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MASTER THESIS

The impact of intellectual capital on high-intangible and low-intangible firms in the European Market.

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1 INTRODUCTION

In 2020 intangible assets (IA) represented more than 90% of the total amount of assets in the global S&P 500 index. Starting from $122bn in 1975, IA reached $21tn in 2018. IA is part of the broader concept of intellectual capital (IC) which is the protagonist of the 21st-century revolution linked to the rise of the intangible economy within global and national economic systems. According to Brand Finance (2019)[1], while global enterprise value[2] stands at US $104.5tn, the value of the world's undisclosed intangible assets is still at US $35.4tn. 'Undisclosed intangible assets' category accounts for the difference between the fair market value of a business and the value of its identifiable tangible and intangible assets. Often the undisclosed part of intangible assets is more valuable than the disclosed one. The rapid development of new upcoming technologies such as the Internet of Things (IoT) and Internet of Services (IoS) has given birth to the so-called 4th industrial revolution or Industry 4.0, widespread in many countries. Knowledge, resulting from the combination between information and experience, interpretation, reflection, and context, has surpassed tangible resources for its capacity to obtain a sustainable competitive advantage. Additionally, in contrast respect to tangible assets that need to be depreciated or replaced over time, knowledge does not wear out in time. In this framework, IC fosters innovation, when innovation can be considered as both input and output and as the driver that, in turn, contributes to improving the company's organizational performance. Despite the lack of a universal definition, IC can be described as the stock of knowledge that a company owns, or as an intangible capital and resource (e.g. knowledge, experience, management philosophy, brands, systems, and human resources) that supports the creation of firm value. IAS 38[3] includes in the intangibles category those assets that have not been seen, touched, or physically measured, according to the three critical attributes: control, identifiability, and future economic benefits. My study addresses two main themes. The first concerns analyzing the relationship between IC and firm performance, given IC, has been viewed as a key driver for companies in strengthening their competitive advantage and in gaining corporate success. This view is in line with the resource-based theory according to which an organization aiming at the achievement of a comparable sustainable advantage must optimize its intangible assets as much as its tangible resources. Thus, IC can be considered as a measurement metric to assess the firm performance through the use of conventional financial statements (balance sheets and income statements). The second theme relates to the accounting treatment of intangible assets. Starting from the roots of financial accounting, the reason for the existence of financial statements prepared and presented by managers is to provide helpful financial information that users can relate to as the main reference point in their decision-making processes. The usefulness of financial information lays in its quality features settled by the Financial Accounting Standards Board (FASB) and International Accounting Standards Board (IASB).

[1] Brand Finance Global Intangible Finance Tracker (GIFT™) 2019 report.
[2] understood as the total worth of the world's publicly traded companies.
[3] For more details, please refer to: https://www.ifrs.org/

Referring to financial statements' usefulness, the term "value relevance (VR)" is often adopted. Accounting information becomes more useful for the stakeholders in a different environment as it expresses higher levels of VR, capable to illustrate changes in the market value. Accordingly, accounting information including IAs is one of the key factors in the decision-making process of the stakeholders. If valued properly, IC could turn into valuable leverage for corporate wealth creation and a profit booster for firms to achieve their strategic objectives and ensure competitive success, regardless of the industry in which they operate. Yet, intangible capital gives rise to a host of accounting problems, as shown by a large amount of IAs that cannot be recognized on the firm's balance sheet[4]. In the U.S., practically all internally-generated intangibles—R&D, information technology, brand creation and enhancement, business designs and processes, employee training and other human resources development costs, "big data" creation and exploitation, customer acquisition costs, etc.—are immediately expensed, whereas expenditures on similar but acquired intangibles (including in-process R&D) are capitalized. IAS/IFRS rules are similar, with one important difference: under IFRS, development costs—the "D" of R&D—should be capitalized (and amortized) when meeting strict conditions, such as the project passed technological feasibility tests, financing for its completion is assured, and development expenditures can be identified. Compliance with this rule varies considerably. These are, in brief, the accounting and reporting rules for intangibles around most of the world. O'Connell et al. (2017) proved that capitalizing R&D expenditures joined by an evaluation of R&D program success have a significantly positive impact on the shareholders' value growth in the European market. Typically, previous literature divides the overall IC into three components, namely human capital, relational capital, and structural capital, however, according to recent studies like the one conducted by Xu and Wang (2019) this decomposition is not sufficient to capture IC essence. Over the last three decades, lots of innovative models and frameworks have been tested to find a proper IC measurement method. Among these, the value-added intellectual coefficient (VAIC) by Pulic is the most widely adopted for its simplicity and data availability. Following previous studies like Chan (2009), Nimtrakoon (2015), Xu and Li (2019), Xu and Wang (2019), Ousama et al. (2019), I adopt the VAIC methodology for the IC measurement. The VAIC model represents the overall value creation efficiency that an organization possesses. It determines the extent to which every component among physical, human, and structural resources affects both corporate performance and value generation. Stahle et al. (2015) and Svarc et al. (2020) have expanded the concept of IC measurement by extracting it from the firm level to the country-level studying the national intellectual capital (NIC) and its role in contributing to national wealth in the future and to digital transformation. Other studies, including Sharma and Dharni (2017) and Oliveira et al. (2020), bring a significant contribution to IC literature by discovering significant correlations between IC and firms' characteristics like the size. Concerning IC association to firm's performance, literature has been

[4] According to Lev (2018), in the last two decades the accounting standards have not been able to overcome the detriment, both actual and sensed, of the relevance of financial informational content to investors.

extended by recent studies covering specific markets, like Dabic et al (2019) that analyzed Croatian firms, or particular sectors like the agricultural industry treated by Xu and Wang (2019), or the banking industry examined by Ousama et. al (2019). Concerning IC association to financial performance, literature shows mixed results. The majority of studies, like those conducted by Khan et al. (2019) and Xu and Li (2019), estimate IC positively affects the firm's performance. Other studies have found opposite results, like Chan (2009) which found a negative relationship between IC and the financial performance of companies. As IAs are a part of accounting information, many prior studies show that firms now greatly invest in IAs because of their effective role in sustaining the success of the firms. However, the impact of IAs on VR represents a critical issue in the accounting field for several reasons. Most of the studies conducted worldwide concluded that IAs positively improve the VR of accounting information. Supporting evidence is provided by Al-Ani and Tawfik (2021) discovering that IAs, together with traditional accounting measures as a whole are value relevant in the Gulf Cooperation Council (GCC) non-financial listed firms. The study on Turkish listed firms conducted by Ocak and Fındık (2019) sustains that recording IAs on financial statements improves the VR of earnings and increases both sustainable growth rates and firm value. The literature presents mixed evidence about the impact of IAS/IFRS adoption over intangibles[5]. Evidence provided by Napoli (2015) shows that the explanatory power of IAs increases the VR more after IAS implementation. On the other hand, the study conducted by Cordazzo and Rossi (2020) on the value relevance of IAs in Italy, illustrates that IAs as a whole are value relevant only under the Italian GAAP, suggesting that the adoption of the IFRS set of accounting standards reduces the investors' perception of intangibles' informative value. Grounded on the resource-based theory, I expect to confirm that, if valued properly, IC represents valuable leverage for corporate wealth creation and a profit booster for firms to achieve their strategic objectives and ensure competitive success, regardless of the industry in which they operate. If a wide number of studies focus on the impact of IC on several measures of financial performance, there is little existing research deepening this theme by comparing high-intangibles and low-intangible firms. My first set of hypotheses, explore and examine the relationship between IC and firm performance of high-intangibles and low-intangible medium-large firms operating in the Euro Area between 2017 and 2019, using the VAIC model. I explore the extent to which medium-large-sized firms' success can be attributed to the efficient use of intangible assets, regardless of the industry. I further assume that IC has a greater influence on the development of firms in knowledge-intensive sectors compared with traditional enterprises, because they depend more on new technologies and skilled talents, as Nimtrakoon (2015) results show. As IAs are a part of accounting information, the usefulness of financial statements reduces as the bulk of the intangibles is left unreported[6]. The

[5] With the aim to align accounting standards, European Union Regulation 1606/2002 introduced the application of IFRS for all European publicly-trades firms. In response, European countries have implemented new investor-oriented accounting rules, generating debates about the impact of this switch.

[6] PricewaterhouseCoopers conducted corporate stakeholders' interviews revealing that information on intangibles is among the five major categories of information.

international standard-setters recognized the potential information gaps in reporting of intangible assets. For instance, the International Standards Accounting Board (IASB) admitted the deficiencies and weaknesses in the guidance given by its intangible assets' standard (i.e. IAS 38). In addition, the present conservative stance in intangibles reporting leads to possible moral hazard and adverse selection behavior that is not in favor of investing public. Financial statements become increasingly useful for investors if including IAs accounting information, as they allow stakeholders to make more informed investment decisions. This leads to my second set of hypotheses that aim at enriching the literature on the association between IAs[7] and VR through applying Ohlson's model to European firms between 2017 and 2019. The sample in the current study is drawn from data of 467 medium and large listed companies belonging to the Euro Area and representative of the European market over the period 2017-2019. The final sample is divided into two subsamples of 154 high-intangibles and 313 low-intangibles firms. I examine my first set of hypotheses using the VAIC model, incorporating its three components namely, capital employed (CE), human capital (HC), and structural capital (SC). For the firm's performance indicators, I use return on assets (ROA) and return on equity (ROE). For my second set of hypotheses related to IAs value relevance, I use Ohlson's model to assess to what extent the firm's sample share price is influenced not only by its original model components, namely earnings per share (EPS) and book value per share (BVS) but also from intangible resources. Finally, multiple regression analysis is used to test the research hypotheses. Through the explicit focus on medium-large public firms belonging to the Euro Area, my research aims to contribute to the current discussion on IA impact over firm performance as well as to the academic debate regarding the lack of relevant information disclosed on IA. I attempt to fill the gap left by little existing literature on possible differences among high and low intangible intensive firms related to the effect that IAs may have in determining a sustainable competitive advantage for firms and in allowing investors to perform accurate decision-making. As the modern global environment is increasingly driven by technological advances, and both practitioners and academics generally agree that irreversible forces have turned intangibles into driving an increasing share of the value created, the objective of my analysis is to drive the attention toward the importance of introducing a proper accounting treatment to reflect intangibles in the financial statements. The remainder of the paper is organized as follows. Section 2 presents an overview of the current literature addressing IA and develops hypotheses. Section 3 illustrates the methodology used in this analysis. Section 4 details the emerging empirical results. Section 5 discusses the results, while Section 6 concludes this research.

[7] Intangible assets are represented by using VAIC as a proxy.

2 LITERATURE REVIEW

2.1 MODERN GLOBAL ENVIRONMENT

Before addressing the main topic of this research, I intend to provide a general overview of the current economic context, so to facilitate the understanding of why exploring IC is so important in the modern global environment.

The 4th Industrial Revolution.

During the 21st century firms have undertaken significant changes which radically altered the concept of value creation. Many academics talk about the fourth industrial revolution, others about the knowledge-based economy. In general, researchers agree in identifying a rising share of the value creation to be determined by intangibles, as a result of the convergence of irreversible forces. The phenomenon resulting from online connections among businesses, people, and devices, known as Industry 4.0 can also comprehend semantically different concepts such as sharing, gig, and platform economies. What the digital economy reflects is the fact that businesses are becoming more and more digitalized with intangibles having an increasingly important role in their income generation. Considering the increasing number of successful multinationals like Airbnb, Netflix, or Uber where physical assets are just a small part of their capital, intangibles are driving not only companies but also regions and entire countries to shift into investing consistent resources in digital transformation. Intellectual capital research has gained momentum since one of the greatest world trends over the past two decades consists in the deep penetration of information and telecommunications technologies in real economic processes that brought a structural transformation of the global economy. Given that information and telecommunication technologies (ICT) are the protagonists of this changing effect, which is expanding among all the socio-economic activities, a sense of urgency for new amendments in the principles of innovative development of the world economies is felt. Born from the spread of the Internet around the mid-1990s, ICT became more and more used, experiencing tremendous growth starting from the late 2000s, with the wide diffusion of smartphones and mobile internet. Today, digitalization is deep-seated into all sectors of the economy as well as the everyday life of people. With the advent of the 4th Industrial Revolution, also known as Industry 4.0[8], the social component (human) has merged with the technical component (technology) resulting in a grade of interconnectedness and interaction of man and machine never reached before. The rapid adoption of upcoming technologies like the Internet of Things (IoT) and the Internet of Services (IoS) has given rise to a new Industry 4.0's disruptive force, which has led to substantial opportunities and challenges to be faced by societies,

[8] Industry 4.0 is defined by Schwab (2016) as a fusion of technologies that are "blending the lines between the physical, digital and biological spheres".

businesses, and governments. A constructive transformation must understand both technical and social systems together and contextualize them with the environment where they are applied. Digitalization of industry 4.0 is not just about having digital ownership of tangible infrastructure, it also leads to digital working systems whose effectiveness and efficiency minimize production costs and augment production results contemporarily. Thus, the implications of Industry 4.0 could be reasonably illustrated by evaluating their impact on working places, jobs, employees' capacities, and society as a whole. Developing countries could take advantage of Industry 4.0 by embracing emerging technologies such as big data analytics, Artificial Intelligence (AI), or blockchain to align faster with developed markets. Governments could exploit this digital-driven industrial revolution to reach a smart society by improving their social and economic aspects. Industry 4.0 could be defined as intelligent because it consists of future industry development trends exploitation to reach more sophisticated manufacturing processes. It implements Cyber-Physical Systems, AI mechanisms, Virtualization Technologies (Virtual and Augmented Reality), Cloud Computing, Big Computing, Big Data analysis, IoT, Adaptive Robots. Industry 4.0 is built on some main pillars: interconnection among products and information, high-speed information transfer, real-time processing, system and product virtualization, unlimited data storage, the existence of communicative links between objects. Despite companies must go through significant changes in their business models to align with digital innovation and use information technologies, the digital transformation revolution has powerful implications also from a social and cultural point of view that cannot be ignored. The sentiment concerning Industry 4.0 can vary from the optimistic view which considers it as a revolutionary power that will benefit society, to the opposite belief which sees digitalization as a threat to democracy, social values, and equality. In any case, there is a general agreement on the fact that no economy or society can escape confrontation with digital transformation to become a prosperous reality. With a focus on the European area, for the first time after 2010, together with the USA, Europe began to invest in intangible assets more than tangible assets. This is because investing in R&D, innovation, software, and human resources were becoming the major source of market success, while the impact of tangible assets over long-term economic growth started to weaken. This enhanced the power of intellectual capital (IC) as part of intangible assets, able to lead to competition and progress. Research conducted by Stahle et al. (2015) showed that the National Intellectual Capital (NIC) represented circa 50% of the European Union's (EU's) gross domestic product (GDP), with Nordic countries as forerunners. These findings are relevant considering how different the requirements are between an intangible economy and a tangible economy in terms of rules, behaviors, and knowledge to work properly. International studies conducted by OECD[9] (2017) and WEF[10] (2017) provided supporting evidence that digitalization contributes to economic growth productivity rise and employment increase. Digital transformation develops at different speeds and

[9] Organization for Economic Co-operation and Development.
[10] World Economic Forum.

intensities from country to country. According to UNCTAD[11] (2019) if the USA and China have a leading position in terms of technological progress, Europe, Latin America, and Africa are far behind. Considering the market capitalization value of the 70 biggest digital platforms around the world, the USA and China boast 90% of this value, with the contribution of companies such as Apple, Google, Alibaba, Microsoft, Tencent, Facebook, while Europe's share is only 4%[12].

The main drivers of the 4th Industrial Revolution.

The degree of success reached by the 4th industrial revolution is determined by the capacity of citizens, businesses, and governments to sustain the transformation process toward a smart society characterized by advanced technologies innovation, skills, and responsive policy. Through a review of the literature, Manda and Dhaou (2019) identified the principal drivers of Industry 4.0, as described below.

1) Technology

   Technology is playing a crucial role in the 4th industrial revolution. Smart products are developed thanks to cloud computing technologies and IoT, intelligent logistics and mobility are accessible through the IoS, and more efficient use of natural resources is possible thanks to the Internet of Energy. An enhanced level of communication, integration, and interoperability among machines, people, and systems has been obtained by exploiting telecommunication technologies and infrastructure as well as other internet technologies. At the heart of the Industry 4.0 revolution, there are cyber-physical systems that control and monitor equipment, and processes, representing a key factor for a successful integration between the real and virtual world. Big data allow improving efficiency and decision making while data analytics enable to grasp more useful information from data to comprehend and exploit decisive information like changing market conditions, evolving trends, or customer preferences so to improve the production efficiency

2) Education and training

   The 4th industrial revolution is expected to disrupt the traditional labor market, characterized by the rising request of high skilled workforce. This is because the innovation and the digital changes related to Industry 4.0 require more skilled workers endowed with innovative orientation and technological savvy. If on one hand Industry 4.0 leaves some perplexities about technology dismissing humans through automation, on the other hand, this revolution can bring on the table new changes, such as research, strategic planning, and development, that demand the use of human abilities to detect, conceptualize and deploy innovative opportunities with a creative process.

3) Innovation

[11] United Nations Conference on Trade and Development.
[12] Notwithstanding some of European countries, like Germany, successfully embraced industrial digitalisation, the non-European countries master the digital economy leading to a concrete threat of technological dependency.

The 4th industrial revolution is giving birth to cutting-edge business models, innovative production methods, and goods driven by technological instruments. For this reason, is increasingly important to invest more resources in research and development (R&D) which can be considered as a key driver of innovation in Industry 4.0. A 2016 survey made by Deloitte to study Industry 4.0 effect on manufacturing companies showed that 78% of the interviewed firms considered R&D as a critical component of the 4th industrial revolution.

4) Policy innovation

   The digital revolution gives rise to challenges such as enterprise and personal data security and privacy, trade restrictions, and liability issues, in response to which governments need to put in place innovative policies and legislative reforms. There are several issues brought by the digital era that require tight regulation and the introduction of new standards, policies, and laws of the economic, labor market, and industrial nature. Aiming at creating a supportive environment for the digital transformation, the policy is fundamental to manage the current challenging smart context and to prepare citizens, industries, and governments at best for any Industry 4.0 new opportunity.

5) Responsive and context-specific strategies

   A crucial element for governments to appropriately address the request of the digital and interconnected environment characterizing the 4th industrial revolution is the presence of successful strategies that could provide regulatory guidelines. On the opposite side, the inability of local contexts to adapt to the so-called "best practices" is most of the time determined by poorly implemented strategies rather than by their absence.

The challenges of the 4th Industrial Revolution

The 4th industrial revolution does not come without its issues. In 2016, for example, the European Parliament identified some significant challenges within the European environment, such as data issues, business models amendments, legal questions of liability and intellectual property, new investment needs, and skills mismatches. Following Manda and Dhaou (2019), the main issues are treated below.

1) Potential job losses

   As introduced before, the rising technology usage, the 4th industrial revolution has brought to the surface some concerns related to job losses. More generally, Industry 4.0 has a substantial impact on global industries and, consequently, on the labor market, spanning from high levels of job creation to job displacement, and from powered labor productivity to broader skills shortcomings.

2) Skill challenges

   To develop and deploy technological initiatives, there is the need for intellectual and creative guidance provided by human skills with innovation systems and knowledge communities. The

skill challenges lay in the abilities-related redundancies and discrepancies that reflect an obstacle in adapting to the mutable nature of jobs which requires a higher-quality knowledge to deal with advanced and manufacturing techniques. As a result, citizens' opportunities to be part of social and economic activities in a smart society could be limited.

3) Infrastructure challenges

   This issue is particularly linked to developing countries whose poor ICT infrastructure causes the reduction of the potential exploitation and development of networks and smart devices considering that even in developed countries many difficulties are faced when it comes to establishing the right condition that allows the introduction of new technologies and the creation of networks and digital devices.

4) Security and privacy

   Security and data privacy issues represent one of the most relevant matters in the 4th industrial revolution where technology has become key. New security and protection instruments are needed for easier and more collaborative value networks and smart production systems. Moreover, the extensive use of data analytics is likely to bring more challenges in the field of data security and privacy, and thus represents one of the major concerns raising significant trust issues toward the Industry 4.0 revolution.

