intangible assets and sustainability initiatives in IT sectors and energy factors.*
Originality/Value: *This study uniquely explores how intangible resources influence financial performance at the intersection of IT and energy sectors. By emphasizing relational capital as the key driver of profitability, it provides novel evidence from an emerging European market and offers practical insights.*

Keywords: *Intangible resources, financial performance, energy sector, IT firms, Resource-Based View (RBV), Fixed Effects Model.*

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1. Introduction

1.1 Intangible Resources

Intangible resources have gained increasing recognition as critical drivers of corporate success, particularly in knowledge-based industries (Lev, 2001, pp. 30-50). These resources, which include human resources, structural resources, and relational resources, contribute to firms' competitive advantages and long-term financial performance (Corrado *et al.,* 2009, pp. 661-685). Human resources, represented by employees' knowledge, skills, and expertise, facilitates innovation and adaptability in a rapidly evolving business landscape (Becker, 1993, pp. 11).

Structural resources, encompassing intellectual property, databases, and organizational processes, provide the infrastructure necessary to support and scale innovation (Edvinsson and Malone, 1997, pp. 15-45). Meanwhile, relational resources, which include brand reputation, customer relationships, and strategic partnerships, enhance firms' market positioning and revenue potential (Nahapiet *et al.,* 1998, pp. 242-266). Despite their significance, empirical studies on the financial impact of intangible resources have yielded mixed results, necessitating further investigation.

The Resource-Based View (RBV) has become a leading framework for understanding the strategic role of intangible resources. According to J.B. Barney, four essential attributes of resources contribute to sustainable competitive advantage: value, rarity, inimitability, and non-substitutability (Barney, 1991, pp. 99-120).

This perspective serves as a strong foundation for examining how intangible resources enhance a firm's ability to outperform its rivals. Over time, researchers have expanded on this concept by introducing aspects like durability, appropriability, and complementarity, highlighting the enduring nature of competitive advantages derived from intangible resources.

The Dynamic Capabilities Theory complements RBV by emphasizing a company's ability to adjust and innovate by leveraging its intangible resources (Teece *et al.,* 1997, pp. 509-533). Scholars argue that dynamic capabilities enable firms to integrate, develop, and transform both internal and external resources in response to rapidly evolving environments. This is particularly relevant for technology-driven industries, where adaptability and continuous innovation are crucial for success.

Additionally, the Intellectual Capital framework provides a more holistic perspective, classifying intangible resources into human capital, structural capital, and relational capital (Corrado *et al.,* 2022, pp. 3-28). This perspective underscores the interconnected nature of intangible capitals and their collective influence on a firm's overall performance.

Empirical research strongly supports the notion that intangible resources positively impact financial outcomes. Companies that possess a higher concentration of intangible resources, such as brand equity and proprietary knowledge, often achieve superior financial performance compared to their competitors (Hall, 1992, pp. 135-144). Likewise, researchers have highlighted the increasing role of intangible resources in market valuation, particularly in industries such as technology, pharmaceuticals, and media (Lev and Zambon, 2003, pp. 597-605).

A recent study examined the role of intangible investments in firm productivity across various sectors. The findings suggest that industries characterized by high intangible intensity, such as semiconductors and software, tend to experience greater productivity growth, reinforcing the idea that intangible resources drive long-term value creation (Corrado *et al.,* 2022, pp. 3-28).

Despite their strategic significance, intangible resources present challenges in measurement and valuation. The absence of standardized accounting practices often leads to underreporting or inconsistencies in the way these resources are recorded. Traditional accounting frameworks are primarily designed for tangible assets, making it difficult to accurately capture intangible value.

Furthermore, the complexity of intangible resources stems from their multifaceted nature and interdependencies. For example, the value of intellectual property is often contingent on complementary factors, such as a highly skilled workforce and efficient operational processes. These challenges complicate the creation of universal measurement standards for intangible resources (Petty and Guthrie, 2000, pp. 155-176).

1.2 IT Sector

The Information Technology (IT) sector is one of the most dynamic and rapidly evolving industries, playing a crucial role in driving economic growth, digital transformation, and innovation across various domains (Brynjolfsson and McAfee, 2014, pp. 5-25). It encompasses a broad range of companies specializing in software development, cloud computing, cybersecurity, artificial intelligence (AI), and big data analytics, among others. As organizations across industries increasingly adopt digital solutions, IT firms are at the forefront of providing innovative technologies that enhance business efficiency, improve decision-making, and streamline operations (Teece, 2018, pp. 40-49).

