

Impact of ICT Sector Research and Development Expenditure on the Market Capitalization in the US, the EU and China

Wojciech Chmielewski*

Purpose: *Due to the growing global role of enterprises from the information and communication technology sector from the leading regions of the USA, EU and China in the industry, the author's research goal was to try to identify factors influencing the value of listed enterprises understood as its stock exchange capitalization.*

For the purpose, research was carried out on the impact of a group of twenty-six variables on the company's market capitalization, among which the most important conclusions concern the impact of seven variables, i.e. revenues, research and development expenses, earnings before interest, taxes, depreciation and amortization (EBITDA), earnings before interest and taxes (EBIT), total equity, total assets, total revenues and dividend rate.

Design/Methodology/Approach: *The study used research methods in the form of a random effects model and a fixed effects model, and then used the Hausmann test to verify which of the models is better suited to establishing the relationship between the selected independent variables and the dependent variable in the form of the stock market capitalization of companies from the ICT sector.*

Findings: *It was found that the impact of equity or the level of revenues on market capitalization is much smaller than in the case of research and development expenses and that the issue of depreciation of assets is an important factor in the market valuation of enterprises from the ICT sector. Additionally, the level of assets and equity has, although limited, impact on the market valuation of the company, regardless of the region in which an entity operates. Revenues are important from a regionalization perspective – company's market capitalization is the largest in the case of the ICT services subsector in China. There is no similar relationship among manufacturers of ICT devices operating in all three regions.*

Research limitations/Implications: *Due to the fact that the COVID-19 pandemic and the global economic slowdown are important factors affecting the ICT sector, further research on the value of ICT enterprises should take the aspects into account.*

Keywords: Information and Communication Technology sector, market capitalization, research and development expenditure, earnings before interest, taxes, depreciation and amortization (EBITDA), earnings before deducting interest and taxes (EBIT), total equity, total asset, total revenues, dividend rate.

Submitted: 19.04.2023 | Accepted: 01.06.2023

* **Wojciech Chmielewski** – PhD, Faculty of Management, University of Warsaw. <https://orcid.org/0000-0003-4516-5063>.

Correspondence address: Faculty of Management, University of Warsaw, Szturmowa 1/3, 02-678 Warsaw, Poland; e-mail: wchmielewski@wz.uw.edu.pl.

Wpływ wydatków na badania i rozwój na kapitalizację rynkową przedsiębiorstw z sektora ICT w USA, UE i Chinach

Cel: w związku z rosnącą globalnie rolą przedsiębiorstw z sektora technologii informacyjno-komunikacyjnych z wiodących w tej branży regionów USA, UE oraz Chin celem badawczym Autora była próba identyfikacji czynników wpływających na wartość przedsiębiorstw giełdowych rozumianą jako jego kapitalizacja giełdowa.

W tym celu przeprowadzono badania dotyczące wpływu grupy dwudziestu sześciu zmiennych na kapitalizację rynkową spółki, wśród których najistotniejsze wnioski dotyczą wpływu siedmiu zmiennych, tj. przychodów, wydatków na badania i rozwój, zysku przed odsetkami, podatkami, amortyzacją (EBITDA), zysku przed odliczeniem odsetek i podatków (EBIT), kapitału własnego ogółem, aktywów ogółem, przychodów ogółem oraz stopy dywidendy.

Metodologia: do badania wykorzystano metody badawcze w postaci modelu efektów losowych oraz modelu efektów stałych, a następnie zastosowanie testu Hausmanna do weryfikacji, który z modeli jest lepiej dopasowany do ustalenia zależności pomiędzy wybranymi zmiennymi niezależnymi a zmienną zależną w postaci kapitalizacji giełdowej spółek z sektora ICT.

Wyniki: ustalono, że wpływ kapitału własnego czy poziomu przychodów na kapitalizację rynkową jest zdecydowanie mniejszy niż w przypadku wydatków na badania i rozwój oraz że kwestia amortyzacji posiadanych aktywów jest ważnym czynnikiem rynkowej wyceny przedsiębiorstw z sektora ICT. Dodatkowo poziom aktywów i kapitału własnego ma, choć ograniczony, wpływ na rynkową wycenę przedsiębiorstwa, niezależnie od regionu, w którym podmiot działa. Przychody mają znaczenie z perspektywy regionalizacji – kapitalizacja giełdowa jest największa w przypadku podsektora ICT usługi w Chinach. Podobnej zależności nie ma wśród producentów urządzeń teleinformatycznych działających we wszystkich trzech regionach.

Ograniczenia/implikacje badawcze: w związku z tym, że istotnymi czynnikami wpływającymi na sektor ICT jest pandemia COVID-19 oraz globalne spowolnienie gospodarcze, dalsze badania na kwestii wartości przedsiębiorstw ICT powinny uwzględniać te aspekty.

Słowa kluczowe: sektor technologii informacyjno-komunikacyjnych, ICT, kapitalizacja rynkowa, wydatki na badania i rozwój, zysk przed odliczeniem odsetek, podatków, amortyzacji (EBITDA), zysk przed odliczeniem odsetek i podatków (EBIT), całkowity kapitał własny, całkowite aktywa, całkowite przychody, stopa dywidendy.