4th Industrial Revolution: a focus on Europe

With a focus on Europe what emerges is that digital technologies are not being fully exploited for their potential. Despite there are several European countries that succeed in embracing the industrial revolution, non-European countries are those that dominate the digital economy. If European companies reflected only 10% of world sales revenues in ICT, as estimated by Schweer and Sahl (2017), it is also true that in the same period European ICT market has grown at a low pace of 1.3% per year. Despite the Western part of Europe maintains a leading position in respect to Eastern Asia and North America, the attempt to fully exploit intangible assets and intellectual capital (IC) for effective integration of the 4th industrial revolution is still a huge challenge. Moreover, distinctions need to be made among EU members for both infrastructure and digital technologies in the context of Industry 4.0, weakening the competitiveness that Europe as a whole can potentially reach. According to Michalczuk et al. (2019), a remarkable disparity exists between the north and south of the EU, with a concentration of intellectual capital resources in Northern Europe. Supporting evidence to this thesis is provided by the findings of the research conducted by Svarc et al. (2020) over a composite index built including 28 EU member countries. What emerges from the study is a positive association between NIC and digital transformation, confirming that countries with a higher level of NIC are more prepared for the digital revolution than those with lower NIC. By classifying EU countries based on their usage of intangible assets, Northern EU leading economies are those with the highest values of NIC. Sweden, Finland,

Denmark, and Luxembourg are part of the EU countries with the highest levels of intellectual capital assets. These countries are followed by another cluster of eight EU members which scored above the Union average of 48.6, comprehending countries such as Germany, Belgium, Austria, and Spain. In turn, this group is followed by more moderate users of intellectual capital which are positioned immediately below the EU average, like France, Portugal, Poland, Slovenia, and Malta. Italy and Greece are positioned in the group of countries with the lowest amount of NIC, together with Eastern Europe counties like Bulgaria, Romania, and Hungary. This last group represents evidence of the existence of a north-south division in the EU in terms of NIC value. The same research also explored how different components of intellectual capital could influence the digital transformation readiness of a country. It has been revealed that social and human components[13] are those with the most significant effect digital transformation. Among the two, human capital, meant as years of schooling, working training, critical thinking, etc. is the one the most powerful over digital transformation readiness with respect to all other IC components.

2.2 THE RISE OF INTELLECTUAL CAPITAL

Once acknowledging how dramatically the relevance of intangible resources rose in the last decades and how disruptive their effect still is, I will start approaching the object of this study by dedicating this section to the investigation of the IC concept and the increasingly high attention received to the subject by the academic world.

The debate around the intellectual capital definition.

The term "intellectual capital" was adopted for the first time by Galbraith in 1969 who defined it as an intellectual contribution owned by individuals. In the following years, several definitions have been elaborated. Some academics associate the concept of IC with investments in employees, customers, suppliers, and technology innovation. Others intend IC as what coincides with the gap between the value perceived by investors and the value reported in the balance sheet. In 1997 Stewart identified IC as the combination of information, experience, knowledge, and intellectual property which can be spent at the scope of creating value for a company. Other researchers refer to IC as firm knowledge with the potential to be turned into tangible profit. Despite no single and comprehensive definition has been given to intellectual capital, IC is surely an extension of the conventional concept of capital and comprises intangible assets that can generate value. Starting from the Financial Accounting Standards Board (FASB)'s definition of an asset[14] in general as "a resource controlled by the entity due to past events (i.e., the result of a purchase or an internal generation) and from which future economic benefits

[13] Human capital is represented by a composite indicator, namely working skills, which includes nine components suggested by the WEF competitiveness report (WEF, 2019).
[14] For mode details, please refer to: https://thefsa.org/downloads/2013/Leisenring_The_FASB_Conceptual_Framework_2013.pdf

(inflows of cash or other assets) are expected", it is then possible to analyze the definition of the intangible asset given by the International Accounting Standards (IAS). IAS 38 defines IAs as "an identifiable non-monetary asset without physical substance." The criteria stated by IAS 38 to identify intangible assets is rooted in two pillars: the first is the probability that the future economic benefits that are expected to come from the intangible asset will flow to the entity; the second refers to the cost of the intangible asset, which must be measured confidently. IAS 38 definition treats as intangibles all those assets that are not classified as monetary, that are free from physical essence, and that are 'identifiable'. The term "identifiable" stands either for something divisible by the rest of the entity (transferred, licensed, or sold) or for something emerging from legal or contractual rights (independently from where those rights reside). To recognize an asset as intangible it must result from a separate acquisition, or a business combination, otherwise, it must be internally originated.

Intellectual Capital literature has gained momentum.

With the expansion and development of the world knowledge economy, IC has received increasing academic interest and numerous different models have been built up at the scope to capture IC substance, function, and benefits. The major challenge all these models met is finding a way to reliably reflect IC and its economic impact and understanding how to exploit IC in the light of an improvement of economic growth. IC measurement has been studied at different levels. Ample IC literature focuses on countries as a whole rather than on companies, extracting IC from the firm level and brought to the national level looking at wealth creation and viable competitiveness. Studies on NIC demonstrate the leading role of knowledge-intensive industries in generating future national wealth. More recent works centered on a single nation, all agree on the overall lack of comprehension of IC and its components followed by an inconsistent disclosure at the country-level. Many studies on IC are grounded on the resource-based theory, which asserts that a company can obtain a comparable and sustainable advantage by optimizing both the tangible and intangible assets it possesses and that these assets should be as rare, valuable, and non-substitutable as possible. An example of a study that validates that companies' success is widely driven by intellectual- and knowledge-based intangible assets is the research carried out by Dabic et al. (2019) confirming the equal importance of intangible resources concerning tangible assets to foster the strategic development in the context of Croatian firms[15]. Part of the literature also emphasizes significant associations between IC reporting and firms' characteristics. Sharma and Dharni (2017) give their valuable contribution to point out the positive correlation between IC reporting and the size of a company. Malikova et al. (2018) also focus on the correlation between the dimension of a firm and the IA[16] (meant as the stock of IC owned by a firm) disclosure within the sector of information

[15] Dabic et al. (2019) also point out that Countries such as Croatia, missing greater levels of innovation, must be allowed to reach other innovation leading countries in order to diminish regional differences in IC exploitation.

[16] In the Czech Republic a rising trend of the share of intangible assets in the total return value of enterprises has been registered. Still, a significant portion of intangible resources cannot be reported in financial statements, and the share of intangibles respect to fixed tangible assets in public firms at the Prague Stock Exchange is very limited.

and communication activities in the Czech Republic. They conclude that, when comparing companies publishing their financial statements and those disclosing IAs, larger firms disclose more intangible resources than smaller companies do and confirm that the share of IA to fixed assets is greater in the case of larger firms. Oliveira et al. (2020) conduct an important study on IC impact over SMEs in Portugal and Brazil, through the use of more qualitative parameters of firm performance to study IC, using cross-sectional surveys and questionnaires about firm's size, industry, revenue as well respondent's role in the enterprise. Confirming the arguments of previous studies, results support the crucial role of IC for SMEs, with evidence about IC creating innovation by supplying knowledge both internally and externally to the firm's boundaries. Furthermore, the research points out how SMEs significantly benefit from IC as a way to gather external knowledge since internal diversity may not be sufficient to create new value and demonstrates that IC components relate to one another and provide innovation which, in turn, strengthens organizational performance. The contribution of IC in improving the firm performance does not provide unique results. Some studies suggest IC impacts firms' performance significantly. This stream includes the research conducted by Khan et. al (2020), that uses questionnaire responses from 329 SMEs in an emerging country, Pakistan[17]. The findings highlight a powerful contribution of firms' intangible resources over financial capability, through using sustainable competitive advantage as a mediating element within Pakistani firms. Accordingly, IC has been promoted in the working environment as a key factor to obtain a competitive position in the markets. However, other studies found opposite results. An example is an analysis conducted by Chan (2009) over organizations belonging to the Hang Seng Index of the Hong Kon Stock Exchange between 2001 and 2005, intending to study the correlations between IC and financial performance of firms, including market valuation, profitability, productivity and return on equity. Contrary to prior studies, empirical results show no statistical evidence to support a relationship between corporate intellectual ability and market valuations, as well as a weak positive association between IC and profitability. A clear lack of relation has been found among IC and productivity and the association between corporate intellectual ability and return on equity has proven to be positive but poor[18]. In accordance with previous results, Dabic et al. (2019) examined the relationship between IC influence on business performance and innovativeness by surveying 253 Croatian small and medium enterprises, confirming it as significantly positive. The contribution of this study lays also in demonstrating that findings related to Croatia, among the post-socialist countries whose innovation development and economic growth have been slowed, is surprisingly similar to comparable research carried out in more stable and market-oriented business environments like EU countries and the US. Xu and Li (2019) found a positive relationship between IC and firm financial performance for small Chinese manufacturing firms.

[17] The research has been conducted in three greater cities of Pakistan: Islamabad, Lahore, and Karachi.

[18] IC impact on market valuation might not be the same for every region or industry. It may vary with the degree of IC awareness that investor have in a specific market. Moreover, since no immediate association between corporate IC and market valuation has been found, the IC explanatory power respect to the market-to-book value gap is also limited.

2.3 IC AND FIRM PERFORMANCE

After a general overview of the IC, in this section, I am going to address possible methods of IC measurement and the previous findings related to the first objective of my research: exploring the relationship between intangible capital and companies' performance.

Intellectual Capital measurement.

The increasing number of frameworks for IC measurement arises from the need to mirror the market value of companies in their financial reports. This supports the growing importance of IC in its role of measurement metric to assess firm performance using traditional balance sheets and income statements as well as to compare the performance metrics among different companies. Within the framework of the resource-based approach, some literature considers IC as a complete set, while other is more focused on its components. In this respect, current literature agrees on the idea that IC is losing sight of its whole meaning and, that, consequently, it is better to treat its components as a completely different construct. Massaro et al. (2019) refer to IC as a situational concept, meaning that organizations may view IC definition with different perspectives. Xu and Wang (2019) report that there is no standard definition of IC and its components and that scholars have tried to categorize it based on different criteria. They also argue that IC's typical division in three categories, namely human capital (HC), structural capital (SC), and relational capital (RC) is not enough, despite it is widely accepted among academics. Over the last three decades, there were more innovative models and frameworks to measure IC such as human resource accounting, economic value added (EVA), value-added intellectual coefficient (VAIC), and value chain scoreboard. Among these, Pulic's VAIC model is broadly adopted by many academics as an IC measurement method, capable of assuring an integrated and standardized measure to compare IC among countries and sectors[19]. The great advantage of this model is that the data it requires is easily obtainable and reasonably objective because they are extracted directly from audited corporate financial reports. The reason why VAIC is still one of the most common methods to measure IC in empirical research lays mainly in its simplicity and data availability. The VAIC model represents the overall value creation efficiency that an organization possesses. It determines the extent to which every component among physical, human, and structural resources affects both corporate performance and value generation. By taking data from the financial statements, what Pulic did is decomposing IC into human and structural capital, and the entire model offers information on the degree of value creation efficiency for both tangible and intangible assets of a firm.

The analysis of the relationship between IC and financial performance.

[19] Pulic (2000) states that current accounting system is not able to comply with the needs of modern companies because the focus of today business has shifted from the costs to value creation is the core of modern business. Thus, if a firm wants to optimize its result with its own resources, it must understand the key to successfully generate value in the company.

The connection between corporate performance and IC, quantified through metrics such as earnings, market performance, productivity, or profitability, has become a topic of in-depth research for both academics and practitioners. The majority of studies focusing on the relationship between IC efficiency and corporate performance have found a positive correlation between the two, with IC remarkably contributing to the enhancement of the performance of companies in the present competitive environment. Nevertheless, some studies also found absent or no significant correlation between IC and firm performance or even opposite results having IC as an element that decreases the performance of firms. I hereby present some examples. Xu and Wang (2019) conducted a study to analyze the IC impact on the financial performance of Chinese firms in the agricultural sector during 2012-2016, selecting agricultural organizations listed on the Shanghai and Shenzhen Stock Exchange. The study uses the VAIC model developed by Pulic to measure IC[20]. By examining the VAIC components, supporting evidence is provided for the influence of capital employed efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE) on earnings quality, as well as CEE's and HCE's positive impact on profitability. Concerning firms' efficiency, a positive relationship has been found with CEE, while a negative correlation has been observed with HCE. The overall evidence supports IC as a crucial element to promote the growth of IC agricultural firms. Mixed evidence is provided by Dzenopoljac et al. (2016), that conducted a study undertaken in the Serbian ICT industry analyzing 13,989 registered companies between 2009 and 2013[21]. On one hand, IC has been identified as a resource that is hard to simulate and that could lead to an enduring competitive advantage if properly implemented. On one hand, their study clearly shows that all VAIC components are significantly correlated with financial performance indexes such as ROE and ROA. On the other hand, it also emerges that tangible and financial capital still represents the component having the strongest relationship with these indexes in the context of Serbian ICT firms. Ousama et al. (2019) evaluate IC efficiency by using VAIC, investigating the relationship between IC efficiency and the financial performance of Islamic banks in Gulf Cooperation Council countries[22]. Grounded on the resource-based theory, IC is assumed to be a strategic element for banks to reach their sustainable and comparable competence through its efficient use. The emerging evidence indicates that the overall IC positively affects banks' financial performance, contributing both to the literature supporting the importance of IC as a booster of business performance for firms and to the belief that value creation in knowledge-intensive industries like the banking sector requires not only physical capital but also IC. Nimtrakoon (2015) analyses the level of IC within the five largest emerging economies in the ASEAN region, namely Indonesia, Malaysia, Philippines, Singapore, and Thailand as well as explores the association between IC and financial

[20] VAIC was chosen because it is an accessible method for shareholders, managers, and any other stakeholder to oversee and measure companies' IC potential and actual performance.
[21] This research analysed for the first time the overall effect of IC on financial performance focusing on the ICT field within the Serbian transitional economy.
[22] Please remind that the financial sector has peculiar set of accounting rules that differ from the reporting practices in the other sectors and that prevent the opportunity of a direct comparison regarding the IC management and implications.

performance, in the technology industry[23]. Resulting evidence highlights that tech firms generate value from intangible resources rather than physical and financial capital. HC results as the most important value driver concerning ROA generation. CE still maintains a remarkable position in the value creation process and a relevant role in companies' improvement. SCE shows to be the least impactful driver among VAIC components. If a wide number of studies focus on the impact of IC on several measures of financial performance such as market performance and profitability, there is little existing research on the comparison between high-tech and non-tech firms in terms of IC efficiency. Xu and Li (2019) reported that in the case of high-tech, each of the innovation capability dimensions has a balanced impact on value creation, while for non-high-tech firms' ideation is the most important component. Their study examined the impact of IC and its components on earnings, profitability, and efficiency on 496 Chinese SMEs, where 116 were classified as high-tech and 380 as non-high-tech SMEs. According to previous research findings, their results highlight that firms with a higher IC level will achieve higher performance, regardless of firms' type. Moreover, they show that whether IC impact on profitability is stronger in high-tech SMEs than non-high-tech SMEs, IC is more impactful on earnings and efficiency of non-high-tech SMEs than it is on high-tech SMEs.

2.4 IC ACCOUNTING ISSUES

Another important theme I decided to address in this paper is that, despite radical changes that have occurred in the economy due to impacting intangibles, recent studies reflect the widespread inability to accurately reporting intangible assets in financial statements.

The general lack of intangible assets reporting.

The intangible asset sphere is characterized by missing absolute values or lack of concrete and descriptive detail that inevitably affect their correct reflection in the reporting statement as well as their evaluation. A remarkable example is that of firms with a large number of intangibles which often report lower book values as a natural consequence of the immediate recording of the intangibles-related expenses and the delayed recognition of their benefits in accounting earnings. This inconsistency is accentuated in the case of small entities having a register of reported losses. As previously mentioned, the International Accounting Standards Board's definition of an intangible asset requires it to be non-monetary, without physical substance, and identifiable. Therefore, accounting issues rise also because the intangible assets that it is possible to record on a balance sheet under IFRS criteria might represent only a portion of what 'intangible assets' in the wider sense can be. Most of the strategic resources of

[23] The cited paper has varied the Pulic VAIC™ model by including another component, namely relational capital (RC), at the scope to obtain a more comprehensive measure of firm's IC efficiency. However, no significant association has been found between RC and financial performance.

business enterprises to create value, such as IT, patents, or brands, are expensed rather than capitalized, without having their nature of assets recognized in financial reports. To show the detachment between reporting and accounting rules and the changing economic reality, Baruch Lev (2018) documents the radical transformation of the U.S. economy during the past half-century. He shows that meanwhile a substantial decline in the aggregate investment in assets with physical nature, such as inventory, property, plant, and equipment occurred between 1997 and 2016, with tangible assets contribution to gross value added shifting from 16% to 10% (with a 38% fall), the investments made by the private sector in intangible assets almost doubled, shifting from 8% to 15% of value-added. While the declining tangible assets are recorded as such in the balance sheet of firms, most of the investments representing the growing sphere of intangibles are immediately expensed in financial reports. IT, brands, R&D which are treated on par with interest expensed or salaries, while tangible fixed assets, currently creating value only with a marginal role given their wide availability to all peers, are capitalized. This accounting behavior seems to be counterintuitive if thinking about intangibles as the major value drivers of modern businesses. The higher the proportion of 'undisclosed value' on balance sheets, the more critical that robust valuation becomes. Moreover, the inconsistency between the accounting treatment of internally generated intangibles that are expensed and that of the similarly acquired intangibles which can be capitalized prevents an efficient performance comparison among peers having different innovation strategies in terms of internally generated intangibles or acquired intangibles. For example, the perceived brand value from promotion and advertising was recorded as prepayment to benefit the customer, and concerning supplying goods, a company should recognize a cost in case it has the right of access to those goods under a signed contract and when the goods are effectively available to the firm (a critical condition to expense reporting requirement). Looking deeper into what is disclosed, it is important to notice that, apart from R&D, other categories of intangible costs are often aggregated within large and generic expense items, mainly cost of sales, or selling, general and administrative costs (SG&A). As things currently stand investors cannot understand from the financial statements how much a company is spending on training and education or IT or if a brand value has grown in time or not. Baruch Lev (2018) argues that the antecedents of the intangibles' expensing can be traced back to a 47-year old FASB standard stating the prompt expensing of R&D, which was established before the rise of the disruptive, knowledge-intensive industries of software, biotech, telecom, electronics, and Internet services providers and that was never modified. As a consequence, accounting was never adjusted to reflect the major business value drivers in the new economic reality.

A focus on R&D treatment: expensing vs. capitalizing

Khan et. Al (2018) researched the impact that the FASB standards settled in its first 25 years of life had on the market and discovered that at the top of the standards that lower shareholder value there is the

R&D expensing rule. Earlier changes to the intangible assets accounting treatment occurred in 2001 when IFRS 3 began to require firms to break down the value of purchased intangibles to classify them in five categories, including advertising and promotional intangibles, rather than including them all in the "goodwill" item as it has been done until that moment[24]. Still, the company's value of firms represented in the balance sheet remains incomplete because internally generated intangibles cannot be recorded. Moreover, once intangible assets are recorded, their value can either remain the same or be adjusted downwards in each following year, with no possibility of reflecting any additional value potentially generated from the new handling. One of the greatest disparities in current accounting rules for intangible assets refers to the R&D item. For a major economy such as the United States, accounting rules require R&D to be treated as expenditures in a company's Income Statement (except for software development costs). As previous studies demonstrate, this specific treatment could discourage R&D investments because of the short-term earnings pressure in firms' decisions that leads managers to avoid investing in items that provide benefits only in the long run. On the other side, under IFRS/IAS regime, the alternative accounting treatment for R&D is settled by IAS 38 for the "D" part and implies the capitalization of development expenditure in all the cases complying with specific technical criteria. In other words, IAS 38 allows, under certain circumstances, to classify the "D" part of R&D as an asset rather than a cost, positioning it in the Balance Sheet rather than the Income Statement. The major thrust of the rules is that to capitalize R&D costs, the underlying project must be technically viable, meaning its likelihood to succeed must be high, and economically feasible, in the sense that the likelihood for the project to become commercially successful must be high. As a result of the limiting criteria to grant timely and fair reporting of intangibles, "under" rather than "over" reporting flows into a moral hazard and adverse selection consequence to the investment public. Relatedly, Oswald et al. (2017) studied U.K. companies that shifted from expensing to capitalizing R&D and reported that the firm which adopts the R&D capitalization invested more in R&D[25]. These findings are consistent with the reduced investor's uncertainty about companies' activities and with the lower cost of capital resulting from the capitalization approach. It means that the trade-off between objectivity and relevance is surpassed by R&D capitalization due to its informative value, mostly coming from the breakdown of R&D expenditures into their capitalized versus expensed elements. The study provides supporting evidence to the improvement brought by R&D capitalization to investors' perception, in terms of information and confidence, of R&D as something producing financially and technologically viable projects, the capitalized ones, that are more likely to succeed and reach the market respect to unproved plans. O'Connell et al. (2017) demonstrate the European companies' effort to capitalize successful

[24] Goodwill is the intangible item emerging from the acquisition of one firm by another. It represents the additional part of the purchase price that leads this price to be greater than the one resulting by making the sum of the net fair value of all of the acquired assets and the liabilities included in the process.

[25] Among the main findings from the cited study there is the information benefit of R&D capitalization, which is given by separating the expensed vs capitalized components of cost. By doing so companies can register in the balance sheet those projects that comply with the feasibility requirements. Companies' shift to capitalization by applying IFRS provide new informational content to the market and influence share prices.

development expenditures belonging to the R&D item, in compliance with IAS 38 and illustrate the significant positive relationship between the capitalized component of R&D expenses and the growth in shareholder value.

The constraints of current IAs accounting treatment.