One of the defining characteristics of the IT sector is its heavy reliance on intangible resources, particularly intellectual capital. Human capital, in the form of skilled developers, data scientists, and IT engineers, is a key driver of innovation and product development. Structural capital, including proprietary software, patents, algorithms, and IT infrastructure, ensures scalability and operational efficiency. Meanwhile, relational capital, such as customer relationships, strategic alliances, and brand reputation, helps IT firms maintain competitive market positions and secure long-term partnerships (Corrado *et al.,* 2009, pp. 661-685).

A major trend shaping the IT sector is the increasing focus on cloud computing and platform-based business models. Leading firms are leveraging cloud-based solutions to offer scalable, cost-effective, and flexible services to businesses and consumers. In parallel, AI and machine learning applications are transforming various industries by enabling automation, predictive analytics, and personalized customer experiences (Mishra, *et al.,* 2021). Additionally, IT companies are actively integrating blockchain technology to enhance security, transparency, and trust in digital transactions, with applications spanning from financial services to supply chain management (Fang, *et al.,* 2012, pp. 944-980).

Furthermore, the IT sector has become an essential player in sustainability and energy efficiency initiatives. IT-driven innovations, such as smart grids, energy optimization algorithms, and Internet of Things (IoT) enabled energy management systems, are reshaping how businesses and households consume and distribute energy (Chwilkowska-Kubala, *et al.*, *2023*, pp. 1-10).

The intersection of digitalization and green technologies highlights the growing role of IT firms in addressing global challenges, such as climate change and resource efficiency. These advancements reinforce the strategic importance of intangible resources in fostering technological progress, economic growth, and sustainable business models.

1.3 Energy Sector

The energy sector has undergone significant transformation in recent years, driven by technological advancements, regulatory changes, and a growing emphasis on sustainability (Fang, *et al.,* 2012, pp. 944-980). The integration of IT solutions into energy production, distribution, and consumption has led to the emergence of smart grids, predictive maintenance systems, and digital energy management platforms (Mishra, *et al.,* 2021).

Technological innovations such as artificial intelligence (AI) for predictive analytics, blockchain for energy trading, and the Internet of Things (IoT) for real-time energy monitoring are playing an increasingly important role in optimizing energy use (Chwilkowska-Kubala, *et al.*, *2023*, pp. 1-10).

IT firms that engage in energy-related projects contribute to efficiency gains and emissions reduction by developing software-driven solutions for optimizing energy consumption and integrating renewable energy sources. However, the financial implications of such engagements remain unclear, particularly regarding whether IT firms benefit from these ventures in terms of financial performance.

The future of the energy sector is increasingly shaped by technological innovation, regulatory pressures, and shifts toward sustainable energy solutions (Porter & Kramer, 2011, pp. 2-17). As the world moves toward carbon neutrality and energy efficiency, IT firms are expected to play a crucial role in facilitating the transition. Emerging technologies such as smart energy management systems, AI-powered demand forecasting, and decentralized energy markets supported by blockchain are expected to redefine the sector (Chwilkowska-Kubala, *et al.*, *2023*, pp. 1-10).

Furthermore, sustainability strategies, including circular economy models, energy storage advancements, and carbon capture technologies, are becoming key investment priorities for companies seeking long-term growth in the energy sector (Jaffe, *et al.*, 2005, pp. 164-174). However, uncertainties regarding regulatory frameworks, investment risks, and market adoption pose challenges to IT firms seeking to expand their presence in energy-related projects. Understanding the financial implications of such strategic engagements is essential for both investors and policymakers to ensure sustainable growth in both sectors.

2. Strategic Engagement of a Company in the Energy Sector

Strategic engagement of enterprises in the energy sector is analyzed in the academic literature from the perspectives of resource management, technological innovation, and regulatory changes. Aragón-Correa and Sharma (2003, pp. 71-88) introduced the contingent resource-based view, emphasizing that proactive environmental strategies can lead to a competitive advantage, particularly in the context of dynamic regulatory and market changes.

Shrivastava (1995, pp. 936-960) highlighted the importance of integrating environmental strategies with overall business strategy, arguing that such an approach can enhance innovation and operational efficiency in enterprises. Günther and Hoppe (2014, pp. 689-707) examined various methods of measuring corporate environmental performance, pointing out the need for consistent assessment frameworks that consider both financial and ecological aspects. Additionally, reports from the International Energy Agency (IEA) in the Energy Technology Perspectives series provide comprehensive analyses of the role of technology in energy transformation and the strategies that businesses can adopt in response to global energy challenges (Energy Technology Perspectives, 2023).