JEL: G3, O3

1. Introduction

There are many studies in the literature on the impact of specific factors on the broadly understood value of an enterprise. The paper is based on the analysis presented fully in the author's doctoral dissertation of entitled "Mapping factors of company value growth as a basis for value management of companies from the communication and information technology sector from the US, the European Union and China".

The author made an attempt to identify the factors and the strength of their impact on the market capitalization of the largest companies from the information and com-

munication technology (ICT) sector. Due to the leading role in the US, the European Union and China sectors, the research took into account the affiliation of ICT companies to one of the regions.

Undertaking research in the indicated area fills a research gap, because the current research focuses mainly on the impact of information and communication technology on such factors as gross domestic product, economic growth, employment or productivity. Significantly less research uses the financial results and financial ratios achieved by companies from the ICT sector to analyze the factors affecting the value of the enterprises in the sector understood as their market capitalization.

2. Digital Global Economy

The dynamically changing global economy has accelerated the pace of development of many industry sectors in an unprecedented way. Globalization and digitization of business processes can be distinguished in particular among the trends that have a significant impact on the activities of enterprises, they contributed to the emergence of new world leaders in the information and communication technology (ICT) sector.

The last few decades have been a period of dynamic development of the sector in the global economy. The scale of changes in the area is so large that the global economy is sometimes referred to as the “**digital economy**”. There are several characteristics of the digital economy, they include the intensive use of information and communication technologies, the integration of physical and digital systems, high-speed communication forcing interdependence and cooperation, the automation of information exchange and data analytics, the dismantling of barriers and resulting new opportunities for the development and intensive use of new business models. The effectiveness of the use of the elements depends on the combination of many factors interacting in different areas. Among them making business structures and processes more flexible, high level of innovation, increased efficiency, quick response to signals generated by the market, creation of intelligent products and services, transition from ownership to use, decreasing role

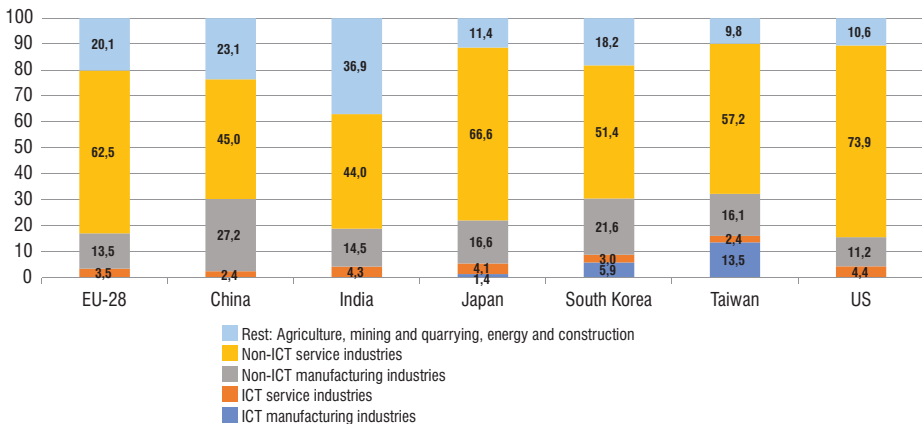
of the human factor are treated as the most important (Golinski, 2015).

The indicated reasons explain the success of the ICT sector in the modern economy. The growing role of the sector is confirmed by changes in the list of companies with the highest capitalization in the world over the last few years. According to the Financial Times Global 500 list in 2010, Exxon Mobile, PetroChina, Apple Inc., BHP Billiton and Microsoft were among the five most valuable companies by market capitalization, while in 2021 they were already: Apple, Microsoft, Amazon, Alphabet, Facebook, i.e. only companies from the ICT sector. It is worth noting that the total capitalization of the five most valuable companies in 2021 is five times higher than the five largest companies in 2010.

In terms of the ICT sector’s value added (VA) as a share of GDP and its distribution by the subsector, four of the five economies with the largest ICT sector are located in East Asia, with Taiwan having the largest share.

The share of companies from the ICT sector in the analyzed countries varies – some, such as Taiwan, South Korea or China, record a significant share of the country’s GDP as compared to other sectors, as shown in Figure 1 below (ICT manufacturing sectors are relevant in terms of VA for only three Asian countries i.e. Taiwan, South Korea and China, while for the remaining countries their presence was almost null) (Maas & Boons, 2010).

Figure 1. ICT sector value added as a share of GDP and comparison with non-ICT economic activities in selected economies, 2014 (in %)



Source: Maas et al., 2017.

In the European Union, the ICT sector is one of the most dynamic sectors, characterized by higher productivity than the entire economy and high intensity of expenditure on research and development. In 2017, the size of the ICT sector in the EU amounted to EUR 630 billion in VA, the sector employed 6.3 million people and spent EUR 32 billion on research and development. In percentage terms, the ICT sector accounted for 4.1% of total EU VA, 2.7% of total employment and 15.2% of total research and development expenditure (R&D expenditure).

3. Literature Review on the Growth of the Enterprise

The issues related to examining what affects the growth, development and value of the company have been present in the literature for a long time.