Accounting conservatism over intangible assets limits both listing requirements and the representative and timely disclosure of price-sensitive information required to be gathered by rating agencies. Companies, as well as investors, should be able to measure the left side of the Balance sheet, including both tangible and intangible assets like they do with liabilities. This paper aims at enriching IC literature supporting the inclusion of internally-generated intangibles such as brands and patents on the balance sheet, to expand the limited intangible representation required by accounting standards. As things currently stand, intangible-growing firm's earnings and assets are more likely to be understated and intangible-declining companies 'earnings and assets are more likely to be overvalued. The inability to satisfy users' information has several implications. The first is that the lack of knowledge of the real entity value drivers causes investors to not be able to detect the real value creation process of a company. The consequence of an inaccurate valuation of intangible-intensive entities leads to the following amendments of their stock prices which, in turn, cause substantial losses for uninformed investors. This absence of clarity pushes managers, financial analysts, and auditors toward unethical behaviors. Syed Musa et. al. (2018) organized focus groups and conducted an online survey questionnaire amongst accountants, both academics and practitioners, and scholars belonging to the committees of Islamic financial institutions to analyze the necessity for intangible assets reporting in the context of Islamic finance. Each focus group and online respondents voiced concerns on the adequacy of disclosure of intangible components by corporations and financial institutions. They stressed the necessity for improvement in present accounting regulation and the assurance of fully disclosed and significant information on intangibles to enhance the transparency and decrease the asymmetry which reduces the efficiency of capital markets.

2.5 DISCRETIONARY DISCLOSURE

In this section, I provide insights on the proposals made by practitioners and academics to keep records of the value created by intangible resources by using non-conventional instruments. I hereby present some of these alternative solutions, together with the relative limits.

Alternative solutions to recognize IAs outside conventional reporting statements.

An entire branch of the literature addressing intangible assets accounting issues is dedicated to finding alternative sources of information, like firms' voluntary[26] disclosures or data purchased from private sellers to overcome the intangible reporting deficiencies and to find ways to recognize these assets. The capability of discretionary disclosure to fully reflect the value of intangible assets owned by a firm and to completely get over the financial statements' inability to include intangibles is still hotly debated and previous studies show contradictory evidence. Dumay and Guthrie (2017) studied the IC disclosures carried out by the firms' stakeholders, rather than by companies themselves. These "involuntary disclosures" turned out to be more value-relevant than those made by the companies; nevertheless, the underlying reliability of such involuntary disclosures has been questioned. Syed Musa et. al. (2018) suggested that managers should offer additional narrative information that stakeholders and analysts can easily comprehend to deliver a full picture of the value creation process within the firm and to illustrate the intangibles contribution. At the same time, they recognize that this type of narrative cannot be considered as a solution for the failure in including intangibles in financial reports because additional disclosure for internally generated intangible assets is only voluntary in many jurisdictions, and not mandated by the standards. The presence or the absence of significant intangibles disclosure may have concrete implications on entity market value. For example, Mukherjee and Zambon (2011) analyzed the reporting context of intangibles to understand whether non-financial disclosures of intangibles on the annual report could affect companies' market risk. The study shows that disclosure of intangibles could differ significantly in content and that there is no evidence of any impact on the market risk of the examined pharmaceutical and healthcare firms[27]. The scope of EFRAG's (2018) "better information on intangibles" project is to "foster alternatives to offer more significant information on intangibles in financial reporting", starting by portraying and categorizing intellectual capital elements while underlying both possible uncertainties and benefits in the future. At the core of the integrated reporting (IR) framework, is the concept that firms should amplify their reporting to include any resource they use as input to their business activities. The objective of the integrated reporting (IR) is to provide managers, investors, and stakeholders as a whole with information about various connected dimensions that impact or can be impacted by organizations. Despite issuing an IR is not compulsory in Europe, a growing number of European companies are spontaneously opting for it, at the scope of helping investors and other stakeholders in their decision-making processes. This effort is done with the belief that voluntary reports or disclosures may represent a solution to moderate the under-reporting of intangible assets in financial statements. Some European corporate practices use a wider range of reports including specific voluntary evaluation and reporting of intangible assets to overcome current obstacles to relevant IA information. According to Albertini et al. (2021), since IC is said to be a key driver for future benefits of the firm, IC-related information should logically be included in discretionary

[26] non-GAAP.
[27] However, it must be noticed that this research presents no indication on what the disclosure threshold of intangibles should be in the analyzed sectors to make the companies' IAs disclosure having any significance in terms of impact on market risk.

accounting narratives, more specifically in the CEOs' letters. Their study assumes that the incremental information related to IC contained in discretionary accountings improves the decision-making by investors or other corporate report users. In particular, the choice to focus on the CEOs' letters to shareholders is determined by the fact it represents the most widely read piece of the annual report and has a large audience, as it leads users toward a complex document and can be read by every category of stakeholders. The results of the lexical content analysis of 241 letters by CEOs from companies listed in the S&P Euro 350 highlight how intellectual capital could be better understood through emphasizing firms' discretionary narratives. In their value creation model, CEOs underline four main intellectual capital components: human, customer, environmental and digital capital. With a forward-looking perspective, CEOs illustrate both the business risks and opportunities that they expect to come from IC. Thus, the discretionary narratives of the CEOs' letters are aligned with the EFRAG's (2018) indications to provide more relevant information about internally built intangibles as well as intangibles-related uncertainties that may harm the organization. However, there are some limitations, mainly deriving from the fact that the words used by CEOs are considerably powerful since they need to set the tone at the top of the organization and this type of narrative does not always reflect the underlying actual practices of the firm. Baruch Lev (2018) expresses doubts regarding the possibility to adequately substitute the decreasing usefulness of financial information with discretionary narratives or any alternative information sources. He argues that, if this is the case, analysts should be able to overcome accounting deficiencies. He then shows an increase in the average dispersion of single analysts' earnings forecasts concerning the consensus estimate over a 40-year range. Given that forecast dispersion is a common estimation of analysts' uncertainty about the future performance of the companies, this rise is, at least partly, attributable to the lower quality of financial statements. Baruch Lev (2018) also makes a point of the fact that during the period in which this study highlights the increased analyst's forecast dispersion, there was ample evidence proving that the macro-economic and business uncertainty was lowering rather than rising, given the better economic control by governments and the development of effective risk management and hedging mechanisms by firms, therefore he rejects the assumption that analyst's rising uncertainty can be the result of any turbulent environment surrounding business enterprises, rather than accountings' relevance lost.

2.6 IC AND VALUE RELEVANCE

After treating the accounting issues around the recording of intangible assets in the balance sheet, and after presenting the doubts referred to the discretionary disclosure solutions advanced up to now, the reader can understand the reasons that have led me to the second theme of my research: investigating the relationship between intangible resources and value relevance of accounting information presented in the balance sheets. Concurrently with the rise of intangibles, a general loss in the relevance of

accounting information has been noticed, therefore my interest goes toward understanding whether IC contributes to this decrease.

The crucial role of earnings.

It is quite clear that investors' and managers' attention is centered on earnings, the prime financial report item. Ample evidence suggests that reported earnings are the most extensively used metric of firm performance and logically provide the basis for valuation. Accordingly, analysts build equity valuation models and compute complex systematic investment analysis to foretell short- and long-term earnings, or to supply earnings forecasts and investment recommendations that are all grounded on corporate reported earnings and the related expectations. Managers consider earning as a priority, sometimes even misrepresenting them in financial statements to meet or beat expectations. The media frenzy around the firms' quarterly earnings announcements is a further demonstration of how powerful the role of this item is for investors' and managers' decisions.

IAs contribution to the decrease in earnings reporting quality.

Through his analysis, Baruch Lev (2018) reports that intangibles cause a deterioration in the quality and relevance of reported earnings, representing significant harm to every category of financial report user. His analysis covers the past 60 years and focuses on the relationship between the changes in companies' intangible intensity and earnings and book equity to investors. Results highlight a loss in the relevance of reported earnings occurring concurrently to the increase in intangible intensity[28]. He then points out the importance of the reduced earnings relevance matter by demonstrating how widespread the problem is. The analysis proceeds by showing that during 2016, in the middle of a booming phase for the U.S. economy, 50% of all U.S. firms and almost 70% of high tech and science-based public companies registered reporting losses. Such massive and pervasive losses are not reflective of the actual performance of these companies and for circa 50% of the loss-making high tech and science-based firms, this result was the consequence of the expensing of intangible investments[29]. It's widely accepted that the quality of earnings, namely their capability in predicting future earnings and cash flow, is strictly related to the periodic matching between revenues gained and the costs sustained in the process of value creation. Firms with higher amounts of intangibles have a substantially lower matching than low intangibles firms, and the more frequently the income statements record large intangible expenses, such as IT, R&D, brand enhancements, the more the revenue-cost mismatch broadens because revenues will be recorded only in future periods. This is a major reason for the detriment of earnings quality. This

28 The documented intangibles-induced relevance loss of reported earnings should be of concern not only to their intended users—investors—but also to corporate managers, whose performance is often evaluated by investors on the basis of by reported earnings.
29 Earnings are also an important driver of managers' compensation, and often used internally to evaluate divisional and investment (e.g., M&A) performance. As the relevance of accounting earnings as an enterprise performance indicator falls with intangibles intensity, the usefulness of earnings for managerial compensation and resource allocation falls, too, adversely affecting the quality of the decisions, internal as well as external, taken on the basis of reported earnings.

detaches reality from the ideal world where investors' resources are allocated to the most convincing corporate investment opportunities, so to grant the optimization of capital market allocations in terms of both individual investor profits and overall economic growth. What really happens is that the intangibles accounting, and not intangibles per se, constitute damage to earnings relevance, mostly due to the indiscriminate expensing of almost all the groups of internally-generated intangibles in the income statement.

The value relevance definition.

A more in-depth analysis of the two words composing the term "value relevance" (VR) is necessary. The first represents the price of the commodity, and in accounting, terms refer to the monetary and economic worth of assets, liabilities, and equity. The latter indicates the predictive value of accounting information. Mirza et al. (2019) defined VR as the accounting information capacity to obtain useful data influencing the share price. Most of the prior studies stated the accounting information can be defined as relevant when reflecting the data that stakeholders use to evaluate the company or its market value. Other studies argued that information is considered as value relevant only if associated with the firm value. There is a large consensus in previous literature around the concept of earnings and book value of shares contain most of the useful accounting information to determine firms' value. Many of these prior studies applied Ohlson's (1995) model to quantify the VR of accounting information[30]. Earnings and book value of shares are the pillars of this model, allowing to represent changes in the market value of the firm. Previous research has demonstrated that the higher is VR of accounting information, the more their explanatory power is, and the better stakeholders can exploit them among different environments. Mirza et al. (2019) study the VR of accounting information in the developing country of Malaysia over the period 2012-2016, confirming that earnings and book value of equity, also including cash flow from operations, are useful for the investment decision making process because these components alone can explain 57.10% variation in share prices for listed companies in the Main Market[31].

The intangibles' impact on and value relevance.

In this context, the impact of IAs on VR is seen as one of the most critical issues in the accounting field for several reasons. Many studies argue that the absence of accounting recognition of IAs has adversely affected the value relevance of financial reporting and that the lack of accounting recognition of intangibles as assets harms financial information. Considering Turkish industries such as

[30] Among research applying this model, those centred on IA's value relevance highlight that whether intangible asset-based accounting information offers a high-quality measure of events included in stock prices, it also proves to be value relevant respect to the company's equity and market value.

[31] Furthermore, they highlight a reduction in VR of financial reporting after the adoption of IFRS in Malaysia, hypothesizing that this lowering explanatory power of accounting information may be driven by the fact that Malaysian investors rely more on alternative sources of information to conventional reporting than before.

telecommunications and technology, Ocak and Fındık (2019) analyze the impact of IA[32] and its components on the market value and the sustainable growth of publicly traded companies in Borsa Istanbul from 2005 to 2013. Their findings sustain that IAs representation improves the VR of earnings and that IAs and their components, such as computerized information and databases, give a significantly positive contribution to sustainable growth rates and firm value. In the ASEAN region context, Nimtrakoon (2015) confirms that firms in the technology industry with higher levels of IC generally have a greater market value, with capital employed still maintaining a key role in companies' improvement process. A lively debate in the academic world refers to whether the value relevance of IAs is influenced by the adoption of IAS/IFRS. Evidence is provided from the study conducted by Napoli (2015), from a sample of Italian public firms since 2005[33]. Given that under IAS 38 the capitalization of the development portion of R&D is allowed, the research tests whether its adoption could improve the IAs informative content and VR. Results show a positive and strong association between information on capitalized R&D and share price, meaning intangibles VR rises under IAS and that investors take it into account in their firms' evaluation activity. The study further demonstrates that investors believe that R&D expenses have a greater positive effect on the share price than that produced by other tangible resources. This also means that the missing reporting of R&D, as intangibles generating more future benefits than other assets, plays a major role in broadening the gap between the book and the market value of the Italian sampled firms. A further contribution to the literature addressing the relationship between IA and VR within the IFRS adoption context is given by Cordazzo and Rossi (2020). They analyzed non-financial firms listed on Borsa Italiana during 2000–2015 to explore if the IFRS introduction has somehow influenced the VR of intangible assets in Italy. This study relies on positive accounting theory[34], supporting the association between accounting information announcements and share prices. They aim at understanding the extent to which IFRS adoption changes national accounting systems in countries that previously had conservative, continental accounting frameworks, such as Italy. Results offer evidence of a mixed influence on the effect of mandatory IFRS adoption on the VR of intangible assets. Contrarily to other studies, they discover that IAs as a whole are value relevant only under the Italian GAAP applied before 2005 and that the adoption of a new set of accounting standards reduces the investors' perception of intangibles' informative value. Evidence of a positive effect of the mandatory IFRS implementation is found only in the case of goodwill and R&D expenditures. Moreover, a further classification of firms into intangible-intensive or non-intangible-intensive shows that a residual part of IAs have seen their VR increasing post-IFRS implementation. Thus, the results do not fully support a decline in value relevance over time among intangible intensive firms. From the perspective of investors, some prior studies such as Malikova et al.

[32] In this research IA is reflected according to a specific classification that categorize three main intangible assets classes, namely "Computerized Information and Databases," "Innovative Property," and "Economic Competence."
[33] when IAS was adopted.
[34] Positive accounting is a field of the accounting investigation that aims at illustrating and forecasting real accounting practices. It emerged with academic research widespread during the 1960s, with Ross Watts and Jerold Zimmerman as main representatives.

(2018) found that the IAs have a relevant informational essence for investors, concluding that the information provided by IAs plays a key role in practically defining the impact of intangible resources on the market value of the firm from. Al-Ani and Tawfik (2021) provide supporting evidence for the fact that IAs, together with traditional accounting measures as a whole are value relevant in the Gulf Cooperation Council (GCC) listed non-financial firms. Their findings illustrate how the BVS, and EPS have a positive and significant impact on the market values of GCC firms, with EPS having greater influence than BV. Concerning the VR of IAs, the research demonstrates that by adding IAs to traditional accounting measures, the joint items are more value relevant than traditional accounting measures only or IAs alone. This result implies that intangibles contribute to the improvement in VR of accounting information.

2.7 HYPOTHESES DEVELOPMENT

Following previous literature, this study uses the VAIC model developed by Pulic to measure IC. It is an accessible method for shareholders, managers, and any other stakeholder to oversee and measure companies' IC potential and actual performance. With a focus on the European Market and grounded on the resource-based theory, the first goal of my research is expanding literature on the association between IC efficiency and firms' financial performance, by making a distinction between high intangibles and low-intangibles firms. The second goal of this study is to understand whether IC influences the VR of accounting information and to discover if its impact varies between high- and low-intangible firms in the European market.

First set of hypotheses.

With the belief that value creation requires not only physical capital but also IC[35], I expect to provide supporting evidence to IC being a relevant driver of value generation. Moreover, I assume knowledge-intensive firms with higher levels of IC to be more successful and to reach a higher competitive advantage compared to other firms, regardless of the sector classification. Considering two measures of profitability as proxies for firm performance, the following hypotheses are developed to test the relationship between IC and financial performance:

- H1a. European firms with greater IC (VAIC) tend to have a better ROA than European firms with lower IC levels.
- H1b. European firms with greater IC (VAIC) tend to have a better ROE than European firms with lower IC levels.

[35] In accordance with the resource-based theory.

Guided by Xu and Li (2019), and Xu and Wang (2019), I use the return on assets (ROA) and return on equity (ROE) as proxies for firm profitability. My study continues by analyzing more in detail the extent to which each component of the VAIC model among physical, human, and structural resources, affects corporate performance and value generation. In this regard, Xu and Li (2019) concluded that earnings of Chinese SMEs are significantly influenced by CEE, HCE, and SCE, which proved to be influential value drivers according to their relationship to earnings before interests and taxes (EBIT) and ROA. CEE and SCE are more impactful in non-high-tech SMEs than in high-tech SMEs, while HCE has more influence on high-tech SMEs than on non-high-tech SMEs. The next hypotheses are developed to test the relationship between VAIC components and financial performance:

- H1c. European firms with greater CEE, HCE, and SCE tend to have better ROA than European firms with lower CEE, HCE, and SCE levels.
- H1d. European firms with greater CEE, HCE, and SCE tend to have better ROE than European firms with lower CEE, HCE, and SCE levels.

Xu and Wang (2019) define capital employed (CE) as physical and financial capital. Some empirical studies demonstrated that CEE has a significant positive impact on organizational financial performance. Previous studies show that human capital (HC) plays a prominent role in a firm's value creation and investors embed the HC information into their firm valuation processes. According to Xu and Li (2019), HC can be defined as the set of skills, experiences, know-how, innovation capacities, loyalty and motivation, flexibility, training, and education that people take with them when leaving an organization. Part of this knowledge could be generic, while part is unique to the individual. Oliveira et al. (2020) describe HC as reflecting people and their skills, knowledge, motivation, and experience. Xu and Wang (2019) refer to HC as the sum of employees' competence, knowledge, innovativeness, wisdom, and commitment and discovered the human capital is the major determinant of a firm's future financial performance. Structural capital (SC) provides the conditions allowing an organization to create and influence knowledge. A company with strong SC promotes an innovative environment. According to Xu and Li (2019), SC can be defined as the knowledge owned by the firm at the end of the day and includes the systems, producers, culture databases, organizational routines. Some of these SC elements might be legally secured and become Intellectual Property Rights owned by the firm. Empirically, Ousama et al. (2019) found SC allows securing a proper environment for innovation such as the introduction of new products supposed to enhance the firm's value. Oliveira et al. (2020) define SC as the sum of non-human warehouses of knowledge that a firm owns and associates it with explicit knowledge. Xu and Wang (2019) indicate SC as the component comprising the firm's most relevant strategic assets, like processes, patents, or organizational culture.

The second set of hypotheses.

Since little research has focused on the difference in intangibles' VR between high-intangibles or low-intangibles firms, regardless of their sectors, my second set of hypotheses follows the example of Cordazzo and Rossi (2020) and aims at filling this gap in current literature. I expect that by including IC information in the balance sheets, the value relevance of accounting information increases. I start with the attempt to provide further evidence to validate original Ohlson's (1995) model as a method to test the VR of accounting information, developing the following hypothesis:

- H2a. EPS and BVS explain changes in the share price of the European firms.

Given the mixed evidence addressing the relationship between VR and IAs, my study adds specific insights to this research domain by applying Ohlson's (1995) model to test the extent to which intangible resources can be considered as value relevant within high- and low-intangible listed firms in the European Market. Thus, using the VAIC model as a proxy for intangibles the next hypothesis is built:

- H2b. IAs (VAIC) in high-intangibles European firms can explain changes in the share price better than in low-intangibles European firms.

Following Al-Ani and Tawfik (2021), I add the IAs (VAIC) component to the original Ohlson's model, that is book value of share and earnings per share, to test whether some changes in accounting value relevance occurs by including information on intangibles. This modified version of the model led to developing the following hypothesis:

- H2c. EPS, BVS, and IAs (VAIC) in high-intangibles European firms can explain changes in share price better than in low-intangibles European firms.

To ensure my investigation to be as exhaustive as possible I extend this last hypothesis (H2c) by splitting the VAIC model into its component, CEE, HCE, SCE to examine the contribution of each one to the value relevance of accounting information. Thus, the last hypothesis is built:

- H2d. EPS, BVS, CEE, HCE, and SCE in high-intangibles European firms can explain changes in share price better than in low-intangibles European firms.