Strategic engagement of enterprises in the energy sector encompasses their ability to adapt to regulatory changes, invest in innovation, and manage risks associated with energy transition. According to Porter's hypothesis (Porter and Linde, *1995*, pp. 97-118) well-designed regulations can drive innovation, leading not only to regulatory compliance but also to economic benefits. Organizations that effectively integrate regulatory requirements with innovative strategies have a higher likelihood of maintaining a competitive advantage.

Strategic engagement in the energy sector is also shaped by national policies and international organizations. EU directives and global climate agreements impose obligations on companies to reduce emissions and implement low-emission technologies (Porter and Kramer, 2011, pp. 2-17). Companies that align with these regulations have the opportunity to achieve a competitive advantage through cost optimization and reputation building.

Despite numerous benefits, this approach is not without challenges. Critics highlight the following issues:

- High investment costs – Implementing modern energy technologies requires significant financial outlays, which may pose a barrier for smaller firms,
- Regulatory uncertainty – Changing regulations can affect the profitability of long-term investments in the energy sector,
- Difficulties in measuring efficiency – The lack of standardized accounting and reporting frameworks complicates the assessment of the impact of energy engagement on corporate financial performance (Jaffe *et.al.*, 2005, pp. 164-174).

Strategic engagement in the energy sector is a key component of long-term business strategy, enabling firms to adapt to global trends in sustainability and low-emission technologies. Despite its many advantages, this approach carries certain risks and challenges, including high implementation costs and regulatory uncertainty. Future research should focus on developing more precise methods for evaluating the effectiveness of energy strategies in relation to financial performance and corporate innovation.

The main aim of this study is to examine the impact of intangible resources on the financial performance of IT firms, with a particular focus on companies engaged in energy-related projects. By applying the Resource-Based View (RBV) and Dynamic Capabilities Theory, the research assesses how human, structural, and relational resources influence key profitability indicators—Return on assets (ROA) and Return on equity (ROE).

3. Materials and Methods

Assessing the influence of intangible resources on corporate financial performance presents a significant methodological challenge. This study adopts an analytical approach based on established research in the field of financial performance and intangible resources in the differentiating between firms engaged in energy-related projects and those that are not.

The focus is on IT firms listed on the Warsaw Stock Exchange, specifically those operating between 2018 and 2022, due to their substantial reliance on intangible resources and their role in shaping industry innovation. The period was chosen due to the dynamic nature of changes in the global economy.

The sample includes 17 IT companies, selected based on the availability of complete financial statements and relevant data on intangible resources. Financial reports serve as the primary data source, containing financial details and disclosures related to intangible resources such as: human resources, structural resources, and relational resources.

Non-financial reports and companies' websites provided information on the energy projects of the respective companies. To ensure data consistency, firms with incomplete records or irregular reporting structures were excluded.

A set of comprehensive descriptive statistics was generated to summarize the dataset, including mean values, standard deviations, and coefficients of variation. Moreover, several statistical tests were conducted to validate the robustness of the model: the Durbin-Watson test for autocorrelation, the Breusch-Pagan test for heteroscedasticity, and variance inflation factors (VIF) to assess potential multicollinearity issues.

The dataset comprises two categories of variables: dependent variables and independent variables. Dependent variables include Return on assets (ROA) and Return on equity (ROE), which measure the financial performance of the firms. Independent variables consist of the following:

- Energy firm: A binary variable indicating whether the company was involved in energy-related projects during the analyzed period (1 = Yes, 0 = No),
- Human resources: Measured as the financial cost associated with workforce investments,
- Structural resources: Represented by the value of possessed structural resources ,
- Relational resources: Defined as the financial cost associated with maintaining and developing business relationships.

The general form of the panel regression is:

$$ROA\ (or\ ROE)i_t = \beta_0 + \beta_1\ Energy\_Firm_{it} + \beta_2 Human\ resources_{it} + \beta_3\ Structural\ resources_{it} + \beta_3\ Relational\ resources_{it} + \alpha_i + u_{it} \quad (1)$$

where:

- i represents the firm,
- t represents the year,
- α_i represents the firm-specific effect (fixed or random),
- u_{it} is the error term.

Based on the systematic review of literature, the following research hypothesis were formulated.