Many studies link the development of the company with specific aspects of the business and concerns the growth of assets, capital, net profit per share and the level of revenues. The level of revenue is considered the best indicator of the company's growth both in the short and long term (Ardishvili et al., 1998). It was also found that fast-growing entities have significant debt (Segarra & Teruel, 2010; Serrasqueiro et al., 2010) and that there is a strong relationship between the level of profitability and the development of companies. As a result, enterprises first use the available own funds to finance operations and make new investments (Hermelo & Vassolo, 2007; Notta & Vlachvei, 2009).

Other growth factors for an enterprise include access to external finance, which creates opportunities for new investment (Becchetti & Trovato, 2002; Mateev & Anastasov, 2010), the industry in which the enterprise operates (Becchetti & Trovato, 2002; Lopez-Garcia & Puente, 2012), the legal form of the enterprise (Almus, 2002; Wyrwich, 2010), and the region in which it operates (Levratto et al., 2010).

The development of an enterprise is also combined in the research with the size and time of operation of the entity on the market. For example, smaller companies have greater development opportunities because they achieve the effects on the scale of production faster (Almus, 2002; Voulgaris et al., 2003; Honjo & Harada,

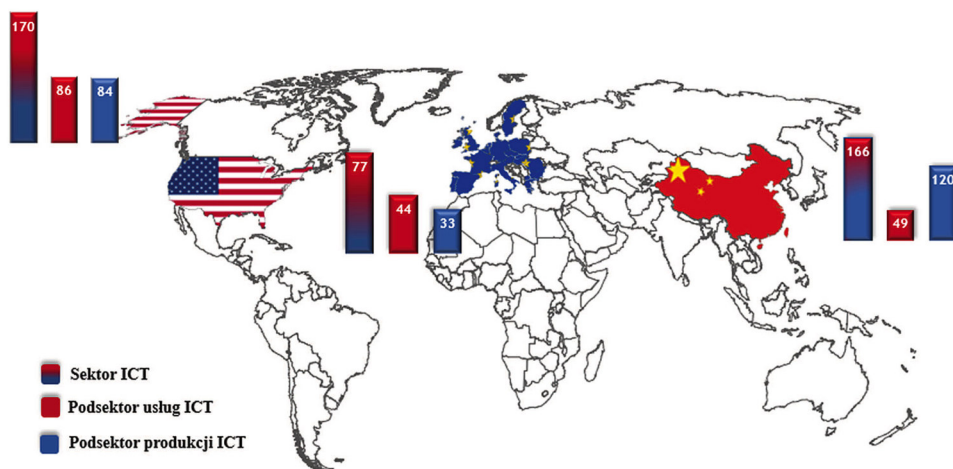
2006; Moreno & Casillas, 2007). As for the age of the company, there is a negative relationship between it and the development of companies – younger companies are more flexible in adapting to market conditions, which results from the fact that they are more active and better informed as to the level of risk associated with new investments (Serrasqueiro et al., 2010).

Another group of factors present in **the research on the growth of enterprise** includes macroeconomic factors, among which foreign investments, among others, the export of products and services, are considered the most pro-development (Becchetti & Trovato, 2002; Hermelo & Vassolo, 2007). In the context of a positive impact on enterprises, the external environment of the company in the form of a developed banking and stock exchange sector is also important, they are strongly correlated with the development of companies (Liu & Hsu, 2006). Similarly, a good economic climate resulting from a high rate of economic growth creates greater opportunities for the expansion of production to foreign markets, leading to the development of enterprises (Liu & Hsu, 2006; Levratto et al., 2010).

The company's growth is also affected by such factors as mergers and acquisitions, which results from increased investment opportunities and lower transaction costs of enterprises (Arrighetti & Lasagne, 2013), concentration of companies with similar activities in a given region, which causes a faster flow of knowledge between them, leading to their greater development (Bogas & Barbosa, 2013) and higher productivity, which turns into all development projects (Voulgaris et al., 2003; Navaretti et al., 2014).

Innovation plays a special role as a driver of the enterprise value. There are studies on the different consequences of using innovation – sales revenues and R&D expenditure, as opposed to profit levels and book value, significantly affect the valuation of technology companies (Xu & Cai, 2016), while internal investment in R&D is a factor ensuring above-average growth (Segarra & Teruel, 2011). Research indicates that thanks to the use of new technologies, enterprises develop faster than others (Liu & Hs, 2006; Serrasqueiro et al., 2010; Schimke & Brenner, 2011), and innovations are treated as the main factor in the rapid development of the company (Mitusch & Schimke, 2011).

Figure 2. Number of ICT enterprises in the US, the EU and China



Significantly fewer studies take into account the economic results obtained by enterprises from the ICT sector as part of their business activity, analyzing the inter-relationships between them. The high dynamics of the development of the sector prompts us to find answers to the question of what are the determinants of an increase in the value of companies from the ICT sector and whether it is important in which region they operate from the point of view of an increase of the value of enterprises.