3 METHODOLOGY

3.1 SAMPLE DESCRIPTION

My empirical analyses are based on an original sample of 742 publicly traded firms drawn from the Euro Area from 2017 to 2019. I obtained the necessary data from the Orbis database, comprising detailed financial information on more than 400 million companies and entities worldwide[36]. The 3-years sample period has been selected to give more robustness to the analysis, spanning 2017-2019 as it includes the most recent data immediately preceding the Covid-19 pandemic. The health crisis period has not been taken into account to avoid that data related to a state of emergency could bias the examined hypotheses. The majority of existing studies on IAs in the European framework, use market indexes as proxies for the European region, as is the case with the FTSEEurofirst 300 used by O'Connell et al. (2017), or the S&P Europe 350 used by Albertini et al. (2021). Differently, my sample of European market firms is drawn from companies belonging to the Euro Area, with an effort to grant geographical and industrial diversity. Concerning firms' dimensions, this research focuses on medium, large, and very large companies, classified as the European Commission does[37]. I thus comprehend only companies with a minimum of €10 million balance sheet total and a minimum of 50 employees, which is what is required by definition. Moreover, all the firms in my sample apply uniform standards for financial disclosure requirements to be identified as medium-sized. The sample is drawn up with public European companies that comply with IFRS. I chose to include only listed companies to ensure as much publicly and freely available reporting data as possible[38]. For the same reason, I also filter the available companies by selecting those with a greater level of transparency and traceability looking at elements like mail, fax, website, and phone numbers. The sample does not include firms and institutions belonging to banking and financial sectors, such as banks, insurance, and asset management companies, because of their standalone accounting and reporting standards. In addition to financial sector companies, the sample is set without entities using local gaaps and different accounting practices, not IFRS-compliant. This condition was essential to avoid any divergence in accounting representations and to grant that companies' financial statements are all produced under the same terms. For the same reason, the sample does not contain enterprises placed outside the European Economic Area to prevent that a different regulatory framework might have an impact on their disclosures. Finally, the sample has been built without including inactive companies, firms in distress, or under liquidation (losses 75% of capital). The purpose of this avoidance is to spare any distortion to the observed data that may arise from the special condition of firms that are expected to exit from the market. By excluding 275 non-

[36] If interested, please refer to: https://www.bvdinfo.com/en-us/our-products/data/international/orbis.
[37] For more details, please refer to: https://ec.europa.eu/growth/smes/sme-definition_en.
[38] Listed firms are subject to specific reporting requirements that private firms don't have to comply with.

financial firms with missing data for some of the variables I come up with a final sample of 467 companies. Once obtained my final sample, following Xu and Li (2019) and Cordazzo and Rossi (2019), I split it up into two subsamples of high-intangibles and low-intangibles firms, regardless of the industry. Using NACE REV 2 industry classification, and following Baruch Lev (2018), I compute the intangible intensity of every company to categorize each one into the high- or low-intangible subsample. As a first step, for every firm in the original sample, I construct a new variable measured by the ratio of the sum of three balance sheet items, namely "intangibles", "goodwill" and "other intangibles", to total assets. Secondly, I compute the intangible-intensity median for every industry[39]. I then classify each firm as part of the final high or low intangible subsample depending on the company-specific intangible intensity being above or below the respective industry median threshold. Of the total of 490 firm years, the intangible intensity dummy takes on a value of "high-intangible" if the firm is classified above the threshold, as it does for 154 companies (20,41% of the sample), and "low-intangible" if the firm is classified below the threshold, as it does for 367 companies (79,59% of the sample). Table 1 shows the summarized sample composition.

Table 1

Sample reduction action	Number of firms
Panel A: distribution of sample firms	
Population of medium-large firms in the Euo Area	742
Firms with missing data	275
Final firms sample	467
Total firm-year observations	1401[a]
Panel B: distribution of sample firms by firm-type	
Firm- type	
High-intangible firms	154 (20,41)[b]
Low-intangible firms	437 (79,59)
Total firm sample	

Notes: [a] 467 x 3 years = 1401 firm-years; [b] the parentheses are percentage

3.2 VARIABLE MEASUREMENT

This section presents the definition and measurement of all the variables that are present in my research. I will organize the following paragraph taking into consideration the dual purpose of this study. The first objective is to verify whether medium-large-sized firms' success can be attributed to the efficient use of IAs, and, relatedly, if there is any difference between high-intangible and low-intangible firms. The second objective is to examine if the IAs recognized in the balance sheets contribute to increasing the VR of accounting information and if their impact on VR differs among high- and low-intangible

[39] Following NACE REV 2.

companies. With this information, this study can either confirm or contest previous literature that generally indicates a positive relationship between intangibles and firms' performance as well as a positive association between intangibles and VR, especially for high-intangible firms. Under the double nature of this study, I will introduce the variables of my first set of hypotheses primarily and then continue by presenting the variables of my second set of hypotheses.

First set of hypotheses.

a. *Dependent variables.*

   In this research, profitability is used as a proxy for performance and represents the dependent variable of my first set of hypotheses. Following Ousama et al. (2019) it is measured by two conventional financial performance indexes: return on assets (ROA) and return on equity (ROE). ROA is an indicator of how profitable a company is relative to its total assets, and it is measured by net income divided by average total assets[40]. ROE tests how effectively management is using money at the company's disposal, and it is measured by net income divided by shareholders' equity[41].

b. *Independent variables.*

   Keeping in mind that IAs are defined as the IC that a company owns, they represent the independent variable in this research, using the VAIC model (and its components) as a proxy. Developed by the Croatian professor Ante Pulic (2000, 2003, and 2005) [42], VAIC is a frequently quoted IC measurement in the academic field, and it has been used in various studies, such as Nimtrakoon (2015), Dzenopoljac et al. (2016), Ousama et al. (2019), Xu and Li (2019), Xu and Wang (2021). The VAIC model allows assessing the extent to which a company can generate added value based on intellectual capital efficiency or intellectual resources. The main advantages of this model are:

   i. It is easy to apply given it is entirely built based on firms' financial statements items.
   ii. It allocates IC concepts straightforwardly to the domain of company economics, as it generates an unambiguous index by attributing explicit value-added (VA) and capital employed (CE) to both human and structural capital, respectively HC and SC.

   The four variables I start with to compute VAIC are:

   1) CE is interpreted as financial capital such as the book value, computed with the difference between total assets and total liabilities.
   2) HC, which coincides with employees' expenses.
   3) VA determined through the difference between total revenues and total costs.

[40] In other words, ROA tells the amount of profit earned by a company for every unit of its assets (assets includes cash, receivables, PPE, furniture, and inventory. It is expressed in percentage.
[41] In other words, ROE tells whether management is making the firm's value increasing at a sufficient rate. It is expressed in percentage.
[42] Pulic has put forward: The present market value of a company can be estimated on the basis of that company's VAIC value. According to the hypothesis VAIC correlates with a company's stock market value or more generally with its economic performance.

4) SC, estimated with the difference between VA and HC.

Once having these four variables, I can proceed by computing the three VAIC components, which are in turn calculated by three ratios:

1) Capital employed efficiency (CEE) is an indicator of VA efficiency of CE and represents the amount of value created through a monetary unit invested in physical or financial capital. CEE is obtained by dividing VA for CE.
2) Human capital efficiency (HCE) is an indicator of the VA efficiency of HC, which reflects the value a company generates by investing a monetary unit into human resources. It results by dividing VA by HC.
3) Structural capital efficiency (SCE) is an indicator of the VA efficiency of SC, which measures how much value a firm can create using its structural capital and is computed through SC divided by VA.

The sum of CEE, HCE, and SCE finally gives VAIC.

c. Control variables.

This research includes four control variables for each regression model. Following Nimtrakoon (2015), the firm's size (SIZE) is a control variable measured as the natural logarithm of total assets. Owning more resources, large firms are expected to invest a proportionately greater amount of money in IAs than smaller firms. The positive relationship between intangibles and size is supported by prior studies such as Sharma and Dharni (2017) and Malikova et al. (2018). Firms with higher financial leverage are more willing to spend on IAs such as R&D to maintain as well as upgrade their products or services. To control this effect, financial leverage (LEV), measured by the ratio between the book value of debt and equity, is inserted into the equations. Previous literature, including Ousama et al. (2019), estimated a positive relationship between IAs and financial leverage. Revenue growth rate (GROWTH) is also likely to affect the amount of IAs possessed by a firm. It has been included in the regression models, since previous literature, like Chen (2005), shows evidence of IAs' contribution to revenues growth. This variable is computed by taking the difference between total revenues of a certain year minus total revenues of the previous year and dividing it by the total revenues of the previous year. As a proxy of the age of my sample firms, I include a control for the firm's reporting experience (REP_EXP) which indicates the number of years a company has been listed on the market. REP_EXP results from the difference between the last closing year[43], and the IPO date. My research controls for reporting experience because firms that have spent long periods on the market may have a greater experience on how to develop and monitor IAs. According to

[43] For the purpose of my research, I consider 2019 as the closing year.

Nimtrakoon (2015) the age of the sample population may influence IC because, for example, more established companies may have had more time to convert HC to SC.

The second set of hypotheses.

Following Al-Ani and Tawfik (2021), my study tests the VR of accounting information on intangibles through the adoption of Ohlson's model. the VR is measured by the R^2 of this accounting-based valuation approach that expresses the company's stock price (P) as a linear function of its book value and earnings per share, BVS and EPS respectively. Ohlson's model is the best known among the approaches that measure VR. It provides a sound theoretical basis for the market evaluation grounded on essential accounting variables. Indeed, Ohlson's model formalizes the relationship between firm value and: BVS as the basis of fair corporate value; EPS to predict future dividend; other information, that contributes to predicting the firm value, as it is the case with IAs (and the related control variables) addressed in this research. Starting from the original version of the Ohlson model, I will extend it by including IAs in the equations of my second set of hypotheses.

a. *Dependent variables.*

   Coherently with Ohlson's model, the dependent variable used in this research is P, the stock price of the company.

b. *Independent variables.*

   The original Ohlson's model requires two independent variables: BVS and EPS. BVS coincides with the minimum value of a firm's equity and measures the book value of a company on a per-share basis[44]. EPS is a common performance indicator as it represents the economic value that a company creates for each share of its stock, and it is computed by dividing the firm's net income (also called known as earnings or profit) by the overall number of shares outstanding. To test the value relevance of accounting information on intangible resources, my research further includes IAs as the third independent variable in the second set of regression models. As for my first set of hypotheses, IAs are represented through VAIC and its components CEE, HCE, SCE.

c. *Control variables.*

   For my second set of hypotheses, I use the same four control variables of the first set: SIZE; LEV; GROWTH; REP_EXP. The reason relates to their impact over IAs, as previously explained (see First set independent variables). The presence of control variables also addresses the explicit suggestion provided by Al-Ani and Tawfik (2021) to further expand their research by adding control variables that are not included in their work.

[44] BVS is obtained by dividing the overall book value by the number of outstanding shares

3.3 MODEL DIAGNOSTIC

Following Liu and Zhang (2018)[45], I execute some model diagnostic measures to be sure of testing my hypotheses through multiple regression models backed by sound data. I hereby illustrate key assumptions to perform linear regression analysis and the models used to check that they are respected.

1) *Model linearity.*

   Linear regression requires a linear relationship between the independent variables (e.g. VAIC) and dependent variables (e.g. ROA). The linearity assumption can be checked with the residuals over fitted plot and confirmed only where residuals draw no clear pattern.

2) *Multivariate normality.*

   The normality assumption in a linear regression foresees all variables to be multivariate normal. In this regard, the Q-Q plot illustrates whether values in a specific part of the plot differ from the whole linear trend and tests if some values are more or less locally concentrated than what the theoretical distribution would demand.

3) *Absence or limited presence of multicollinearity.*

   In linear regressions analysis, there must be little or no multicollinearity in the data. Multicollinearity occurs when the independent variables show a linear relationship with each other. If it is the case, one explanatory variable can be seen as a linear combination of the other dependent variable. The Variance Inflation Factor (VIF) of linear regression is a commonly used tool to capture the presence of multicollinearity. It quantifies the extent to which the variance (or standard error) of the established regression coefficient is inflated because of collinearity. VIF is computed as 1 divided by Tolerance. In turn, Tolerance is equal to $1 - R_j^2$, where R_j^2 constitutes the unadjusted coefficient of determination[46] for regressing the j^{th} independent variable on the remaining variables. The higher R^2 is, the more of the dependent variables have the power to explain the variance of the independent variable. Generally, a VIF above 4 means that some multicollinearity might exist among dependent variables, but it is when VIF reaches 10 that multicollinearity is ascertained and must be corrected[47]. The multicollinearity threshold is established at the discretion of the researcher, keeping in mind that the more VIF gets closer to 1, the more the multicollinearity assumption can be confidently rejected.

4) *Absence or limited presence of autocorrelation.*

   Linear regression analysis demands no or little autocorrelation in the data. Autocorrelation represents how similar a given time series and its own lagged versions over subsequent time intervals can be. In other words, it gauges the relationship between the current value and the

[45] For further explanation please visit: https://www.tandfonline.com/doi/pdf/10.1080/01621459.2017.1292915?needAccess=true
[46] Unadjusted coefficient of determination = (1- residuals sum of squares) / total sum of squares.
[47] VIF equal to 10 corresponds to R^2 of 90%.

past values of a given variable. It can be measured by performing the Durbin-Watson's d test, with the null hypothesis that there is no linear autocorrelation among the residuals. With d values spanning from 0 to 4, as a rule of thumb if d is included in a 1.5 - 2.5 range it means that data do not show autocorrelation.

5) *Homoskedasticity*.

   Homoskedasticity is a central assumption for the linear regression analysis. It represents the condition in which the error term[48] remains constant across every value of the independent variables. The scale-location scatter plot is a common way to control whether the data are homoskedastic. It shows the fitted values of a regression model on the x-axis and the squared residuals along the y-axis. The assumption holds when the plot shows no clear path among the residuals, that must be randomly scattered around the horizontal red line with an almost equal variability at all fitted values.

6) *Outlier's influence*.

   Outliers are defined as an observation with a large residual, meaning that the observed value that coincides with a given point varies substantially concerning what is expected by the regression model. A common tool to check for outliers through the so-called Cook's distance is the residuals vs. leverage plot. This plot reflects distance along the x-axis and observed value along the y-axis and drafts data points on the model. It is used to understand if there is an observation in the data that significantly influences the result of the esteemed coefficients.

In the following chapter, I will execute these tests for every set of observations in both high- and low-intangibles subsamples, and I will perform a brief analysis to facilitate the reader in interpreting the results of the model diagnostic measures.

3.4 MODEL SPECIFICATION

After investigating previous literature related to intangible assets from different perspectives and after a more detailed description of each variable used in this research, the reader has the instrument to comprehend the hypotheses I am going to analyze. To test both the first and second sets of hypotheses, this study estimates the regression coefficients using multiple regressions. The same models were applied for high-intangible firms and low-intangible firms subsamples. Multiple regression analysis is an expansion of the Ordinary Least Squares (OLS)[49] regression and it is applied where the dependent value is the result of more explanatory variables. My first set of hypotheses examine the difference in the impact of IC on the financial performance among high-intangibles and low-intangibles firms.

[48] Defined as the "noise" in the relationship between the independent variables and the dependent variable.
[49] OLS regression evaluates the parameters in a model by minimizing the sum of squared residuals.

Previous research exploring the relationship in question has found mixed results. Investigating the association between IC efficiency and financial performance, the evidence from Chan (2009) studying listed companies on the Hong Kong Stock Exchange, failed to reveal support for a relationship between IC and financial performance[50]. Xu and Li (2019) found that that firms with a higher IC level will achieve higher performance. Results from Ousama et al. (2019) indicate that the overall IC positively affects banks' financial performance. Models, performed for both subsamples, are presented as follows:

Model (1) and (2) address the VAIC influence over financial performance indicators, ROA and ROE.

$$(1) \quad ROA_{i\,t} = \beta_0 + \beta_1 VAIC_{i\,t} + \beta_2\, SIZE_{i\,t} + \beta_3 LEV_{i\,t} + \beta_4 GROWTH_{i\,t} + \beta_5 REP\_EXP_{i\,t} + \varepsilon_{i\,t}$$

where for firm *i* and year *t*, ROA is the return on assets; VAIC is the Value Added Intellectual Capital coefficient used as a proxy for intangible resources. While performing this regression, as well as the following ones, I will control for the subsequent variables: SIZE is the market capitalization; LEV is the leverage index; GROWTH is revenues growth; REP_EXP is the reporting experience[51], and ε denotes the disturbance.

$$(2) \quad ROE_{i\,t} = \beta_0 + \beta_1 VAIC_{i\,t} + \beta_2\, SIZE_{i\,t} + \beta_3 LEV_{i\,t} + \beta_4 GROWTH_{i\,t} + \beta_5 REP\_EXP_{i\,t} + \varepsilon_{i\,t}$$

where for firm *i* and year *t*, ROE is the return on equity.

Model (3) and (4) break down the VAIC into its three components, CEE, HCE, SCE to further investigate and deepen the analysis of the relationship between IAs and financial performance.

$$(3) \quad ROA_{i\,t} = \beta_0 + \beta_1 CEE_{i\,t} + \beta_2\, HCE_{i\,t} + \beta_3 SCE_{i\,t} + \beta_4 SIZE_{i\,t} + \beta_5 LEV_{i\,t} + \beta_6 GROWTH_{i\,t} + \beta_7 REP\_EXP_{i\,t} + \varepsilon_{i\,t}$$

where for firm *i* and year *t*, CEE is capital employed efficiency; HCE is human capital efficiency; SCE is structural capital efficiency.

$$(4) \quad ROE_{i\,t} = \beta_0 + \beta_1 CEE_{i\,t} + \beta_2\, HCE_{i\,t} + \beta_3 SCE_{i\,t} + \beta_4 SIZE_{i\,t} + \beta_5 LEV_{i\,t} + \beta_6 GROWTH_{i\,t} + \beta_7 REP\_EXP_{i\,t} + \varepsilon_{i\,t}$$

The second set of hypotheses examines the relationship between IC and VR based on Ohlson's model. Evidence from previous literature, such as Cordazzo and Rossi (2019) illustrates that the presence of intangible contributes to increasing the VR of accounting information. By keeping the same control variables used in my first set of hypotheses, in line with Al-Ani and Tawfik (2021) I present my second set of hypotheses is tested using three models, each one performed for both high- and low-intangible firms. The models are presented as follows:

[50] The cited study uses four measures of financial performance: market valuation, profitability, productivity, return on equity. No evidence has been found to support any relevant association between IC and these measures.
[51] All the cited variables are described in detail in Section 3.2.

Model (5) includes only the original components of Ohlson's model, which represents the market value of a company as a linear function of its book value of share and earnings[52].

(5) $$P_{it} = \beta_0 + \beta_1 BV_{it} + \beta_2 EPS_{it} + \beta_3 SIZE_{it} + \beta_4 LEV_{it} + \beta_5 GROWTH_{it} + \beta_6 REP\_EXP_{it} + \varepsilon_{it}$$

where for firm *i* and year *t*, P is the share price at the end of the year; BVS is the book value of the share; EPS is earnings per share.

Model (6) exclusively comprehends intangibles, measured with the VAIC proxy, to estimate the relationship between IAs and the VR of accounting information, using the same control variables of my first set of hypotheses.

(6) $$P_{it} = \beta_0 + \beta_1 VAIC_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 GROWTH_{it} + \beta_5 REP\_EXP_{it} + \varepsilon_{it}$$

Model (7)[53] tests the original components of Ohlson's model, that is BVS and EPS, with the addition of IAs to see if the VR of accounting information changes.

(7) $$P_{it} = \beta_0 + \beta_1 BV_{it} + \beta_2 EPS_{it} + \beta_3 VAIC_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 GROWTH_{it} + \beta_7 REP\_EXP_{it} + \varepsilon_{it}$$

To further developing the analysis, Model (8)[54] is created as an extension of Model (7) to see how much each component of the VAIC model contributes to value relevance.

(8) $$P_{it} = \beta_0 + \beta_1 BV_{it} + \beta_2 EPS_{it} + \beta_3 CEE_{it} + \beta_4 HCE_{it} + \beta_5 SCE_{it} + \beta_6 SIZE_{it} + \beta_7 LEV_{it} + \beta_8 GROWTH_{it} + \beta_9 REP\_EXP_{it} + \varepsilon_{it}$$

4 EMPIRICAL RESULTS

This chapter reports the results of my analysis of IAs' impact on the European firm's financial performance and information VR in the period between 2017 and 2019. I will start by performing the analysis for my first set of hypotheses and I will then compute the same steps for my second set. For both tests, I will begin by presenting the descriptive statistics and performing the checks for data compliance with linear regression assumptions. I will then continue by performing the correlation analysis and finally by running the multiple regression models.

[52] In my research I build Model (5) not to directly address the objective of my analysis, but to confirm the validity of the Ohlson's model so to proceed in testing the relationship between IA and VR with the awareness of being backed by sound method.
[53] Model (7) represents the modified version of the Ohlson model I test in this research.
[54] Model (8) is the extended version of Model (7).

4.1 DESCRIPTIVE STATISTICS

This paragraph summarizes the descriptive statistics of the explanatory variables which relate to companies' financial performance in the first set of hypotheses and the firm's share price in the second set of hypotheses.

First set of hypotheses.