Table 1. *Research hypotheses formulated based on the literature on intangible resources and company competitiveness.*

Hypothesis	Justification
Companies engaged in the energy sector achieve higher profitability than those outside this sector.	According to the Resource-Based View (RBV) theory, strategic involvement in the energy sector can provide a competitive advantage. The results of the FEM model suggest significantly higher ROA and ROE for energy firms.
Human resources have a positive impact on firms' financial performance.	Companies investing in human resources can achieve higher operational efficiency and innovation, which translates into greater profitability.
Structural resources have a positive impact on company's profitability.	Structural resources have been recognized as the foundation of profitability.
Relational resources have a positive impacts on company's profitability.	Relational resources are crucial for building a competitive advantage. This is confirmed by the study results, which indicate a significant effect of relational resources on ROA and ROE.

Source: *Own study based on Barney, 1991, Edvinsson & Malone, 1997.*

4. Results

This section presents the empirical findings of the study, analyzing the relationship between intangible resources**,** energy sector engagement**,** and financial performance of IT firms. The results are derived from a Fixed Effects Model (FEM) estimation, assessing the impact of human, structural, and relational resources on Return on assets (ROA) and Return on equity (ROE)**.**

The analysis begins with descriptive statistics, providing an overview of the variability in financial indicators and resource allocation across firms. This is followed by the estimation results, which determine the significance and magnitude of each independent variable in explaining financial performance. Additionally, key diagnostic tests are presented to validate the model's assumptions and robustness. The findings offer insights into how intangible resources contribute to profitability, particularly in the context of strategic engagement in the energy sector.

Table 2. *Descriptive statistics*

Variable	Mean	Standard Deviation	Coefficient of Variation (%)	Skewness
ROA (%)	5.12	14.38	280.9	3.45
ROE (%)	7.23	15.29	211.4	2.87
Human Resources (zloty in millions/number of employees)	118.452	58.321	49.2	0.98

Structural Resources (zloty in millions/number of employees)	1.2e6	4.8e7	3.900	5.12
Relational Resources (zloty in millions/number of employees)	98.721	132,457	134.2	2.15

Source: *Own study.*

The results of the descriptive statistical analysis for companies from 2018 to 2022 revealed significant variability in financial indicators and resources. The average Return on assets (ROA) was 5.12%**,** while Return on equity (ROE) reached a higher average of 7.23%**.** The standard deviation for ROA was 14.38 percentage points, and for ROE 15.29 percentage points, indicating substantial variation in results among companies.

Structural resources exhibited the highest instability, with an extremely high coefficient of variation, reflecting the dominance of a few firms in the dataset. The distribution of this variable was strongly right-skewed **(**skewness = 5.12). Human resources demonstrated relative stability, with a moderate coefficient of variation, suggesting a more balanced investment in workforce development.

Relational resources showed a higher level of variability, with a strong right-skewed distribution **(**skewness = 2.15), driven by leading companies, which recorded significantly higher relational resource values compared to the sample average.

Table 3. *The estimation results*

Variable	**ROA**	**ROE**
Energy firm	3.11 (0.85)	4.22 (1.12)
Log (structural resources)	-0.02 (0.01)	-0.03 (0.02)
Human resources	0.024 (0.008)	0.025 (0.011)
Relational resources	0.0005 (0.0001)	0.0007 (0.0002)
Constant	5.34 (1.45)	7.89 (2.01)
R^2 within	0.45	0.51
F-statistic	12.34	15.89
Observations	85	85

Source: *Own study.*

The estimation results of the Fixed Effects Model (FEM) demonstrated a statistically significant impact of energy sector affiliation on corporate profitability. For the dependent variable ROA, the coefficient for Energy_Firm was 3.11 ($p < 0.01$), indicating that energy companies achieved, on average, 3.11 percentage points higher Return on assets (ROA) compared to non-energy firms, controlling for other variables.

In the case of ROE, this effect was even stronger, with a coefficient of 4.22 ($p < 0.001$), suggesting a 4.22 percentage point advantage for energy firms. The standard errors of the estimates were 0.85 (ROA) and 1.12 (ROE), with 95% confidence intervals of [1.41; 4.81] and [2.01; 6.43], respectively.

Relational resources emerged as the strongest predictor of profitability—an increase of 100,000 units in this category was associated with a 0.05 percentage point increase in ROA ($\beta = 0.0005^{***}$, $p < 0.001$) and a 0.07 percentage point increase in ROE ($\beta = 0.0007^{***}$, $p < 0.001$). Human resources had a moderate positive effect ($\beta\_ROA = 0.024^{**}$, $\beta\_ROE = 0.025^{**}$), whereas structural resources did not reach statistical significance ($p > 0.1$).

The explained variance (R^2 within) for the model was 0.45 for ROA and 0.51 for ROE, with the global F-statistic being statistically significant at $p < 0.001$ in both cases.