4. Research Objectives and Research Method

As part of the conducted research, the impact of a group of 26 factors on the market capitalization of 414 companies from the ICT sector with average annual revenues of over USD 300 million in the period 2008–2017 was analyzed. The company market capitalization is now a widely accepted measure of enterprise valuation (Shrimal & Prasad, 2014) and is treated as the current market value of the company.

The research took into account the division of the ICT sector into manufacturing and services enterprises and functioning in one of three geographical regions, i.e. the USA, the European Union and China.

As a result of a series of studies, a group of factors was selected determining the change of the value of listed companies from the ICT sector. In addition, it was found that the type and strength of factors

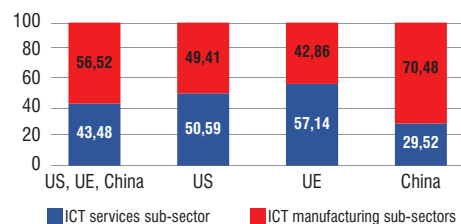
affecting the value of market capitalization of companies from the ICT sector depends on which of the three regions (USA, EU and China) the company belongs to and whether it is a **manufacturing or service enterprise**.

For the study 414 enterprises with average revenues exceeding USD 300 million in the period 2008–2017 were selected. Among them, the largest number of companies come from the US and China (170 and 166 enterprises, respectively), while in the EU there were 77 such entities. The figure 2 below shows the distribution of companies from the ICT sector, taking into account the division into sub-sectors in three regions: the US, the EU and China.

The general view on the ICT sector shows that there are more manufacturing companies than those providing services.

Among three regions, i.e. the US, the EU and China, the ICT sector is not developing evenly (as shown on Figure 3). In the US, there is roughly the same number of service

Figure 3. Share of ICT services and ICT manufacturing sub-sectors in US, UE and China (in %)



enterprises as manufacturing enterprises (51% and 49%, respectively). In the EU the services sub-sector is better developed than the manufacturing sub-sector (the share of sub-sectors is 57% and 43%, respectively). In the case of China, the number of companies producing ICT devices has a clear advantage within the ICT sector – accounting for 70% of the total sector.

The study analyzed the impact of a group of 26 variables (independent variables) on a company’s market capitalization as the dependent variable (treated as the product of market price of one share and their total number), which has become a widely accepted measure of business valuation. It is an undoubted advantage of market capitalization that it reflects the current market interest in all activities undertaken by the company.

The aim of the research was to try to verify the possible impact of the most important positions of the balance sheet and profit and loss account as well as the commonly used financial ratios used to analyze the financial situation of a company. The list of independent variables describing the market capitalization of companies from the ICT sector is presented in Table 1.

To verify the adopted hypotheses, fixed and random effects models were used, and the Hausman test was carried out, with the

help of which a model more suitable for a specific group of companies from the ICT sector was identified.

5. Impact of Seven Factors on the Market Capitalization

As a result of the research, it was possible to distinguish twelve factors of varying impact that determine the change of the market capitalization of enterprises from the ICT sector.

It was confirmed that the type and strength of factors influencing market capitalization is diverse and depends on whether the enterprise is of a service or production nature.

Using an approach that takes into account the geographic region (US, EU, China) of an ICT company, in the case of service companies, nine factors in the US, eleven in the EU region and nine in China were identified that affect market capitalization.

Among manufacturing companies, the distribution of factors influencing the market capitalization of companies is different – in the US region it concerns four factors, in the EU region it concerns ten factors, and in the China region it concerns twelve factors. In this sub-sector, market capitalization depends to the greatest extent on the amount of revenue.

Table 1. List of variables describing the market capitalization of companies from the ICT sector

Profit and loss account and balance sheet positions		Financial ratios	
1.	Intangibles net	1.	Historic dividend yield
2.	Research and development expenditure	2.	Earnings/Share ratio (EPS)
3.	Total operating costs	3.	Total book value/Share ratio
4.	Total equity	4.	Return on Assets (ROA, %)
5.	Total assets	5.	Return on Equity (ROE, %)
6.	Total revenue	6.	Return on Capital (ROC, %)
7.	Earnings before deducting interest and taxes (EBIT)	7.	Enterprise value to market capitalization (EV/Market. Cap.) ratio
8.	Earnings before interest, taxes and depreciation (EBITDA)	8.	Price/Earnings ratio (P/E)
9.	Income net after tax	9.	Operating profit margin
10.	Cash and short-term investments	10.	Gross margin
11.	Total debt	11.	Enterprise Value/Revenue ratio
12.	Net debt	12.	Total debt/Total equity ratio
		13.	Current ratio
		14.	Quick ratio

The most interesting detailed findings concern expenditure on research and development, revenues and the dividend rate.

Depending on the study, the influence of the same factor may cause an increase or a decrease of the market capitalization.

Conducting research on the dependence of selected factors on the market capitalization of enterprises from the ICT sector operating in three regions (the US, the EU and China) brought interesting results. Depending on the region, there were significant differences in the strength of the impact of a particular factor on market capitalization. This applies in particular to research and development expenditure, earnings before interest, taxes, depreciation and amortization (EBITDA) and earnings before deducting interest and taxes (EBIT).

The next section will show impact of seven factors on the market capitalization.