Descriptive statistics are shown in Table (2) for Model (1)-(4). The mean value of ROA is 5,6% meaning that sample companies can generate satisfying levels of profit and that every 100s euro invested in assets generate net income for 5,6, achieving a maximum of 32,9 per unit. The mean value of ROE is and 12,4%, which means that the undertaken European firms can provide acceptable returns for their stakeholders. Considering that good levels of ROE strictly depend on the firm's industry and competitors, results are satisfying with ROE reaching a maximum of 71,8%. The mean values of profitability ratios show a greater ability in making profits concerning what was reported in other research, such as Nimtrakoon (2015), where the mean score of ROA for tech firms is 0,02%. In contrast with Nimtrakoon (2015) and other studies showing a positive VAIC mean, the average score of VAIC is -0,70, revealing that medium-large listed companies in the Euro Area decrease value for -0,70 for every euro spent on intangible resources. Either way, the VAIC has a high standard deviation, meaning that European firms invest in IAs at different levels. As shown by the maximum score of VAIC, intangible resources can contribute to organizational value until a maximum of 71,58 for every additional unit invested in IC. In contrast with Dženopoljac et al. (2016), with CEE being the most impactful of VAIC components for firm's profitability, this research illustrates that among the VAIC components and SCE (mean value of -1,90) has the strongest relationship with financial performance indicators. The negative sign of SCE means that for every additional unit invested in SC, the firm's profitability decreases by 1,90. With the mean value of 0,93, HCE demonstrates to be the VAIC component contributing the most to wealth creation, compared to CEE (mean score of 0,27). Despite HCE mean is lower than means reported in prior studies, such as Xu and Li (2019) and Ousama et al. (2019), this validates their evidence of HC is the most important driver of value creation among the VAIC components[55]. CEE presents a mean value of 0,27 reflecting physical and financial capital, hence the tangible component. HCE and SCE reflect how much value is created by investing in employees and structural capital, hence the intangible assets. The sum of the mean values of HCE and SCE is -0,98, which is lower than the mean of CEE equal to 0,27. The comparison implies that European firms create more value from tangible resources than from intangible assets and IC, in contrast with previous literature, such as Nimtrakoon (2015). Concerning the control variables, the descriptive analysis shows firms having an average size-dummy of 0,89. Firms' size is evaluated as the natural logarithm of total

[55] This may be a preliminary indication of the emphasis that European firms give to the efficient use of HC.

assets; thus the average result is complex to interpret[56]. The high standard deviation of SIZE reflects that firms in the sample vary significantly in size. The sample average LEV is 0,89, showing that sample companies on average make substantial use of debt. The standard deviation in GROWTH illustrates a high variation in sample firm's growth rates, meaning the analyzed companies find themselves at different stages of a firm's life. This is consistent with the results of the standard deviation of REP_EXP: it is shown that the average reporting experience of the examined European firms is 20 years, but sample firms' presence on the market can vary (SD = 11,34), with some companies being more recently listed.

Table 2

Variables	*n*	*Minimum*	*Maximum*	*Mean*	*SD*
ROA	467	-16,810	32,923	5,599	5,976
ROE	467	-77,763	71,797	12,415	14,726
VAIC	467	-100,340	71,581	-0,705	8,309
CEE	467	-0,178	1,741	0,270	0,175
HCE	467	-1,792	39,814	0,934	2,473
SCE	467	-100,359	71,608	-1,909	7,696
SIZE	467	9,612	19,938	13,493	1,954
LEV	467	0,006	7,475	0,891	0,813
GROWTH	467	-0,392	0,976	0,072	0,128
REP_EXP	467	2,504	129,345	20,135	11,335

Financial performance and intangible resources efficiency may differ depending on a firm being high-intangible intensive or not. The two-subsamples t-test is performed to discover whether the mean change across the two groups. Table (3) exposes descriptive statistics for high-intangibles and low-intangibles firms. On average, it is shown that low-intangible firms generate high profitability ratios (ROA and ROE) than high-intangible firms, but with no significant difference among the two groups. Moreover, VAIC finds no statistically significant difference between high-intangibles and low-intangibles has been found. The difference among high- and low-intangible European firms concerning the performance indexes as well as the level of IAs proves to be not as accentuated as expected. This is probably explained by the variety of sectors that each subsample includes, leading to some heterogeneity in the levels of each variable. On average VAIC is shown to decrease the company's worth rather than improve it, with this negative effect being slightly lower for high intangible firms compared to low intangible firms. These results do not support previous studies' findings of IC contributing to a firm's profitability (Nimtrakoon (2015); Xu and Li (2019), Xu (2019); Ousama et al. (2019), despite the damage caused by intangible resources is lower for high- than for low-intangible companies. Coherently, no significant differences are observed in the two subsamples for CEE, HCE,

[56] The mean value of the logarithmic form of total assets cannot be read on a standalone basis.

and SCE. Physical and financial capital is slightly higher in low-intangible firms, while HC is found more in high-intangible firms and SC appears to have a less negative effect over low-intangible firms.

Table 3

Variables	*High-intangible firms*	*Low-intangible firms*	*Difference t-statistic*
ROA	5,130	5,829	0,235
ROE	11,798	12,719	0,526
VAIC	-0,703	-0,706	0,998
CEE	0,270	0,271	0,989
HCE	1,028	0,888	0,565
SCE	-2,001	-1,864	0,856

***Notes** : *p < 0.10; **p < 0.05; ***p < 0.01*

The second set of hypotheses.

Table (4) describes the statistics of the variables in my second set of hypotheses reflected in Model (5)-(8). The mean value of P is positive and equal to 43,90. The mean score of EPS is 5,41, meaning that on average a sample company generates profits for 5,41 relatives to its share price. With a mean of 717,89, BVS is highly above the price of the share in the panel firms, showing that, on average, listed firms in the Euro Area are more likely to be undervalued. The VAIC mean is slightly negative (-0,71), as shown in my first set of regressions represented by Model (1)-(4). On average, for every euro spent on intangible resources, European firms lose worth of 0,71. Either way, the high standard deviation of the VAIC indicates that European firms invest in IAs at different levels. SCE has the greatest effect on European firm's market prices concerning other VAIC components, with a mean value of -1,91. Being negative, on average SC impairs for 1,91 the sample firms' share price for every additional unit they invest in it. In referral to HCE and CEE that have a positive impact on firms' price. HCE shows to contribute the most to raise the share price, with the mean value of 0,93, compared to the positive mean score of 0,27 for physical and financial capital. The mean of HCE supports evidence provided by prior literature, like Xu and Li (2019) and Ousama et al. (2019), highlighting workforce as the most remarkable driver of stock value among the VAIC components[57]. The sum of the mean values of HCE and SCE, the intangible part of VAIC, is -0.98, lower than the CEE mean of 0,27. This evidence suggests that European firms create more stock value using tangible resources than IAs[58]. As described

[57] This may suggest that European companies are expected to attribute more relevance to the efficient use of HC.
[58] As previously demonstrated in Table 1.

in Table 2, the mean values of control variables are: (13,49) for SIZE; (0,89) for LEV; (0,07) for GROWTH; (20,14) for REP_EXP.

Table 4

Variables	*n*	*Minimum*	*Maximum*	*Mean*	*SD*
P	467	0,057	2285,650	43,901	131,649
BVS	467	0,000	329489,292	717,891	15246,610
EPS	467	-17,120	1502,120	5,405	69,684
VAIC	467	-100,340	71,581	-0,705	8,309
CEE	467	-0,178	1,741	0,270	0,175
HCE	467	-1,792	39,814	0,934	2,473
SCE	467	-100,359	71,608	-1,909	7,696
SIZE	467	9,612	19,938	13,493	1,954
LEV	467	0,006	7,475	0,891	0,813
GROWTH	467	-0,392	0,976	0,072	0,128
REP_EXP	467	2,504	129,345	20,135	11,335

The VR of recorded intangibles may differ depending on a firm being high-intangible intensive or not. Table (5) exposes descriptive statistics for high-intangibles and low-intangibles firms. On average, it is shown that low-intangible firms have a high share price than high-intangible firms, but without a significant difference between the two subsamples. Even in the case of EPS and BVS positive mean scores have no significant difference among high- and low-intangible firms. The values of P, EPS, IC and its components that are found in high-intangible firms are similar to those emerging from low-intangible firms. This is probably due to the wide range of sectors composing both subsamples, leading to some heterogeneity in the levels of each variable. Overall findings provide evidence that BVS and EPS positively relate to the share price. On average, EPS has the highest mean in low-intangible firms, 7,31, compared to the 1,52 in high intangible firms. The BVS is below the price of the share in high-intangible firms and above the price of the share in low- intangible firms. In opposition to prior literature such as Al-Ani and Tawfik (2021), in both subsamples, the VAIC shows a negative relationship with the market price. Neither for VAIC nor VAIC components, namely CEE HCE and SCE, any statistically significant difference between high-intangibles and low-intangibles has been found. SCE is the most impactful VAIC component, and its negative influence is more pronounced for high-intangible firms rather than low-intangible firms. On the contrary, HCE is the component with the highest positive influence on price, impacting high-intangible companies more than low-intangible companies. Finally, CEE has a greater positive impact on Low-intangible firms compared to high-intangible firms. However, the overall findings illustrate that VAIC components do not significantly explain changes in the market value.

Table 5			
Variables	*High-intangible firms*	*Low-intangible firms*	*Difference t-statistic*
P	34,842	48,359	0,297
BVS	4,125	1069,073	0,479
EPS	1,524	7,314	0,399
VAIC	-0,703	-0,706	0,998
CEE	0,270	0,271	0,989
HCE	1,028	0,888	0,565
SCE	-2,001	-1,864	0,856

***Notes**: *p < 0.10; **p < 0.05; ***p < 0.01*

4.2 MULTICOLLINEARITY, AUTOCORRELATION RESULTS, AND MODEL DIAGNOSTIC EXAMPLES

The VIF method is applied to compute the multicollinearity check between the performance ratios, respectively ROA and ROE, and the explanatory variable used in Model (1) and (2), namely VAIC. The test is performed by running the relative regressions and using the R^2 to compute the VIF according to the formula explained in paragraph 3.3 Model Diagnostic. The same process is then applied to check for multicollinearity between the performance indicators and the VAIC components in Model (3) and (4). The VIF method is then implemented for Model (5) to (8) respectively reflecting: the original Ohlson's model; the price-VAIC relationship; the Ohlson's model modified by adding VAIC; the extended version of the Ohlson's model with VAIC split into its components. As we can see from Table 6 for the first set of hypotheses and Table 7 for the second set, all the VIFs are below 10, suggesting that, notwithstanding the presence of some multicollinearity is revealed, it is acceptable and doesn't impair this analysis. With a VIF higher than 5, a moderate relationship among exploratory variables is found in the regressions reflecting the association between ROA and VAIC in high-intangible companies (Table 6). Concerning low-intangible firms, VIFs above 6 are found in Table (7) for the association of P with EPS, BVS, and VAIC in the modified Ohlson's model, as well as in the extended Ohlson's model with VAIC components. The last result is coherent with the fact that CEE, HCE, and SCE are all part of the VAIC structure and present higher VIF due to a certain degree of association among each other.

Table (6)			
Models		*ROA*	*ROE*
VAIC	*High-int.*	2,110	1,739
	Low-int.	2,188	1,942
VAIC components	*High-int.*	5,714	4,739
	Low-int.	4,184	4,785

Table (7)

Models	P	
Ohlson's model	High-int.	3,55
	Low-int.	6,13
VAIC	High-int.	1,60
	Low-int.	1,12
modified Ohlson's model	High-int.	3,56
	Low-int.	6,13
extended modified Ohlson's model	High-int.	3,69
	Low-int.	6,13

To check for the absence or limited presence of autocorrelation in Model (1) – (8) I execute the Durbin-Watson's d test by running my regressions. According to the explanation provided in paragraph 3.3 - Model Diagnostic, the findings highlight d values all close to 2, comprised between 1.5 and 2.5. These values allow to safely reject autocorrelation among the residuals, meaning that that the variables are not influenced by their values over time.

Table (8)

Models		ROA	ROE
VAIC	High-int.	1,889	1,961
	Low-int.	1,912	2,026
VAIC components	High-int.	2,084	1,922
	Low-int.	1,979	1,836

Table (9)

Models		P
Ohlson's model	High-int.	1,799
	Low-int.	1,942
VAIC	High-int.	1,866
	Low-int.	1,932
modified Ohlson's model	High-int.	1,790
	Low-int.	1,943
extended modified Ohlson's model	High-int.	1,769
	Low-int.	1,946

As anticipated in chapter 3, I will briefly discuss the model diagnostics tests explained in paragraph 3.3-Model diagnostic. Figures 1.1 (Model 1), 1.2 (Model 2), 1.3 (Model 3), 1.4 (Model 4), 1.5 (Model 5),

1.6 (Model 6), 1.7 (Model 7), 1.8 (Model 8) show the four plots previously mentioned for both high- and low intangible European firms' subsamples: residual vs. fitted plot, Q-Q plot, scale-location plot, and residual vs- leverage plot[59]. Before analyzing the following plots, I wish to remind the reader that the multivariate regression applied in my research is just one of the possible methods to analyze these data. Precisely for this reason, I intend to keep my data as true as possible, without any alteration done with the sole intention of creating a better fit with the linear model chosen in a discretional manner. This way, I safely perform my research with the awareness of keeping my results genuine and authentic. The reader also needs to consider that in the practical application of the linear model it frequently occurs that the stated theoretical assumptions are not fully respected. Similar to Mirza et al. (2019), despite the evidence emerging by the following plots shows the linear model is not the best method to examine these data, I do not apply corrective measures to obtain a better fit for the model. Concerning residual vs. fitted plots, Figures 1.1 to 1.4 related to the first set of hypotheses don't highlight specific patterns in the residuals, meaning that the data can be read through a linear model. For the second set of hypotheses represented in Figures 1.5 to 1.8, the plotted values demonstrate that that linear regression might not represent the most accurate method to analyze these data. The Normal Q-Q plots show no clear results: there are values in some parts of the plots that locally differ from a linear trend. In general, the first set of hypotheses (Figures 1.1- 1.4) looks more normally distributed than the second set (Figures 1.5 – 1.8). The latter has more concentrated points compared to what the theoretical distribution would suggest in that section of the graph. According to Hair et al. (2010), the normality assumption becomes less relevant as the sample size increase. Indeed, the larger is the sample dimension, the higher is its statistical power by diminishing the sampling error. Consistently, it is indicated that a sample size of more than 200, as this is the case, reduces the damaging effect of non-normality, which can be neglected[60]. The scale-location graphs display the more or less accentuated presence of homoskedasticity, given the red line is not horizontal across the presented plots. The figures present residual vs leverage graphs showing few observations with significantly high distance. Nevertheless, excluding outliers by normalizing the data could generate possible unwanted influence on the regression's interpretation as well as cause further outliers. Moreover, the outliers emerging from the data are authentic and taken from the authoritative Orbis source. This evidence constitutes the starting point from which the reader will examine the results of this research over the IAs impact over high- and low- intangible European firms.

[59] Figures 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8 can be found in the dedicated section Appendix – Figures.
[60] The relevance of the normality test mostly lays in the explanatory power of the model in the correlation analysis which follows.

4.3 CORRELATION ANALYSIS

After having described the basic features of the data collected in this research and having performed the check for the assumptions of the linear regression analysis, I will continue my investigation by performing the Pearson's correlation coefficient analysis to test the linear correlation of variables in my first and second set of hypotheses.

First set of hypotheses.

Table 10 illustrates a correlation matrix using Pearson's correlation coefficient analysis[61]. As expected for high-intangible European firms, VAIC has a significantly positive association with both ROA and ROE. These findings are aligned with Ousama et al. (2019) for both firm's profitability indexes and with Xu and Li (2019) for ROA. Regarding the VAIC components in high-intangible companies' subsample, if CEE and SCE are significantly associated with both ROA and ROE, HCE does not expose any significant correlation with the two ratios. By looking at low-intangible firms' subsample, VAIC doesn't prove any significant relationship with ROA and ROE, in opposition with Xu and Li (2019) finding a strong positive association between VAIC and ROA in non-high-tech companies. By breaking down the VAIC index, CEE is the only component statistically and positively associated with both performance indicators, while HCE and SCE are not statistically significant. Evidence from low-intangible firms is coherent with previous studies, such as Xu and Wang (2019) showing no consistent association between VAIC components and the performance ratios ROA and ROE. These associations will be taken into consideration in the multiple regression analyses.

Table 10

Variables	*VAIC*	*CEE*	*HCE*	*SCE*
High-intangible firms				
ROA	0,193**	0,634***	0,1066	0,163**
ROE	0,215***	0,727***	0,0690	0,197**
Low-intangible firms				
ROA	0,0498	0,400***	0,0361	0,0321
ROE	0,0752	0,616***	0,0453	0,0511

***Notes**: *p < 0.10; **p < 0.05; ***p < 0.01*

[61] Pearson's correlation coefficient is the test statistics that tests the statistical association among a continuous variable and another. It is considered the most accurate approach to evaluate the relationship existing among variables of interest, since it is grounded on the covariance. It provides details concerning about the intensity of the correlation, together with the sign related to the association.

The second set of hypotheses.

Table 11 illustrates a correlation matrix using Pearson's correlation coefficient analysis. Consistently with Cordazzo and Rossi (2019), and Al-Ani and Tawfik (2021), for both my subsamples of high- and low-intangible firms BVS and EPS demonstrate to be statistically and positively associated with P, confirming their high explanatory power following Ohlson's model. Unfortunately, no significant association has been found between VAIC and P neither for high- nor for low-intangible firms. Thus, this investigation fails in providing supporting evidence neither to a positive correlation between IAs and share price as shown by Cordazzo and Rossi (2019), nor to a negative association between intangible resources and P as illustrated by Al-Ani and Tawfik (2021) in Kuwait. Regarding the three VAIC components, for both subsamples, none of the CEE, HCE, and SCE results being significantly associated with P.

Table 11

Variables	*BVS*	*EPS*	*VAIC*	*CEE*	*HCE*	*SCE*
High-intangible firms						
P	*0,664****	*0,607****	*0,085*	*0,131*	*-0,048*	*0,104*
Low-intangible firms						
P	*0,166****	*0,198****	*0,040*	*0,030*	*0,002*	*0,042*

Notes *: *p < 0.10; **p < 0.05; ***p < 0.01*

4.4 REGRESSION RESULTS

This section is dedicated to the results of the regression models. As explained in chapter 3 – Methodology, multiple linear regression analysis was applied to examine the relationships between VAIC and its component and the selected ratios of financial performance, as well as the VR of accounting information between high- and low-intangible companies in the European market.

First set of hypotheses.

Table 12 presents the regression results of Model (1)-(2) testing the relationship between intangibles and European firms' financial performance. The first profitability indicator is ROA, addressed by Model (1), which demonstrates a medium fit with an adjusted R^2 of 51 percent in the high-intangible subsample and 53,5 percent in the low intangible subsample. Thus, the first regression model can explain half of all ROA changes in the two subsamples. For high-intangible firms' subsample, VAIC

has a positive and significant effect on ROA at 0.10 (p-value < 0.10) indicating that ROA is determined by VAIC, consistently with Nimtrakoon (2015). This implies that with an additional VAIC unit created by companies in the European market, the firm's ROA is predicted to rise by 0,095 units for high-intangible firms. Concerning low-intangible firms, VAIC doesn't significantly affect ROA. Therefore, the overall results support H1a, with VAIC having a positive influence in high-intangible respect to low-intangible firms where ROA remains unchanged with or without intangible assets. These findings are partially consistent with previous studies like Xu and Li (2019), where it emerges that VAIC increases companies' profitability and that the coefficient of VAIC in high-tech firms is higher than in non-hight tech companies. Model (2) concerns ROE, the second financial performance indicator of my analysis. This model has adjusted R^2 of 40,6 percent for high-intangible firms and 47,7 percent for low-intangible firms, revealing a middle explanatory power in both cases[62]. It shows that the VAIC coefficient is positive and significant just for high-intangible firms at 0.05 (p-value < 0.05), equal to 29,6 (t = 2,17). These findings support H1b, highlighting that with one more unit of VAIC, ROE is expected to rise by 0,296 in high-intangible firms, while leaving it unvaried in low-intangible firms[63]. According to previous literature, such as Ousama et al. (2019), both Model (1) and (2) highlight a significantly positive association between VAIC and company profitability measures, validating the initial discovering in the correlation analysis in high-intangible firms and supporting evidence for H1a and H1b. Additionally, SIZE reveals its positive impact on the performance indexes in both subsamples. LEV demonstrates to have a negative influence over European companies' performance, although non-statistically significant for ROE in high-intangible firms. Also, in this case, my results are aligned with previous research findings provided by Nimtrakoon (2015), Dzenopoljac et al. (2017), Xu and Wang (2019), Xu and Li (2019). GROWTH is positively and significantly related to ROA and ROE only for low-intangible companies, partially confirming previous results provided by Chen et al. (2005) suggesting that firms with greater intangible resources have higher revenue growth rates. REP_EXP shows a statistically negative effect on these ratios just for the high-intangible companies' subsample.

[62] Model two can explain less than a half of variation in terms of ROE in both subsamples.
[63] In other words, IC influence on ROE is higher in high-intangible firms than in low-intangible firms in the European market.