Table 4. *Diagnostic tests*

Test	Statistic	p-value	Conclusion
Hausman (FE vs RE)	χ^2 (4) = 24.17	0.000	FE preferred
Breusch-Pagan (heter.)	χ^2 (1) = 9.12	0.057	No heteroscedasticity
Wooldridge (autokorr.)	F (1,16) = 1.89	0.175	No autocorrelation
VIF (max)	1.98	-	No multicollinearity

Source: *Own study.*

Table 4 presents the results of key diagnostic tests conducted to assess the validity of the Fixed Effects Model (FEM) specification. The Hausman test compares the fixed effects (FE) and random effects (RE) models. The test statistic χ^2 (4) = 24.17 with p < 0.001 indicates a significant difference between the models, justifying the selection of the FE model as the more appropriate specification. The Breusch-Pagan test was applied to detect heteroskedasticity in the error terms. The test statistic χ^2 (1) = 9.12 with p = 0.057 suggests no significant heteroskedasticity in the data, confirming the validity of using the Huber-White estimator.

The Wooldridge test examines the presence of autocorrelation in the model's residuals. The result F (1,16) = 1.89 with p = 0.175 indicates no autocorrelation in the panel data, meaning that error components are independent over time. The Variance Inflation Factor (VIF) was used to assess multicollinearity among explanatory variables. The maximum VIF value of 1.98 is well below the threshold of 10, suggesting that multicollinearity is not a concern in the model.

The diagnostic test results confirm the validity of the FEM model specification. The absence of heteroskedasticity, autocorrelation, and multicollinearity ensures the reliability of the estimates and the stability of the results.

5. Conclusions

The results of the panel model FEM analysis confirm the hypothesis of the strategic advantage of firms engaged in the energy sector. The effect of the energy sector on profitability indicators remains statistically significant at 3.11 percentage points for ROA ($p < 0.01$) and 4.22 percentage points for ROE ($p < 0.001$) after controlling for resources.

This finding supports the Resource-Based View (RBV) theory, which states that specific resources and capabilities can translate into a sustainable competitive advantage (Barney, 1991, pp. 99-120). Energy firms can leverage their intangible resources create long-term value by investing in energy technologies, adapting to changing regulatory environments, and developing strong relationships with key stakeholders.

Relational resources emerged as the strongest predictor of profitability, suggesting that firms building strong relationships with clients and business partners are more effective at converting their resources into financial performance. An increase in relational resources by 100,00 units leads to a 0.05 percentage point increase in ROA and a 0.07 percentage point increase in ROE ($p < 0.001$).

This finding aligns with existing literature on the importance of relational resources in achieving a competitive advantage ((Nahapiet *et al.,* 1998, pp. 242-266). Energy companies often establish strategic partnerships and long-term contracts, which contribute to revenue stability and improved financial outcomes.

Human resources showed a significant yet moderate positive effect on financial performance (0.024 for ROA, 0.025 for ROE). This suggests that investments in human resources are crucial for effective business operations, aligning with the dynamic capabilities' theory (Teece *et al.,* 1997, pp. 509-533). The expertise of specialists in the energy sector enables firms to better manage projects and adapt to changing market conditions.

Structural resources did not demonstrate a statistically significant impact on financial performance, which may be due to their specific nature—while they do not always directly contribute to profitability, they may play a supporting role, such as through patents or IT infrastructure. Literature suggests that structural resources become significant when combined with other resources (Lev and Zambon, 2003, pp. 597-605), warranting further research into their synergy with human and relational resources.

The study also indicates a non-linear effect—the impact of energy sector affiliation on ROA increases by 0.05 percentage points for every additional 100,000 units in relational resources. This suggests that firms that actively develop their networks can more effectively capitalize on their position within the energy sector.

Based on the results of the FEM analysis, the verification of the hypotheses is presented below.

Table 5. *The verification of research hypotheses*

Hypothesis	Result
Companies engaged in the energy sector achieve higher profitability than those outside this sector.	Positively verified
Human resources have a positive impact on firms' financial performance.	Positively verified
Structural resources have a positive impact on company's profitability.	Rejected
Relational resources have a positive impacts on company's profitability.	Positively verified

Source: *Own study.*

The study confirms the strategic advantage of firms engaged in the energy sector, particularly through relational and human resources. The findings indicate that RBV and Dynamic Capabilities Theory are highly applicable in the energy sector context. Future research could explore the synergy between structural resources and other factors and the role of corporate strategies in managing the energy transition.

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