5.1. Research and Development Expenditure

Research and development expenditure – expenses for research and development of a company's new products and services incurred to gain a competitive advantage. The percentage of revenue that is spent on research and development will depend on the specific company and sector or industry in which it operates.

The most spectacular research results concern the impact of R&D expenditures on the market capitalization of companies from the ICT sector. For the entire ICT services sub-sector, the increase in R&D expenditures by USD 1 million meant an increase of the market capitalization by USD 29.36 million. This type of the relationship is the weakest among manufacturing

companies, where the increase in expenditure on research and development by USD 1 million was associated with market capitalization increased by USD 3.32 million.

The relationship between R&D expenditures and market capitalization was significant in each region (the US, the EU and China), although more for the ICT services companies than for manufacturing companies. The strongest correlation between them is in the US region, where for the ICT services companies R&D expenditure increased by USD 1 million meant an increase of the company's market capitalization by USD 18.2 million.

For the ICT services enterprises from the EU, R&D expenditure increased by USD 1 million was associated with an increase of the market capitalization by USD 14.48 million and by USD 13.25 million for China. Data concerning the most spectacular strength of the impact of R&D expenditure on the companies from the ICT sector is presented in Figure 4 below.

5.2. Earnings before Deducting Interest and Taxes (EBIT) and Earnings before Interest, Taxes and Depreciation (EBITDA)

Earnings before deducting interest and taxes (EBIT): revenue minus expenses excluding tax and interest.

Earnings before interest, taxes and depreciation (EBITDA): the level of depreciation and financial costs depends on a company's operating activities and therefore EBITDA reflects the profit generated by it from its operating activities. While EBITDA does not show how much cash flows into the company, it is a measure of a company's ability to generate it.

Figure 4. Multiplicity of increased market capitalization of the companies from the ICT sector and R&D expenditure increased by 1 unit

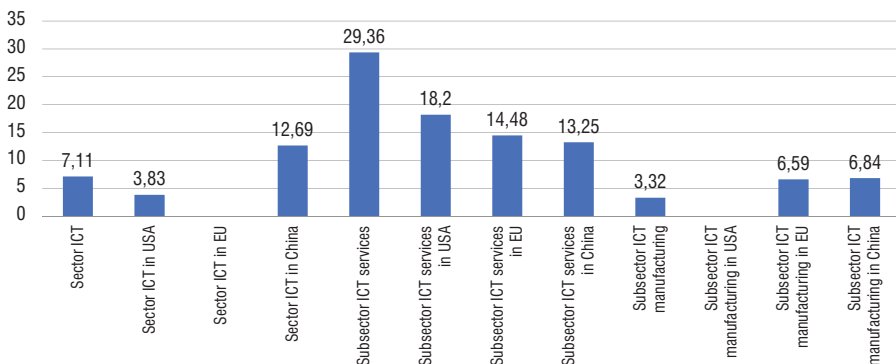
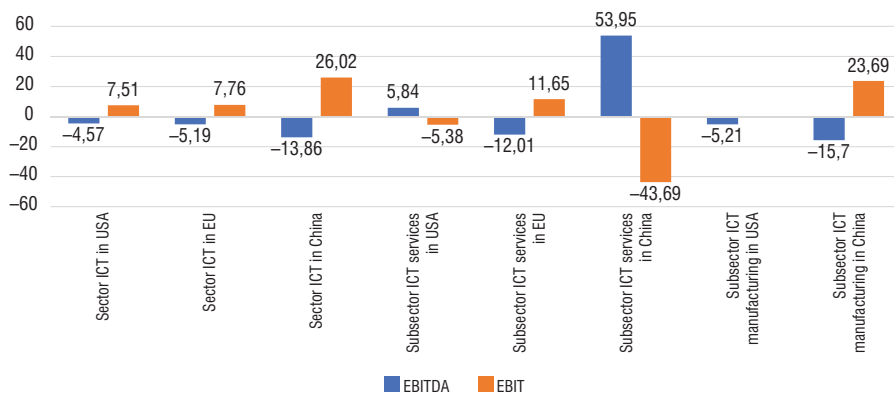


Figure 5. Multiplicity of change of the market capitalization of companies from the ICT sector with the increase in EBIT and EBITDA by 1 unit



In the case of EBIT, its largest contribution to the market capitalization was recorded for the companies from the subsector of ICT services from the region of China, for which the increase by USD 1 million was associated with the decrease in the company's market capitalization by as much as USD 43.7 million. Due to the fact that in the same group of Chinese enterprises, the increase in EBITDA by USD 1 million means a very large increase in the market capitalization of USD 53.95 million, such large fluctuations can be associated with depreciation of assets owned by enterprises. It should be noted, however, that in three regions (the US, the EU and China) the impact of the factors on the market capitalization is not uniform – while in the US and China increased EBITDA influenced increased market capitalization, in the case of companies from the EU, it was the other way around.

The indicated relationships between EBIT and EBITDA for companies from the ICT sector are presented in Figure 5.