Table 12

	High-intangible firms		*Low-intangible firms*	
	Model (1)	*Model (2)*	*Model (1)*	*Model (2)*
Variables	*ROA*	*ROE*	*ROA*	*ROE*
VAIC	0,095* (1,956)	0,296** (2,170)	0,036 (0,881)	0,126 (1,288)
SIZE	0,617*** (7,067)	1,388*** (5,618)	0,581*** (9,164)	1,123*** (7,410)
LEV	-2,522*** (-3,686)	-2,925 (-1,512)	-2,493*** (-6,341)	-2,323 (-2,465)
GROWTH	0,054 (0,018)	-1,445 (-0,174)	6,685** (2,354)	17,119 (2,515)
REP_EXP	-0,053 (-1,319)	-0,2111* (-1,862)	-0,006 (-0,214)	-0,057 (-0,796)
n	154	154	313	313
R^2	0,526	0,425	0,543	0,485
Adjusted R^2	0,510	0,406	0,535	0,477

Notes *: t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

By breaking down VAIC into its components, Table 13 presents the regression findings of Model (3)-(4), addressing the relationship between CEE, HCE, SCE, and the financial performance of high-intangible and low-intangible European firms. Both regression models have a high-quality explanatory power for high-intangible companies (81,6 percent and 77,9 percent) and low-intangible companies (75,6 percent and 78,6 percent). Looking at high-intangible subsample, Model (3) illustrates that two VAIC components, CEE and HCE are positively associated with companies' ROA, with correlation coefficients of 28,26 (t = 15,86; *p*-value < 0.01) and 0,25 (t = 2,34; *p*-value < 0.05), respectively. For the t-statistics, CEE contribution to the regression model is substantially higher than HCE. Correlation coefficients underline that for every additional unit of CEE generated, ROA of high-intangible firms is expected to increase by 28,26, while for one more unit of HCE created, the firm's ROA is predicted to rise by 0,25 units. It is noted that no statistically relevant association exists between ROA and the third component, SCE. Evidence from high-intangible firms is in line with results provided by Nimtrakoon (2015) and Ousama et. al (2019), namely that companies with greater physical/financial resources and human resources can create more ROA in the European market. Moreover, the HC's positive influence on ROA is consistent with previous studies such as Dzenopoljac et al. (2017). Concerning the low-intangible subsample, ROA is positively and significantly influenced by physical and financial capital, as CEE presents a correlation coefficient of 25,6 (t = 16,73; *p*-value < 0.01). For every additional unit of CE created by firms belonging to the second subsample, their ROA increase by 25,6 units. These results are partially coherent with Ousama et al. (2019), while on the other side, HCE shows no significant association with ROA. As for the first subsample, the empirical investigation has failed in detecting any significant correlation between SCE and ROA in low-intangible firms. In line with previous literature, like Nimtrakoon (2015), Xu and Wang (2019) the overall findings are in favor of H1c stating that VAIC components of high-intangible firms contribute to ROA more than in low-intangible firms in the European Market. In Model (4)'s high-intangible subsample, ROE is determined by the values of physical and financial capital, CE, and structural capital, SC. Indeed, CEE and SCE

have a positive and significant impact on ROE at 0.01 (*p*-value < 0.01) and 0.10 (*p*-value < 0.10), respectively. HCE does not affect ROE. The coefficients of CEE in high-intangible European firms, 80,23 (t = 15.99) are greater than those of low-intangible European firms, 68,53 (t = 21,19). As CEE increases by one unit, ROE is expected to rise by 80,23 in high-, and by 68,53 in low-intangible firms. The only significant coefficient of SCE in Model (4) is 0,18 (t = 1,95) for high-intangible firms, meaning that if SCE rises by one unit, ROE is predicted to rise by 0,18. These findings are consistent with H1d showing that the impact of VAIC components on ROE is greater for high-intangible firms than for low-intangible firms, even if HC is not determinant for ROE in both subsamples, and SC is not impactful on ROE in low-intangible firms' subsample. It is also revealed that for both financial performance indicators CEE is the most relevant value driver, with ROA being positively and significantly influenced by HCE for high-intangible firms without any association with SCE; and ROE being positively and significantly related to SCE in high-intangible firms without any association with HCE. The main conclusion drawn from Model (3) and (4) is that European firms put more emphasis on the return of physical capital compared to structural and relational assets. Confirming results from Model (1) and (2), SIZE reveals its positive impact on the performance indexes in both subsamples of Model (3). LEV negatively impacts influence over both European companies' performance indexes. GROWTH is positively and significantly related to ROA and ROE at 0,05 (*p*-value < 0.01) only for low-intangible companies. REP_EXP statistically and negatively influence ROE in high-intangible companies subsample only.

Table 13

	High-intangible firms		*Low-intangible firms*	
	Model (3)	*Model (4)*	*Model (3)*	*Model (4)*
Variables	*ROA*	*ROE*	*ROA*	*ROE*
CEE	28,263*** (15,860)	80,234*** (15,995)	25,604*** (16,730)	68,526*** (21,195)
HCE	0,254** (2,344)	0,309 (1,013)	0,045 (0,455)	0,088 (0,424)
SCE	0,035** (1,103)	0,176* (1,952)	0,001 (0,041)	0,042 (0,610)
SIZE	0,153 (2,477)	0,123 (0,707)	0,2161*** (4,230)	0,154 (1,424)
LEV	-4,932*** (-11,053)	-9,637*** (-7,672)	-5,0852*** (-15,664)	-9,252*** (-13,489)
GROWTH	-1,015 (-0,564)	-4,676 (-0,923)	4,248** (2,057)	10,603** (2,431)
REP_EXP	-0,015 (-0,619)	-0,117* (-1,679)	0,016 (0,739)	0,004 (0,091)
n	154	154	306	306
R^2	0,825	0,789	0,761	0,791
Adjusted R^2	0,816	0,779	0,756	0,786

Notes *: t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

The second set of hypotheses.

Table 14 presents the regression results of Model (5) reflecting the original Ohlson's model. As it is seen from the adjusted R^2 equal to 70,7 percent for high-intangible firms and 83,3 percent for low-intangible firms, the model has a high degree of fit[64]. Evidence provided in Table 14 demonstrates that EPS and BVS have a significant impact on VR in both high- and low-intangible firms at 0.01 (*p*-value < 0.05). The VR of accounting information as EPS and BVS, represented by unadjusted R^2, reaches 71,8 percent for high-intangible firms, and 83,7 percent for low-intangible firms. It means that the two independent variables, jointly explain variation in share prices of European public firms for 71,8 percent and 83,7 percent, respectively. In line with previous studies, like Mirza et al. (2019), there is a significantly positive association between EPS and P, as shown by the correlation coefficients of 7,22 (t=11,31; *p*-value < 0.01) for high-intangible firms, and 21,39 (t = 36,56; *p*-value < 0.01) for low-intangible firms. For every additional unit of EPS created, the value relevance of the information contained in P increase for 7,22 and 21,39 respectively. Consistently with Mirza et al. (2019), Cordazzo and Rossi (2019), and Al-Ani and Tawfik (2021), the association between BVS and P is significant and positive for high-intangible firms, with a correlation coefficient of 0,90 (t = 8,45; *p*-value < 0.01). However, in opposition with prior literature, for low-intangible firms, the relationship between price and BVS is significantly negative, with a coefficient of -0,096 (t = -36,06; *p*-value < 0.01). Thus, for every additional unit of BVS generated the value relevance of accounting information reflected in P increases of 0,90 for the first subsample and a decrease of -0,096 for the second subsample. For both subsamples, from the t-statistic, it emerges that EPS contribution to the regression model is greater than that of BVS. This evidence implies investors pay attention to earnings because they are the ultimate drivers of stock prices[65]. For BVS, the share price is improved in the case of high-intangible firms and reduced in the case of low-intangible firms. In the last case, given low intangible firms are the most profitable of the two subsamples, the negative sign is probably caused by the accounting practices according to which tangible resources are measured at cost and that these firms are undervalued by the market. The overall findings provide support to H2a, which validates the original Ohlson's model[66]. Focusing on the control variables SIZE positively affects P at 0,05 (*p*-value < 0.01) for high-intangible firms, whereas it is not significant for the other subsample. GROWTH is positively and statistically associated to P at 0,10 (*p*-value < 0.10) for high-intangible firms and 0,05 (*p*-value < 0.01) for low-intangible firms. LEV and REP_EXP reveal no relevant influence over P.

[64] In other words, the regression presented by Model (5) can explain the 70,7 percent for high-intangible firms and 83,3 percent for low-intangible firms of changes in share price by using EPS and BVS, after controlling for enterprise size, leverage, growth rate, and reporting experience.
[65] the higher the EPS, the higher the P.
[66] This way I can go on with my analysis by having proved the soundness and consistency of the model I have chosen to assess the relationship between IAs and VR.

Table 14		
	High-intangible firms	*Low-intangible firms*
	Model (5)	*Model (5)*
Variables	*P*	*P*
BVS	0,904*** (8,454)	-0,096*** (-36,056)
EPS	7,216*** (11,313)	21,385*** (36,565)
SIZE	1,373** (2,363)	-0,964 (-1,305)
LEV	-4,491 (-1,031)	3,654 (-0,797)
GROWTH	34,210* (1,839)	69,9819** (2,1203)
REP_EXP	0,144 (0,568)	-0,052 (-0,149)
n	154	313
R^2	0,718	0,837
Adjusted R^2	0,707	0,833

***Notes** : t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

Table 15 presents findings of regression analyzed by Model (6) that addresses the value relevance of IAs accounting information. In general, the explanatory power in Model (6) is poor for high-intangible firms, with a fit[67] of 35,3 percent, and close to zero for low-intangible firms (0,097)[68]. The VR of accounting information related to intangible resources is represented by unadjusted R^2 and equals 37,4 percent for high-intangible firms, and 11,1 percent for low-intangible firms. Consistently with Al-Ani and Tawfik (2021), this suggests that conventional accounting information without intangibles (EPS and BVS) are value relevant to investors in their decision-making process and explain a much greater portion of the market value compared to IAs. Findings show VAIC to have no significant effect on the relevance of accounting information contained in P for both high- and low-intangible firms' subsamples. This result indicates that stakeholders don't account for intangible resources as a reliable signal for equity valuation and investment decision-making. Since intangible resources do not improve the VR of accounting information, H2b is rejected[69]. Similar findings are obtained by Al-Ani and Tawfik (2019) for listed firms in the Gulf Cooperation Council area. Concerning control variables, in high-intangible firms' subsample the relationship between SIZE and P is positive and statistically significant at at 0,01 (p-value < 0.01), while LEV has a negative and significant influence on P at 0,10 (p-value < 0.10). In low-intangible firms subsample GROWTH positively impacts share price at 0,10 (p-value < 0.10).

[67] Represented by adjusted R^2.
[68] In other words, IAs information are not able to explain variations in share price at a satisfying level.
[69] The assumption that IAs' explanatory power of share price variations is greater in high-intangible firms rather than low-intangible firms in the European market cannot be validated since no subsample show any statistically significant relationship between VAIC and VR.

Table 15		
	High-intangible firms	*Low-intangible firms*
	Model (6)	*Model (6)*
Variables	*P*	*P*
VAIC	0,379 (0,832)	0,695 (1,050)
SIZE	3,488*** (4,259)	2,342 (1,367)
LEV	-12,066* (-1,881)	-11,112 (-1,045)
GROWTH	12,918 (0,469)	127,267* (1,658)
REP_EXP	-0,073 (-0,193)	1,050 (1,306)
n	154	313
R^2	0,374	0,111
Adjusted R^2	0,353	0,097

Notes *: t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

Table 16 presents findings of regression analyzed by Model (7) addressing the association between share price (P) and EPS, BVS, and IAs accounting information. The overall model has a high fit of 70,5 percent for high-intangible firms and 83,3 percent for low intangible firms. Consistently with Al-Ani and Tawfik (2019), the unadjusted R^2 increased in high-intangible firms from 71,8 percent to 71,9 percent, which means that VAIC inclusion provokes a slight implementation to conventional accounting information so that the changes of P are better in Model (7) than in Model (5). On the other side for low-intangible firms the unadjusted R^2 remains the same (83,7), meaning that the explanatory power of accounting information does not improve by including IAs. For both subsample EPS has a significantly positive effect on P at 0,01 (p-value < 0.01), with correlation coefficients of 7,21 (t = 11,27) and 21,92 (t = 36,49). It means that by every additional EPS generated, P increases by 7,21 in high-intangible firms and 21,92 in low-intangible firms. The relationship between BVS and P is significantly positive for high-intangible firms' group, with a coefficient of 0,90 (t = 8,38; p-value < 0.01) and significantly negative for low-intangible companies, with a coefficient of -0,096 (t = -35,98; p-value < 0.01)[70]. One more unit of BVS leads the price to rise by 0,90 in the first case and to diminish by 0,096 in the second case[71]. For both subsamples, from the t-statistic, it emerges that EPS contribution to the regression model is greater than that of BVS. As illustrated in Table 15, the association between VAIC and P proves to be non-statistically significant for both subsamples, meaning that investors don't consider IAs information in their decision-making process neither for high- nor low-intangible companies. Findings do not support previous literature, neither like Cordazzo and Rossi (2019) sustaining IAs and stock prices to be positively and significantly correlated in intangible-intensive firms nor like Al-Ani and Tawfik where IAs have a negative influence over P. These results are not sufficient to confirm H2c

[70] As for results emerging from Table 14, the negative sign is probably caused by the accounting practices according to which tangible resources are measured at cost, leading to an undervaluation of these firms.
[71] Again, the significant but opposite effect of BVS on share price in high- and low-intangibles European firms found by Model (5) is confirmed in Model (7).

because, despite the small rise in the overall accounting information quality of high-intangible, the share price is not affected by IAs. Concerning SIZE and GROWTH Model (7) illustrate the same evidence previously provided by Model (5), while no significant relationship is identified from the other control variables.

Table 16

	High-intangible firms *Model (7)*	*Low-intangible firms* *Model (7)*
Variables	*P*	*P*
BVS	0,899*** (8,384)	-0,096*** (-35,976)
EPS	7,210*** (11,273)	21,917*** (36,489)
VAIC	0,173 (0,561)	-35,976 (-0,262)
SIZE	1,341** (2,292)	-0,981 (-1,3216)
LEV	-4,447 (-1,018)	3,701 (-0,806)
GROWTH	34,396* (1,845)	69,865** (-2,113)
REP_EXP	0,169 (0,652)	-0,047 (-0,134)
n	154	313
R^2	0,719	0,837
Adjusted R^2	0,705	0,833

***Notes** : t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

Table 17 presents findings of regression analyzed by Model (8), which expands of Model (7) by decomposing VAIC and examining the relationship between P and BVS, EPS, CEE, SCE, and HCE. The adjusted R^2 is high and equal to 71,3 percent and 83,2 percent respectively for high- and low-intangible firms. It indicates that the model explains potential variations in European companies' share price for 71,3 percent in the first case and 83,2 percent in the second case. The VR ranks 72,9 percent for high-intangible firms and 83,7 for low-intangible firms. As for Model (7), EPS is positively and significantly related to P, with a coefficient of 7,08 (t = 11,17; *p*-value < 0.01) for high-intangible firms and 21,43 (t = 36,33; *p*-value < 0.01) for low-intangible firms. Thus, for every additional unit of EPS, the share price of European firms improves by 7,08 and 21,43, respectively for the first and the second subsample. The association between BVS and P is significant and positive for high-intangible firms, with a correlation coefficient of 0,93 (t = 8,67; *p*-value < 0.01) whereas is significant and negative for low-intangible firms with a coefficient of -0,096 (t = -35,82; *p*-value < 0.01)[72]. Each additional unit of BVS improves P by 0,93 for the first subsample and diminishes P by 0,096 for the second subsample. This reflects investors evaluate both EPS and BVS when making investment decisions in high intangible firms. both subsamples. Concerning VAIC components, with a coefficient of 40,51 (t = 2,20), CEE is the only component having a significantly positive association with P at 0.05 (*p*-value < 0.05) just for

[72] As for results emerging from Table 14, the negative sign is probably caused by the accounting practices according to which tangible resources are measured at cost, leading to an undervaluation of these firms.

high-intangible firms' subsample. The t-statistics highlight that EPS contribution to the regression model is greater than that of BVS and CEE in the case of high-intangible firms, and greater than BVS in the case of low-intangible firms. For both subsamples HCE and SCE have a no-statistically significant influence on P. Being CEE the physical and financial part of VAIC, findings demonstrate once again that investors do not consider IAs in their investment decisions within the European market context. Whether emerging evidence shows that the VAIC implements the overall VR of accounting information in high-intangible firms, the only component contributing is CEE representing physical capital. This evidence leads to rejecting H2d. In respect to the control variables, LEV has a negative effect on P at 0,10 (*p*-value < 0.10) for high-intangible firms, GROWTH positively influence P in both subsamples at 0,10 (*p*-value < 0.10) and at 0,05 (*p*-value < 0.05), respectively.

Table 17

Variables	*High-intangible firms Model (7)* P	*Low-intangible firms Model (7)* P
BVS	0,929*** (8.658)	-0,097*** (-35.820)
EPS	7,083*** (11.166)	21,432*** (36.333)
CEE	40,514** (2.198)	-20,777 (-0.841)
HCE	-0,719 (-0.648)	-0,170 (-0.108)
SCE	0,202 (0.617)	-0,093 (-0.180)
SIZE	0,847 (1.284)	-0,690 (-0.837)
LEV	-7,636* (-1.660)	5,825 (1.109)
GROWTH	32,217* (1.747)	71,707** (2.160)
REP_EXP	0,173 (0.672)	-0,066 (-0.190)
n	154	313
R^2	0,729	0,837
Adjusted R^2	0,713	0,832

***Notes** : t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

5 DISCUSSIONS

To sum up, the first objective of my research is to explore the relationship between VAIC and its components and the financial performance of European listed companies. More specifically, I assumed that intangible resources have a positive influence on a firm's financial performance and that this effect is more pronounced in high-intangible firms than in low-intangible firms. I proceeded by building four regression models addressing two profitability ratios: ROA and ROE. Model (1) tests the relationship between VAIC and ROA. Model (2) explores the association between VAIC and ROE. By dividing

VAIC into its components, Model (3) examines the link between CEE, HCE, and SCE with ROA, while Model (4) assesses the correlation between CEE, HCE, SCE, and ROE. The second objective of this study is to evaluate the VAIC contribution to the VR of accounting information in European listed firms. In particular, I assumed that intangible resources implement the quality of accounting information and that this effect is more pronounced for high-intangible firms than low-intangible firms. I continued by constructing four regression models following the approach established by Ohlson (1995). According to previous studies such as Al-Ani and Tawfik (2021), my analysis proceeds progressively. Model (5) validates the original Ohlson's model testing the relationship between P, EPS, and BVS. Model (6) explores the association between VAIC, and P. Model (7) presents a modified version of Ohlson's model by testing the link between EPS, BVS, VAIC and P. Model (8) represents an extended version of Model (7) examining the correlation between BVS, EPS, CEE, SCE HCE and P. While performing my regressions, I controlled for the firms' size, leverage index, revenues growth, and age. Concerning my first set of hypotheses, the first findings from the European market demonstrate that VAIC significantly improves ROA and ROE in high-intangible firms, while leaving the same indexes unaltered in low-intangible firms. Consistently with the resource-based theory, intangibles reveal to be a key driver of profitability for firms making extensive use of IC. On the other side, IAs are non-determinant to profits of brick-and-mortar European firms, that exclusively derive from tangible assets. Focusing on VAIC components, evidence from Model (3) and (4) shows that CEE significantly contributes to ROA and ROE in both subsamples. Just for high-intangible European firms, evidence shows ROA being positively affected by HCE, while ROE results improved by SCE. For both subsamples, the research fails to detect any relevant association between ROA and structural capital as well as ROE and human capital. This mixed evidence leads to the less preferred, yet reliable conclusion that CEE remains the most relevant value driver for the two chosen ratios of financial performance. Concerning my second set of hypotheses, evidence from Model (5), Model (7), and Model (8) further validate the original Ohlson's model, demonstrating that EPS and BVS have a significant impact on VR in both high- and low-intangible firms. The positive association between P and EPS, confirms that companies producing higher earnings are those in which stakeholders aim at investing[73]. On the one hand, BVS significantly improves P in high-intangible European firms, indicating that the value of their assets overcomes that of liabilities. On the other, BVS significantly reduces P in low-intangible firms. Given this last subsample is the one with the highest means of ROA and ROE, as shown by the 4.1 Descriptive Statistics section, the negative impact of BVS on P is not necessarily a negative signal. Indeed, it probably results from how tangible resources are recorded on the balance sheet, namely at cost, that does not make these items updated enough to be considered useful by investors. Examining the relationship between VAIC and P, this research fails to detect any significant correlation in both high- and low-intangible firms' subsamples. The difference among the two subsamples concerning the

[73] Investors accept to pay higher prices for a company's shares when they are convinced that it generates greater profits respect to its share price, as well as if they expect the company to be profitable in the future.

magnitude of IAs' impact on VR in the European market proves to be not as accentuated as expected. In other words, IC's inability to explain changes in share price is registered for high-intangible firms as much as for low-intangible firms. This might result from the variety of sectors included in both subsamples: the intangibles-intensity medians associated with every sector take values that are substantially different from one another, provoking some heterogeneity. Analyzing the modified version of Ohlson's model by including IAs, Model (7) and (8) show that, despite the absence of significant association between VAIC and P for both subsamples, the unadjusted R^2 is slightly higher with the presence of IAs for high-intangible firms[74]. However, deepening the analysis by decomposing VAIC, CEE reveals to be the only element having a significant and positive association with P for high-intangible firms' subsample. This is the only reason for the rise in value relevance of accounting content, highlighting that the variations in P are better explained by conventional accounting information rather than IAs. No homogeneous evidence concerns the control variables. Interesting findings indicate that a firm's SIZE and LEV are significant control variables for most regression models. Consistently with Dabic et al. (2018), SIZE is positively correlated with a firm's performance ratios and with the share price. Firms with greater dimensions usually dispose of more resources that allow the achievement of substantial profits. LEV negatively influences both ROA and ROE in the European market, with a less pronounced detrimental effect on the share price. This reveals an excessive use of financial debt by European firms causing the inability of acquired resources to earn more than the cost at which they were purchased, leading to the deterioration of firm's profitability and value. GROWTH is positively and significantly correlated to European companies' performance indicators in low-intangible firms only while demonstrating a stronger correlation with share price for both subsamples[75]. REP_EXP, the proxy of a firm's age is the variable with the less significant control impact. Concerning the first set of multiple regression analyses, my four hypotheses can be said to be validated. IC has a greater influence on high than on low- intangible firms' performance, confirming H1a and H1b. CEE implements European firms' ROA and ROE in both subsamples. Only in the case of European high-intangible firms, HCE proves to increase profitability acting over ROA, whereas SCE reveals to favor profitability acting over ROE. Thus, H1c and H1d are partially confirmed. The major conclusions highlighted from the second set of regression models relate to further confirmation of the viability of Ohlson's model, thus supporting H2a. Given the little value relevance for IAs information and the absence of a significant correlation between VAIC and P, it follows that H2b is rejected. The modified Ohlson's model reflects that IAs inclusion in the balance sheets still determines a slight increase in their reporting quality for high-intangible firms. However, the VAIC decomposition reveals that CEE is the only component influencing the share price. Unfortunately, this evidence is not sufficient to support H2c and H2d.

[74] In other words, for this subsample, it appears that the VAIC inclusion provokes a little implementation to conventional accounting information.
[75] Investors are more incentivized to spend their resources on firms that are expected to grow in revenues, thus causing a rise in the share price.

Contributions.

Considering the current global environment, this research aims at putting the right emphasis on the IC theme, enriching the IC literature regarding the relationship between IAs and firms' performance as well as information reporting quality. Some contributions are provided. First, an effort has been made to focus on the European market as a whole in 3 years rather than on a specific country, or sector, or year to make results more solid and consistent. Second, to reflect the European market, this study selects companies from the Euro Area applying IFRS rules to ensure uniformity in accounting practices and to avoid reporting interpretation discrepancies. Third, this study contributes to filling the literature gap in the analysis of potential differences in IAs' impact between high- and low- intangible firms, regardless form the industry. Fourth, I expand my research by exploring each VAIC component, human, structural and employed capital, rather than just considering IAs as a whole. Fifth, following suggestions from Dabic et al. (2018) and Al-Ani and Tawfik (2021), I examine the relationship between IAs and financial performance or VR by including control variables to improve the regression models, assuming size, leverage, revenues growth, and reporting experience to have a potential influence on the dependent variables. Finally, academically speaking, evidence in this study supports the resource-based theory by showing that European firms achieve a competitive advantage through intangible assets together with traditional resources.

Suggestions.

The evidence contained in this analysis supports prior literature considering IAs as a driving force for the financial performance of European firms. Examples are Nimtrakoon (2015), Xu and Wang (2019), Xu and Li (2019), Ousama et al. (2019). With this evidence, my study aims at encouraging European entities to include IC in their investment planning, since intangibles proved to be relevant to companies' value creation. In general, both high- and low-intangible firms still focus on physical and financial capital to make a profit. Consistently with other studies such as Dzenopoljac et al. (2016) and Xu and Wang (2021), this should incentivize managers to focus on the optimization of tangible resources to reach a greater competitive advantage. Also, investors should interpret this evidence in support of investing in tangible-driven companies that are still the most profitable and those more likely to be undervalued due to the representation of assets at cost in the balance sheets[76]. A partial contribution is given to research, like Nimtrakoon (2015) and Xu and Wang (2019), supporting the positive influence of human resources over ROA. This should encourage managers of high-intangible European firms to invest more in HC to supply the right basis for employees to strengthen their expertise and knowledge. Findings should also drive policymakers to introduce more training programs for employees and raise awareness of the IC's importance. In addition, high-intangible firms in the European Market should pay

[76] This accounting practice register the assets at their original cost, so in time this information lose its usefulness and does not reflect the actual value of the resources.

more attention to optimize structural capital by implementing more instruments and practices to allow knowledge to be as absorbed, shared, and applied as possible. This study fails to support previous literature such as Ocak and Fındık (2019), Cordazzo and Rossi (2019), and Al-Ani and Tawfik (2021) since results illustrate IAs to neither provoke rises in the predictability of future earnings nor increase the accounting information quality. It emerges that the only accounting information capable to explain variations in the market value of European listed companies are the traditional items and that investors don't account for IAs as value relevant informational content, conducting their investment decisions just based on traditional resources. This study brings attention to the inconsistency between the fact that investors do not consider IAs information in their investment decisions and the fact that IAs currently represent an increasingly recognized value driver to firms' success. This situation may be attributed to the lack of trust of intangible representation in financial statements and the perceived information risk in IC disclosures. However, investors need to overcome the uncertainty around IC and examine the value creation ability of the companies' IC if they want to properly select firms in their portfolio[77]. For this reason, from the perspective of accountants, it is possible to reduce investors' doubts by improving the way IAs are reflected in the financial statements. From the policymakers' point of view, concrete attempts to change traditional accounting rules should be done since their structure is no longer suitable to reflect value which is more and more driven by IC.

Limitations.

This research presents some limitations that don't allow findings to be generalized. The first lays in the research design, which is not grounded on sophisticated statistical models. The multiple regression method is a discretionary choice that proves to have a limited fit with my sample data. Consequently, evidence needs to be interpreted very carefully. The second major limitation relates to the fact that the threshold dividing my two subsamples has no absolute basis. On the contrary, the division between high- and low-intangible firms is strictly dependent on the specific companies included in my sample because the threshold determining whether a firm belongs to the first or the second subsample is built on the accounting information of the chosen companies. In other words, by picking up different firms with different accounting information, the threshold might change and the firms belonging to the two samples might change too. The fourth limitation is related to the choice to represent IC using the VAIC method. Some scholars criticize this model because of reflecting the efficiency of human resources and capital invested rather than that of IC, and because it is based on information coming from financial statements, without accounting for relational capital or synergies among assets.

[77] Long-term investments, either of tangible or intangible nature, should not escape investors' control.

Further analysis.

My analysis can be considered as a starting point for further investigations on the IC. It might be interesting to deepen the assessment of the IAs' impact on firms in the European Market using more sophisticated statistical methods. Always looking at the European Market, further analysis could address the IC influence over SMEs rather than medium-large sized firms. The IC effect on firms' performance could be examined not only from the profitability point of view but also by looking at companies' earnings or efficiency. Given all European companies in my sample are IAS/IFRS-compliant, another interesting theme would be to study whether IFRS has a positive or negative impact on IAs representation in conventional financial reporting compared to other accounting practices. Finally, an additional investigation should address the relationship between IAs and earnings' quality. Given this research support previous literature highlighting that the earnings, together with the book value of shares, contain most of the useful accounting information to determine firm's value, and considering the earnings deterioration trend of recent years, it would be interesting to understand if the way IAs are reported in the financial statement contributes to the reduction in earnings relevance.

6 CONCLUSIONS

My empirical analysis addresses the intellectual capital of companies in the European market, meaning intangible resources, to examine: 1) IC relationship with the financial performance of firms; 2) IC contribution to the value relevance of accounting information. By picking the necessary data from the Orbis database, I build my original sample of 742 publicly traded firms drawn from the Euro Area from 2017 to 2019. To address the IC topic, I also divided my sample into high- and low-intangible firms to see whether substantial differences exist among these groups regarding the influence of IAs. I conduct my research by establishing two sets of hypotheses, containing four multiple regressions each. Following previous literature, such as Nimtrakoon (2015), Dzenopoljac et al. (2016), Xu and Wang (2019), Xu and Li (2019), Ousama et al. (2019), I apply the VAIC index as a proxy of IC, benefiting from its wide applicability and data availability. My first set of hypotheses uses profitability indexes, namely ROA and ROE, to assess the difference in the impact of IC on the financial performance among high-intangibles and low-intangibles firms. My second set of hypotheses applies Ohlson's model to test the relationship between IC and VR between high-and low-intangible firms, according to previous studies such as Mirza et. al (2019), Ocak and Findik (2019), Cordazzo and Rossi (2019), Al-Ani and Tawfik (2021). Evidence from my first set of hypotheses suggests that IC significantly improves ROA and ROE in high-intangible European firms. CEE is the main value driver among the three VAIC components to the two profitability ratios in both subsamples. Just for high-intangible European companies, evidence shows that ROA is positively affected by human resources, while structural

resources improve ROE. What emerges from my second set of hypotheses is that EPS and BVS have a significant impact on VR in both high- and low-intangible firms, further confirming the validity of the original Ohlson's model. The association between share price and EPS proves to be positive, while BVS significantly improves P in high-intangible firms and reduces P in low-intangible firms. This research fails to detect any significant IAs influence on the accounting information contained in P for both high- and low-intangible firms' subsamples. The unadjusted R^2 representing the quality of accounting information slightly increases for high-intangible firms by including IAs to the traditional accounting information, whereas for low-intangible firms the unadjusted R^2 remains the same. This increase is due to the influence of CEE, the only VAIC component significantly improving P. On one side, I conclude this analysis by sustaining IC's positive influence on the financial performance of intangible-intensive firms in the European market, thus encouraging these firms to invest more into human and structural resources. On the other side, I complete my research discovering the absence of any relevant relationship between IC and financial reporting quality. In today's more and more digitalized global environment, variations in European firms' share price are still exclusively explained by traditional resources, therefore my findings aim at promoting changes in the conventional reporting to allow an adequate inclusion of IC value in the financial statements.

REFERENCES

1. Al Ani M., & Tawfik O. (2021). *Effect of Intangible Assets on the Value Relevance of Accounting Information: Evidence from Emerging Markets*. Journal of Asian Finance Economics and Business Vol. 8, No. 2, pp. 387 – 0399.

2. Albertini E., Berger-Remy F., Lefrancq S., Morgana L., Petkovic M., & Walliser E. (2021). *Voluntary disclosure and intellectual capital: how CEOs mobilize discretionary accounting narratives to account for value creation stemming from intellectual capital*. Available on Emerald Insight at: https://www.emerald.com/insight/0967-5426.htm

3. Alhabshi S. M., Sharifah K. S. A., & Mezbah U. A. (2018). *Financial Reporting Dimensions of Intangibles in the Context of Islamic Finance*. Journal of Islamic Thought and Civilization of the International Islamic University Malaysia

4. Babkin A., Tashenova L., Smirnova O., & Burkaltseva D. (2020). *Analyzing the trends in the digital economy and the factors of industrial clustering.* SPBPU IDE2020, No. 46, pp 1–10.

5. Chan (2009). *Impact of intellectual capital on organizational performance - An empirical study of companies in the Hang Seng Index (Part 2)*. Available at: www.emeraldinsight.com/0969-6474.htm

6. Chen, M. C., Cheng, S. J., & Hwang Y. (2016). *An Empirical Investigation of the Relationship between Intellectual Capital and Firms' Market Value and Financial Performance*. Journal of Intellectual Capital, Vol 6.

7. Codazzo M., & Rossi P. (2019) *The influence of IFRS mandatory adoption on the value relevance of intangible assets in Italy*. Available on Emerald Insight at: https://www.emerald.com/insight/0967-5426.htm

8. Dabić M., Lažnjak J., Smallbone D., & Švarc J., *Intellectual capital, organizational climate, innovation culture, and SME performance Evidence from Croatia*. Available on Emerald Insight at: www.emeraldinsight.com/1462-6004.htm

9. Deloitte (2016). *Industry 4.0: Is Africa ready for digital transformation*. Available from: http://www2.deloitte.com/za/africaindustry4- 0?id=za:2el:3or:awa_AI40:ai40_vs

10. Dzenopoljac V., Bontis N., & Janosevic S. (2016). *Intellectual capital and financial performance in the Serbian ICT industry.* Journal of Intellectual Capital, Vol 17.

11. EFRAG (2021). Better information on intangibles – which is the best way to go? Discussion Paper 2021: Full report https://www.efrag.org/Activities/1809040410591417/EFRAG-research-project-on-better-information-on-intangibles?AspxAutoDetectCookieSupport=1#

12. European Parliament (2016). *Industry 4.0: digitalization for productivity and growth*. Available from: www.europarl.europa.eu/RegData/etudes/BRIE/.../EPRS_BRI(2015)568337 _EN.pdf

13. Financial Accounting Standards Board (FASB) (2010). *Statement of financial accounting concepts.* Available from https:// www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1176157498129&acceptedDisclaimer=true

14. Global Intangible Finance Tracker (GIFT™) (2019). *An annual review of the world's intangible value 2019*: Full Report https://brandirectory.com/download-report/brand-finance-gift-2019-full-report.pdf

15. International Accounting Standards Board (IASB) (2004). *IAS 38: Intangible assets.* Available from https://www.iasplus.com/en/meeting-types/ iasb/2004

16. Khan S. Z., Yang Q., Waheed A., (2018) *Investment in intangible resources and capabilities spurs sustainable competitive advantage and firm performance*. Corporate Social Responsibility and Environmental Management, Vol. 26, No. 1.

17. Kulshrestha A., & Patro A. (2021). *Intellectual capital reporting and mandatory adoption of post-IFRS – An empirical analysis using computational linguistic tools.* Available on Emerald Insight at: https://www.emerald.com/insight/1469-1930.htm

18. Lev B. (2018). *Intangibles.* Available at SSRN: https://ssrn.com/abstract=3218586

19. Liu D., & Zhang H. (2016). *Residuals and Diagnostics for Ordinal RegressionModels: A Surrogate Approach.* Journal of the American Statistical Association, Vol. 113, No. 522, pp. 845 – 854.

20. Malikova, O., Brabec, Z., & Rozkovec, J. (2018). *Financial reporting of intangible assets – evidence on information and communication companies in the Czech Republic*. Journal of International Studies, Vol. 11, No. 2, pp. 327 - 340.

21. Manda M. I., & Dhaou S. B. (2019). *Responding to the challenges and opportunities in the 4th Industrial revolution in developing countries*. ICEGOV2019, pp. 244 – 253.

22. Masrifah N., & Sudira P. (2020). *Redesign of Vocational Education Curriculum in Industrial Digitalization 4.0*. ICMET '20, pp. 25 – 29.

23. Michalczuk, G., Skrodzka, I. & Paszko, J. (2019). *National intellectual capital in European union countries in 2013-2017.* European Research Studies Journal, Vol. 0 No. 4, pp. 115-125

24. Mirza A., Malek M., & Abdul-Hamid M. A. (2019). *Value relevance of financial reporting: Evidence from Malaysia.* Cogent Economics & Finance, Vol 7, No 1.

25. Mukherjee S. &, Zambon S. (2011). *The Relevance of Intangibles Disclosure for Market Risk: An Exploratory Study of US Healthcare and Pharmaceutical Industry*. Indian Accounting Review, Vol. 15, No. 1, pp. 24 - 41.

26. Nimtrakoon S. (2015). *The relationship between intellectual capital, firms' market value, and financial performance - Empirical evidence from the ASEAN.* Available on Emerald Insight at: www.emeraldinsight.com/1469-1930.htm

27. Ocak M., & Findik D. (2019). *The Impact of Intangible Assets and Sub-Components of Intangible Assets on Sustainable Growth and Firm Value: Evidence from Turkish Listed Firms.* Sustainability, Vol. 11.

28. Napoli F. (2015). *The value relevance of R&D expenditure after the adoption of the International Accounting Standards by Italian publicly listed companies.* Problems and Perspectives in Management, Vol. 13.

29. OECD (2017). *Key issues for digital transformation in the G20*. Report prepared for a joint G20 German Presidency/OECD conference, Berlin, Germany, 12 January 2017.

39. Oliveira M., Balle A., Curado C., Kianto A. (2020). *Knowledge sharing, intellectual capital, and organizational results in SMEs: are they related?* Journal of Intellectual Capital.

40. O'Connell V., AbuGhazaleh N., & Kintou A. (2018). *The impact of R&D program success on the decision to capitalize development expenditures in European firms*. Technology Analysis & Strategic Management, Vol (30), No. 1, pp. 15 – 30.

41. Oswald D. R., Simpson A. V., & Zarowin P. (2017). *The Information Benefits of R&D Capitalization*. Available at SSRN: https://ssrn.com/abstract=2952388

42. Ousama A. A., Hammami H., & Abdulkarim M. (2019). *The association between intellectual capital and financial performance in the Islamic banking industry - An analysis of the GCC banks.* Available on Emerald Insight at: https://www.emerald.com/insight/1753-8394.htm

43. Pulic A. (200). *VAIC™ an accounting tool for IC management*. International Journal of Technology Management, Vol (20), No. 5.

44. Schweer, D. & Sahl, J.C. (2017). *The digital transformation of industry – the benefit for Germany*. The Drivers of Digital Transformation, Springer International Publishing Switzerland, Cham, pp. 23-33.
45. Ståhle P., Ståhle S., & Aho S. (2011). *Value Added Intellectual Coefficient (VAIC): a critical analysis.* Journal of Intellectual Capital Vol 12, No. 4, pp. 247 – 268

46. Stahle, P., Stahle, S. & Lin, C. (2015). *Intangibles and national economic wealth – a new perspective on how they are linked*. Journal of Intellectual Capital, Vol. 16 No. 1, pp. 20 - 57.

47. Stewart, T.A. (1997). *Intellectual Capital*. The New Wealth of Organizations, Doubleday, New York, NY.

48. Švark J., Lažnjak J., & Dabić M. (2020). *The role of national intellectual capital in the digital transformation of EU countries. Another digital divide?* Available on Emerald Insight at: https://www.emerald.com/insight/1469-1930.htm

49. UNCTAD (2019). *Digital economy report 2019.* United Nations Conference on Trade and development, New York, United Nation Publications.

50. WEF (2017). *White Paper: Technology and Innovation for the Future of Production: Accelerating Value Creation*. World Economic Forum, Geneva 2017.

51. Xu J., & Li J. (2019). *The impact of intellectual capital on SMEs' performance in China: Empirical evidence from non-high-tech vs. high-tech SMEs.* Available on Emerald Insight at:

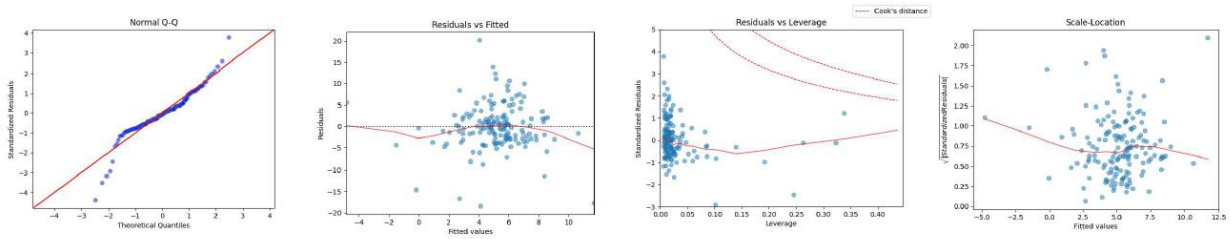
www.emeraldinsight.com/1469-1930.htm

52. Xu J., & Wang B. (2019). *Intellectual capital and financial performance of Chinese agricultural listed companies*. Custos e Agronegocio, Vol. 15, No. 1, pp. 273 – 290.