5.3. Total Equity

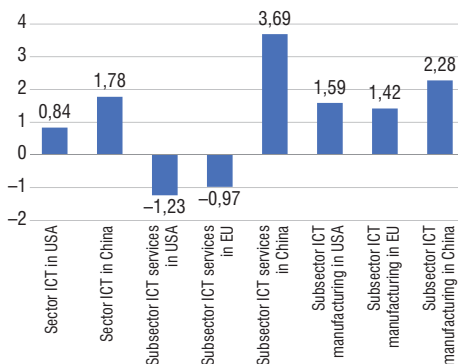
Total equity is equal to assets contributed by the owner(s) of an enterprise at the time of its creation. In the course of an entity's operation, the value of equity is equal to the difference between the value of the company's assets and the value of its liabilities. If equity is positive, the firm has sufficient assets to cover its liabilities.

Total equity turned out to be one of the significant asset factors that affects the market capitalization. In most cases, an increase in equity means an increase in market capitalization, nonetheless comparing its impact

with the impact of R&D expenditure, EBIT or EBITDA, it should be stated that this impact is much weaker. The strength of the dependence for the ICT manufacturing sector is different for each of the three surveyed regions of the US, the EU and China. Because of the fact that the largest number of companies producing ICT devices is located in China, this may indicate that investors take into account information on the size of the company's equity, which is important in the context of capital expenditures necessary to launch large-scale production of ICT devices.

Another issue concerns the result when an increase in total equity results in a decrease in market capitalization. This type of observation was noted in the ICT services sub-sector in the US and in the European Union as shown in Figure 6.

Figure 6. Multiplicity of change of the market capitalization of companies from the ICT sector with the increase in total equity by 1 unit



5.4. Total Assets

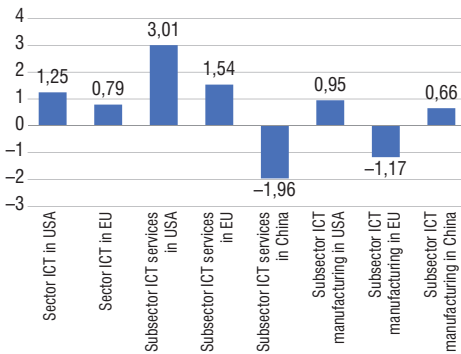
Total assets is the total amount of resources owned by a company. Assets represent the value of property that can be converted into cash. Assets include cash, transferable securities, receivables, prepayments, inventories, fixed assets, intangible assets, goodwill and other assets.

The findings on the relationship between the impact of the total assets factor on the market capitalization of companies from the ICT sector are interesting.

Firstly, regardless of the study, it turned out that its strength is relatively small, in comparison for example with the impact of R&D expenditure.

Secondly, in the case of the ICT services sub-sector in China and the ICT production sub-sector in the EU increased total assets mean a decrease of the market capitalization of companies from the ICT sector. Thus, the results of the research confirm the fact that the market valuation of companies from the ICT sector is influenced to a greater extent by human capital and to a lesser extent by the assets owned.

Figure 7. Multiplicity of change of the market capitalization of companies from the ICT sector with the increase of total assets by 1 unit



The results showing the greatest impact within the relationship between total assets and the market capitalization are shown in Figure 7.

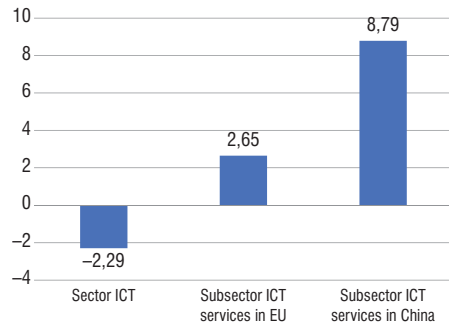
5.5. Total Revenue

Total revenue is revenue from all of the company's operating activities after deducting all sales adjustments and their equivalents during the period. They are calculated by multiplying the total quantity of goods and services sold by their price.

It may be surprising to find that the level of revenues of enterprises from the ICT

sector, the size of which reflects the scale of operations, turned out to be statistically significant in only four studies, including importantly, in the sub-sector of ICT services in two geographical regions, i.e. in China and in the EU. In China, the relationship between revenue and the market capitalization is stronger – the USD 1 million increase in revenue means increased market capitalization of USD 8.79 million. This means that market investors appreciate the expansion of entities from the region, which is associated with an increase in revenues in this market segment.

Figure 8. Multiplicity of change of the market capitalization of companies from the ICT sector with the increase of total revenues by 1 unit



A different situation is observed in the case of ICT production sub-sector in the US, the EU and China, where the described relationship does not occur. This may be related to the low profitability of activities conducted by ICT equipment manufacturers in relation to companies from the ICT services sub-sector in every of the three regions. It can be concluded that for this reason, a possible increase in revenues does not mean any additional incentive for the market investors to buy shares of the enterprises. The described relationships are shown in Figure 8.

5.6. Historical Dividend Rate

Historic dividend yield — the quotient of the dividend per share for the financial period and the share price multiplied by 100.

The dividend rate, the amount of which is considered a sign of the company's attractiveness because it is associated with the possibility of drawing financial benefits by shareholders, turned out to be either statistically insignificant or, if statistically

significant, only in two of twelve carried out studies and it resulted in a decrease in the value companies from the ICT sector. In the case of companies in the ICT services sub-sector, including companies from the US, European Union and China regions, the increase in the historical dividend ratio by USD 1 million meant a decrease in the value of market capitalization by approximately USD 9 million.

6. Conclusions

Research involving companies from the ICT sector listed on the public markets, including their operations in the US, the EU and China regions, is a significant contribution to the research area related to the segment of the global economy. The high value of the obtained results is related to the fact that they concerned the largest companies from the ICT sector and covered the period 2008–2017, i.e. both the time of organic growth and the global financial crisis of 2008–2009. The obtained results can help in the preparation of value creation strategies for ICT companies in different geographic regions.

As a result of dynamic changes in the global economy, the role of the ICT sector is growing and is perceived as such by the market. In September 2021 the five largest companies in terms of capitalization from the S&P 500 index of the American stock exchange are companies from the ICT sector (Apple Inc., Microsoft Corp., Alphabet Inc., Amazon Comp. Inc. and Facebook Inc.) and the capitalization of each of them exceeded USD 1 trillion (for Apple Inc. the market capitalization exceeded USD 2.5 trillion). In this context, the mapping model of factors affecting the market capitalization of companies from the ICT sector developed, as a result, the research can be considered a useful tool from the perspective how to build the value of enterprises in selected geographical regions.

In other words selection of a group of factors influencing the market capitalization of the enterprises from the ICT sector in the US, the EU, and China makes it possible to formulate strategies aimed at increasing value and to verify their effectiveness by measuring changes in the size of the variables in subsequent years.

Research involving companies from the ICT sector listed on public markets, includ-

ing their operations in the US, the EU and China regions, is a significant contribution to the research area related to the segment of the global economy. The high value of the obtained results is related to the fact that they concerned the largest companies from the ICT sector and covered the period 2008–2017, i.e. both the time of organic growth and the global financial crisis of 2008–2009.

Although the stock exchanges operating in the US, the EU and China are at different stages of development, and entities investing in the shares of the companies from the ICT sector have different motivations depending on the region, it was possible to identify a common behavior of the stock market investors in some areas, depending on the region in which the company operates.

First, investors recognize, regardless of the region, that the R&D expenditure is associated with an increase of the market capitalization of the company from the ICT sector.

Secondly, the issue of depreciation of owned assets is an important factor for the market valuation of enterprises from the ICT sector. In the vast majority of studies conducted, in the case of EBIT, which includes depreciation, an increase in the category of profit meant an increase of the market capitalization of an ICT company (with one exception for companies in the services sub-sector from China). In the case of EBITDA (which doesn't include depreciation), there is a reverse relationship in principle – an increase in EBITDA means a decrease in market capitalization, with an extremely great impact for the two categories of profit on market capitalization recorded in China.

Thirdly, regionalization is important in terms of revenues – investors appreciate the aspect most in the case of the service sub-sector in China. There is no similar dependence among producers of ICT devices operating in all three regions.

Fourthly, the value of property (i.e. assets) and equity has, albeit limited, an impact on the market valuation of an ICT company, regardless of the region in which the entity operates. This means that the assets held by ICT companies are of secondary importance from the perspective of building their market capitalization. In the extreme case of entities from the ICT ser-

vices industry from China and entities from the EU producing ICT devices, an increase in revenues is perceived negatively by the market and is associated with a decrease in market capitalization.

Summarizing the observed relationships in the group of seven described variables regardless of the identification of the impact of the size of revenues, equity, or the level of revenues on the market capitalization, the impact of the factors is definitely lower than in the case of expenditure on research and development. Therefore, it can be concluded that the issue of expenditure on research and development is considered by market investors to be the most important in the context of the impact on a possible increase in the value of enterprises from the ICT sector. Investors see the greatest potential in this aspect, which should be associated with the broadly understood development of the company, bringing the greatest benefits to the investors in the adopted investment perspective. It is worth emphasizing that the issue of the value of companies from the ICT sector is not limited only to the interests of shareholders and management boards of the entities. The development of the ICT industry is crucial from the point of view of the civilization progress and the economic development of the individual countries. According to the European Commission, progress in key technologies in the ICT sector – such as the development of 5G communication networks, the Internet of Things, information processing in the cloud, Big Data processing and analysis, automation and robotics – have a significant impact on the development of other sectors of the economy and social life. On the other hand, the fact that the economies of countries increasingly rely on the use of digital data, and the amount of the data is growing exponentially, basically determines the direction of development of the global economy. In other words, taking into account the trends present in the world's largest economies, it can be assumed that their development will increasingly depend on the pace at which the offer of enterprises from the ICT sector will grow. In this context, conducting research on the factors responsible for the development of the entities may be important for the direction of solutions that contribute to the broadly understood development of civilization.

In view of further research into the sector, the COVID-19 pandemic and the risk of a global economic slowdown will be an important factor affecting the sector.

Regardless of the type of impulses that will affect the ICT sector, the growing role of information and communication technologies in the modern economy will increase the demand for research in the area.

References

- Almus, M. (2002). What characterizes a fast growing company? *Applied Economics*, 34(12), 1497–1508. <https://doi.org/10.1080/00036840110105010>
- Ardishvili, A., Cardozo, S., Harmon, S., & Vadakath, S. (1998). *Towards a theory of new venture growth*. Babson Entrepreneurship Research Conference. Ghent, Belgium, 21–23.
- Arrighetti, A., & Lasagni, A. (2013). Assessing the Determinants of High-Growth Manufacturing Firms in Italy. *International Journal of the Economics of Business*, 20(2), 245–267. <http://dx.doi.org/10.1080/13571516.2013.783456>
- Becchetti, L., & Trovato, G. (2002). The determinants of growth for small and medium sized firms. The role of the availability of external finance. *Small Business Economics*, 19, 291–306. <https://doi.org/10.1023/A:1019678429111>
- Bogas, P., & Barbosa, N. (2013). High-Growth Firms: What is the Impact of Region Specific Characteristics? *NIPE Working Papers*, 19. https://doi.org/10.1007/978-3-319-12871-9_15
- Golinski, M. (2015). Share of the Information Technology Sector in the Global Economy. *Scientific Journals of the University of Economics in Katowice*, 24(3), 96108.
- Hermelo, F., & Vassolo, R. (2007). The determinants of firm's growth: an empirical examination. *Revista Abante*, 10(1), 3–20.
- Honjo, Y., & Harada, N. (2006). SME Policy, Financial Structure and Firm Growth: Evidence from Japan. *Small Business Economics*, 27, 289–300. <https://doi.org/10.1007/s11187-005-6703-0>
- Levratto, N., Tessier, L., & Zoukri, M. (2010). The determinants of growth for SMES. A longitudinal study from French manufacturing firms. *EconomiX-CNRS-University of Paris Ouest Working Papers*, 28, 1–30. <https://doi.org/10.2139/ssrn.1780466>
- Liu, W.-Ch., & Hsu, Ch.-M. (2006). Financial structure, corporate finance and growth of Taiwan's manufacturing firms. *Review of Pacific Basin Financial Markets and Policies*, 9(1), 67–95. <https://doi.org/10.1142/S0219091506000653>
- Lopez-Garcia, P., & Puente, S. (2012). What makes a high-growth company? A dynamic prob analysis

- using Spanish firm-level data. *Small Business Economics*, 39(4), 1029–041.
<https://doi.org/10.1007/s11187-011-9321-z>
- Maas, K., & Boons, F. (2010). CSR as a strategic activity: Value creation, redistribution and integration. *Innovative CSR: From Risk Management to Value Creation*. Routledge 154–172.
<https://doi.org/10.4324/9781351279000-8>
- Mateev, M., & Anastasov, Y. (2010). Determinants of small and medium sized fast growing enterprises in Central and Eastern Europe: a panel data analysis. *Financial Theory and Practice*, 34(3), 269–295.
- Mitusch, K., & Schimke, A. (2011). Gazelles -high-growth companies. Final report. European Commission: Consortium Europe INNOVA Sectoral Innovation Watch.
- Moreno, A., & Casillas, J. (2007). High-growth SMEs versus non-high-growth SMEs: A discriminant analysis. *Entrepreneurship and Regional Development*, 19, 69–88.
<https://doi.org/10.1080/08985620601002162>
- Navaretti, G., Castellani, D., & Pieri, F. (2014). Age and firm growth: evidence from three European countries. *Small Business Economics*, 43, 823–837.
<https://doi.org/10.1007/s11187-014-9564-6>
- Schimke, A., & Brenner, T. (2011). Temporal structure of firm growth and the impact of R&D. *Working Paper Series in Economics*, 32, Karlsruhe Institute of Technology (KIT), Department of Economics and Management.
- Segarra, A., & Teruel, M. (2011). High Growth firms and innovation: an empirical analysis for Spanish firms. *CREIP, Working Papers*, 32 Reus.
<https://doi.org/10.1596/1813-9450-5906>
- Serrasqueiro, Z., Nunes, P., Leitão, J., & Armada, M. (2010). Are there nonlinearities between SME growth and their determinants? A quantile approach. *Industrial and Corporate Change*, 19(4), 1071–1108. <https://doi.org/10.1093/icc/dtp053>
- Shrimal, K., & Prasad, H. (2014). A Literature Review on Relationship Between Financial Performance and Market Capitalization. *Midas Touch International Journal of Commerce, Management and Technology*, 2(9), 48–55.
- Voulgaris, F., Asteriou, D., & Agiomirgianakis, G. (2003). The determinants of small firms growth in the Greek manufacturing sector. *Journal of Economic Integration*, 18(4), 817–836.
<https://doi.org/10.11130/jei.2003.18.4.817>
- Xu, L., & Cai, F. (2016). Value Relevance of Earnings, Book Value, Revenue, and R&D. *Business Review, Cambridge*, 24(1), 91–97.
- Wyrwich, M. (2010). Assessing the role of strategy and socioeconomic heritage for rapidly growing firms: evidence from Germany. *International Journal Entrepreneurial Venturing*, 3, 245–263.
<https://doi.org/10.1504/IJEV.2010.030976>