APPENDIX – FIGURES

Figure 1.1

High-intangible firms



Low-intangible firms

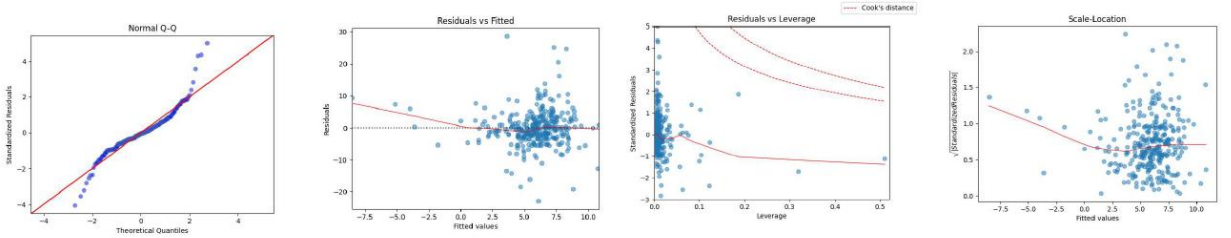
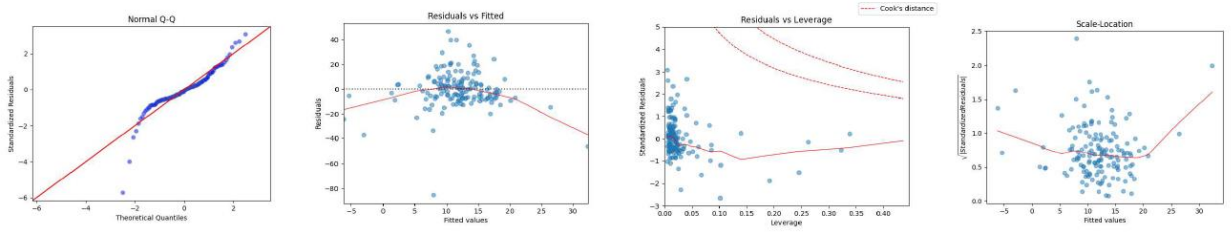


Figure 1.2

High-intangible firms



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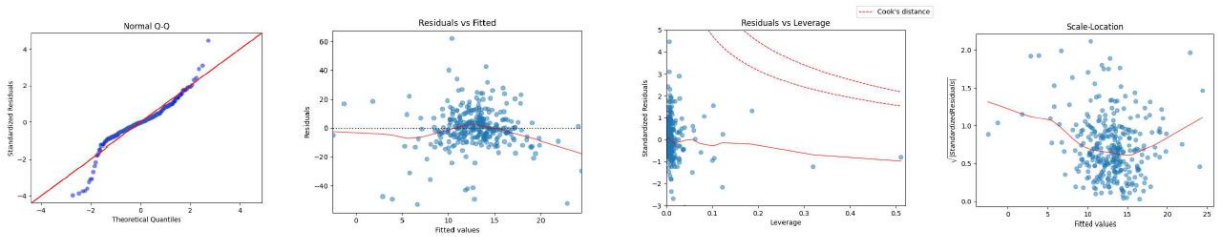
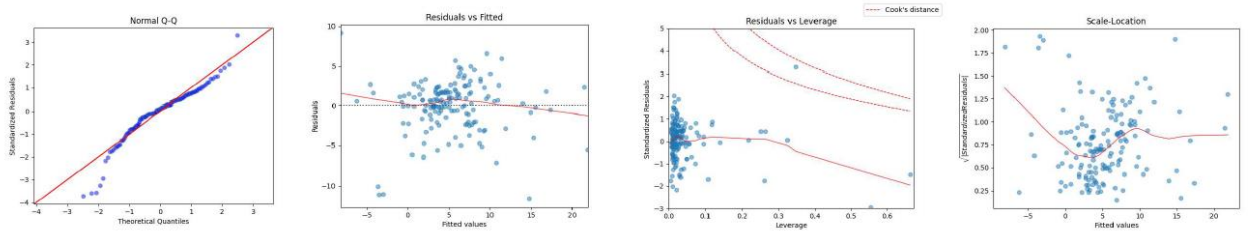


Figure 1.3

High-intangible firms



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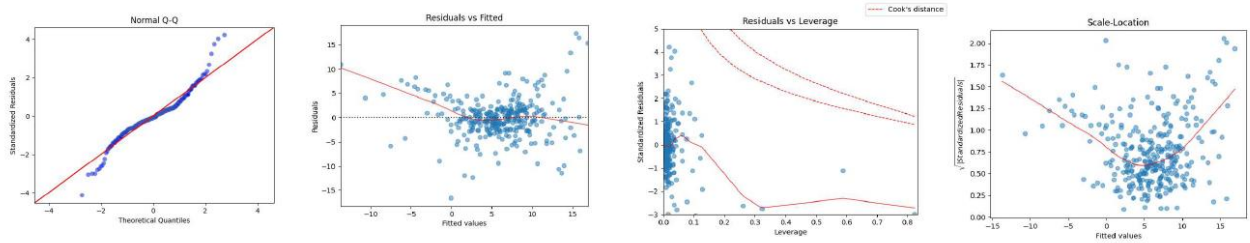
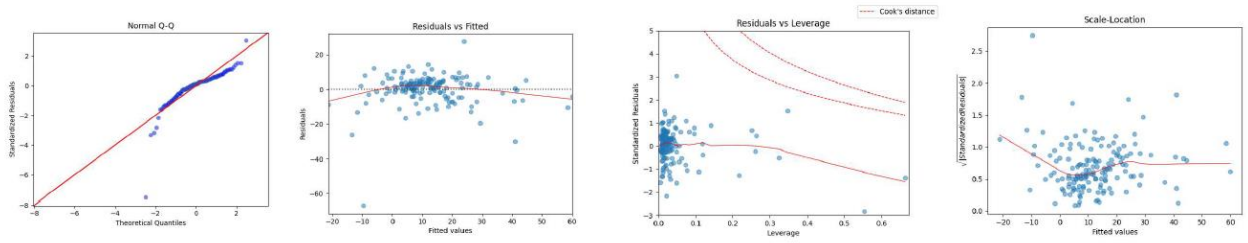


Figure 1.4

High-intangible firms



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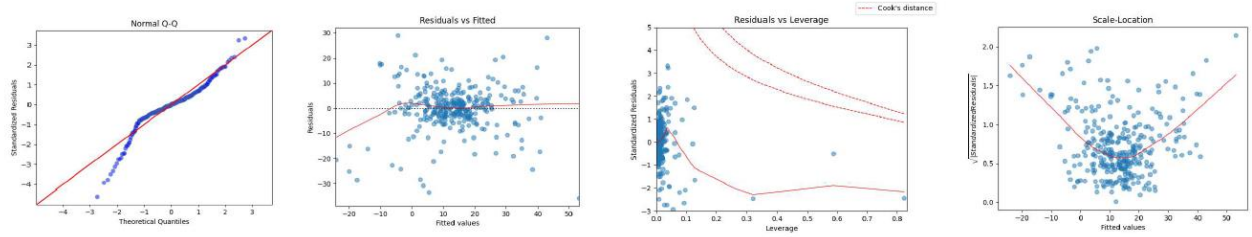

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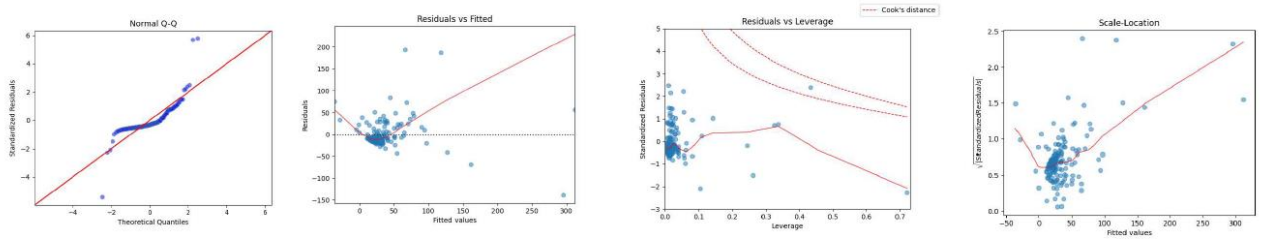

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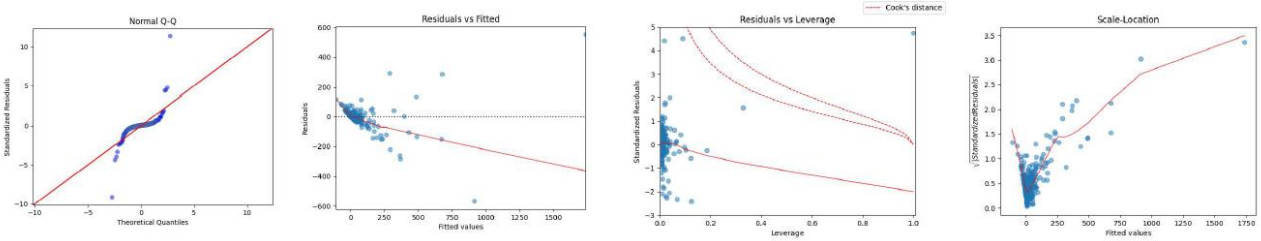

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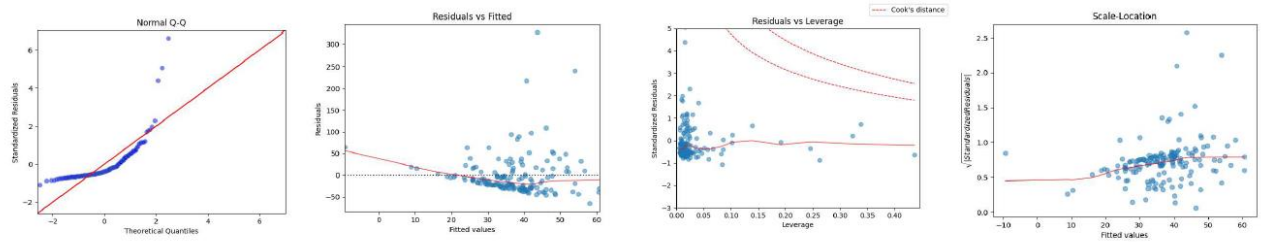
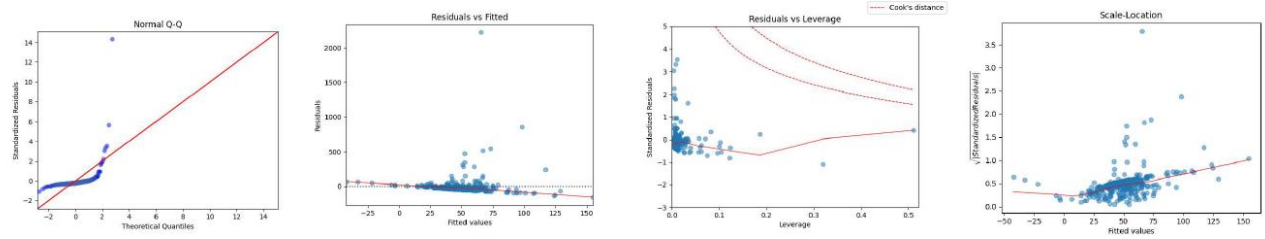


Low-intangible firms



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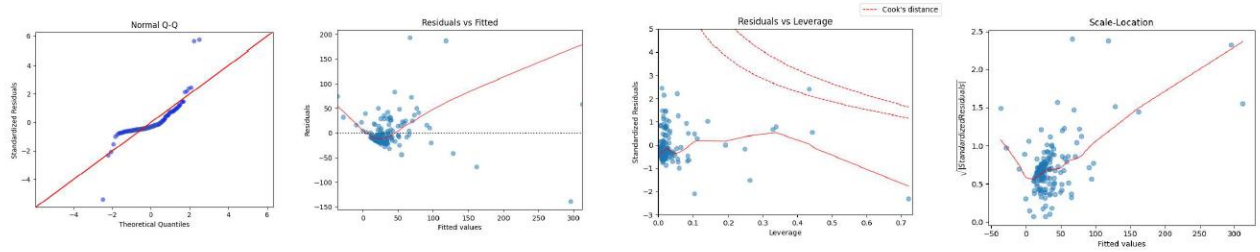
High-intangible firms



Low-intangible firms

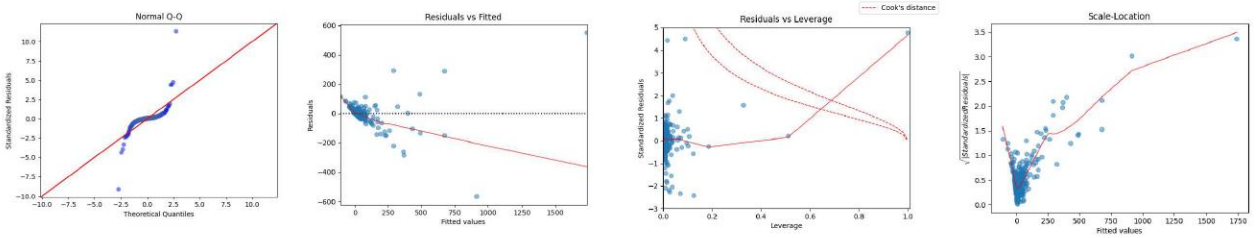
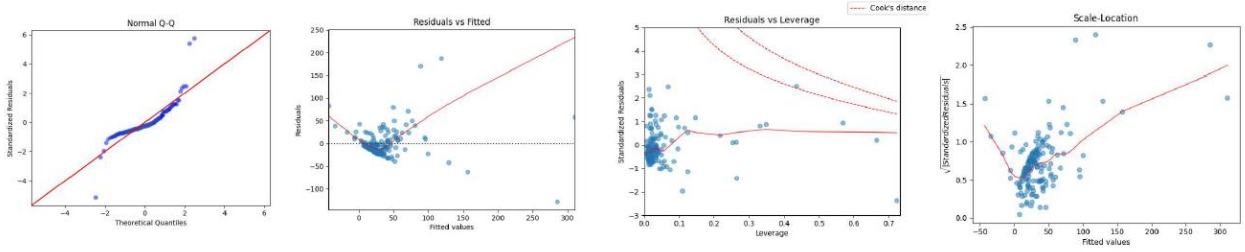
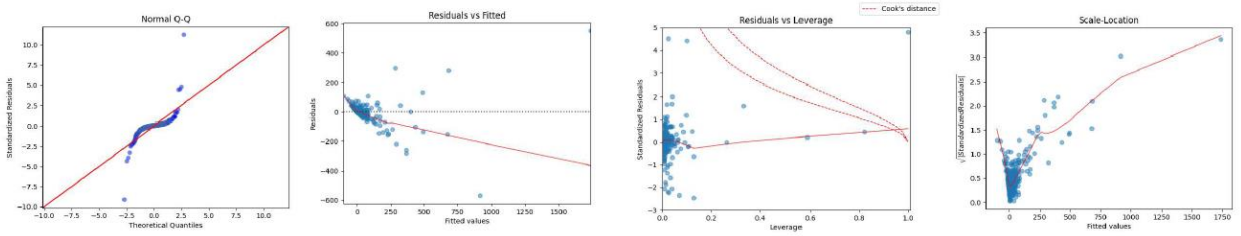


Figure 1.8

High-intangible firms



Low-intangible firms



SUMMARY

TABLE OF CONTENTS

1. INTRODUCTION

IA is part of the broader concept of intellectual capital (IC) which is the protagonist of the 21st-century revolution linked to the rise of the intangible economy within global and national economic systems. The rapid development of new upcoming technologies has given birth to the so-called 4th industrial revolution or Industry 4.0, widespread in many countries. Despite the lack of a universal definition of IC, IAS 38 includes in the intangibles category those assets that have not been seen, touched, or physically measured, in accordance with the critical attributes: control, identifiability, and future economic benefits. My study addresses two main themes. The first concerns the analysis of the relationship between IC and firm performance, since IC has been viewed as a key driver for companies in strengthening their competitive advantage and in gaining corporate success. This view is in line with the resource-based theory according to which an organization aiming at the achievement of a comparable sustainable advantage must optimize its intangible assets as much as its tangible resources. The second theme relates to the accounting treatment of intangible assets. Starting from the roots of financial accounting, the reason for the existence of financial statements prepared and presented by managers is to provide helpful financial information that users can relate to in their decision-making. Referring to financial statements' usefulness, the term "value relevance (VR)" is often adopted. Accounting information becomes more useful for the stakeholders as its levels of VR get higher, achieving a better explanatory power of changes in the market value. Yet, intangible capital gives rise to a host of accounting problems, as shown by a large amount of IAs that cannot be recognized on the firm's balance sheet. I attempt to fill the gap left by little existing literature on possible differences among high- and low- intangible intensive firms related to the effect that IAs may have in determining a sustainable competitive advantage for firms and in allowing investors to perform accurate decision-making. With a sample of high-intangibles and low-intangible medium-large firms operating in the Euro Area between 2017 and 2019, I build two sets of hypotheses. The first set explores the extent to which sample firms' success can be attributed to the efficient use of intangible assets, regardless of the industry. The second set aims at enriching the literature on the association between IAs and VR. As the modern global environment is increasingly driven by technological advances, and both practitioners and academics generally agree that irreversible forces have turned intangibles into driving an increasing share of the created value, the objective of my analysis is to highlight the importance of introducing a proper accounting treatment to reflect intangibles in the financial statements. The remainder of the paper is organized as follows. Section 2 presents an overview of the current IAs' literature and develops hypotheses. Section 4 details the research method. Section 5 discusses the results and concludes this research.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

During the 21st century firms have undertaken significant changes which radically altered the concept of value creation. Many academics talk about the fourth industrial revolution, others about the

knowledge-based economy, or Industry 4.0. In general, researchers agree in identifying a rising share of the value creation to be determined by intangibles. IC is an extension of the conventional concept of capital and comprises intangible assets that can generate value. The International Accounting Standards (IAS). IAS 38 defines IAs as "an identifiable non-monetary asset without physical substance." IAS 38 definition treats as intangibles all those assets that are not classified as monetary, that are free from physical essence, and that are identifiable[78]. Many studies on IC, such as Dabic et al (2019), are grounded on the resource-based theory, which asserts that a company can obtain a comparable and sustainable advantage by optimizing both the tangible and intangible assets it owns. Among the several models developed to measure IC, Pulic's VAIC model is broadly adopted by many academics. The VAIC model represents the overall value creation efficiency that an organization possesses. It is the sum of three components: capital employed efficiency (CEE), representing the amount of value created through a monetary unit invested in physical or financial capital; human capital efficiency (HCE) reflecting the value a company generates by investing a monetary unit into human resources; and structural capital efficiency (SCE) measuring how much value a firm can create using its structural capital[79]. The contribution of IC in improving the firm performance does not provide unique results. Some studies suggest IC improve firms' performance significantly. Examples are Nimtrakoon (2015) for firms in the ASEAN region, Dabic et al. (2019) for Croatian SMEs, Xu, and Wang (2019) for Chinese agricultural firms, Khan et. al (2020) for Pakistani SMEs, Ousama et al. (2019) for Islamic banks. Xu and Li (2019) reported that Chinese manufacturing firms with a higher IC level will achieve higher performance, regardless of firms' type. Other studies found opposite results, like Chan (2009) investigating organizations belonging to the Hang Seng Index. Mixed evidence is provided by Dzenopoljac et al. (2016) within the Serbian ICT industry, showing that despite all VAIC components are significantly correlated with financial performance, tangible and financial capital still represents the component having the strongest influence on firms' success. As mentioned before, the IAS's definition of IAs leads IFRS-compliant firms to record only a portion of what 'intangible assets' in the wider sense can be. Most of the strategic resources of business enterprises to create value, such as IT, patents, or brands, are expensed rather than capitalized, without having their nature of assets recognized in financial reports[80]. According to Baruch Lev (2018), this accounting behavior seems to be counterintuitive if thinking about intangibles as the major value drivers of modern businesses. Moreover, the inconsistency between the accounting treatment of internally generated intangibles (expensed) and that of the similarly acquired intangibles (capitalized) prevents an efficient performance comparison among peers having different innovation strategies. Concurrently with the rise of IAs, a

[78] The term "identifiable" stands either for something divisible by the rest of the entity (transferred, licensed, or sold) or for something emerging from legal or contractual rights.

[79] CEE is obtained by dividing value added (VA = total revenues - total costs) for capital employed (CE = total assets - total liabilities). HCE coincides with employees' expenses. SCE is computed dividing Structural capital (SC = VA – HC) by VA.

[80] A remarkable example is that of firms with a large number of intangibles which often report lower book values as a natural consequence of the immediate recording of the intangibles-related expenses and the delayed recognition of their benefits in accounting earnings.

general loss in the relevance of accounting information has been noticed, therefore my interest goes toward understanding whether IC contributes to this decrease. Mirza et al. (2019) defined VR as the accounting information capacity to obtain useful data influencing the share price. Baruch Lev (2018), states that intangibles cause a deterioration in the quality and relevance of reported earnings, which represent an absolute priority for managers[81]. Many prior studies applied Ohlson's (1995) model to quantify the VR of accounting information. Earnings and book value of shares are the pillars of this model, allowing to represent changes in the market value of the firm. The impact of IAs on VR is seen as one of the most critical issues in the accounting field for several reasons. Many studies, such as Ocak and Fındık (2019) in the Turkish ICT sector, argue that the scarce accounting representation of IAs has adversely affected the value relevance of financial reporting and that the lack of accounting recognition of intangibles as assets harms financial information. Al-Ani and Tawfik (2021) provide supporting evidence for IAs' value relevance in the Gulf Cooperation Council (GCC) listed non-financial firms. From the perspective of investors, prior studies such as Malikova et al. (2018) found that the IAs have a relevant informational essence for investors.

With the belief that value creation requires not only physical capital but also IC, I expect to provide supporting evidence to IC being a relevant driver of value generation. Using return on assets (ROA) and return on equity (ROE) as proxies for performance, I develop the following hypotheses:

(H1a) European firms with greater IC (VAIC) tend to have a better ROA than European firms with lower IC levels.

(H1b) European firms with greater IC (VAIC) tend to have a better ROE than European firms with lower IC levels.

My study continues by analyzing the extent to which each VAIC component affects corporate performance:

(H1c) European firms with greater CEE, HCE, and SCE tend to have better ROA than European firms with lower CEE, HCE, and SCE levels.

(H1d) European firms with greater CEE, HCE, and SCE tend to have better ROE than European firms with lower CEE, HCE, and SCE levels.

Xu and Wang (2019) define capital employed (CE) as physical and financial capital. Oliveira et al. (2020) state that human capital (HC) reflects people and their skills, knowledge, motivation, and experience. Xu and Li (2019), define structural capital (SC) as the knowledge owned by the firm at the end of the day and includes the systems, producers, culture databases, organizational routines. Since little research has focused on the difference in intangibles' VR between high-intangibles or low-intangibles firms, regardless of their sectors, my second set of hypotheses aims at filling this gap in

[81] What really happens is that the intangibles accounting, and not intangibles per se, constitute damage to earnings relevance, mostly due to the indiscriminate expensing of almost all the groups of internally-generated intangibles in the income statement.

current literature. I start with the attempt to provide further evidence to validate original Ohlson's (1995) model as a method to test the VR of accounting information, developing the following hypothesis:

(H2a) EPS and BVS explain changes in the share price of the European firms.

My study adds specific insights to this research domain by applying Ohlson's (1995) model to test the extent to which IAs can be considered as value relevant within high- and low-intangible listed firms in the European Market. Thus, using the VAIC model as a proxy for intangibles the next hypothesis is built:

(H2b) IAs (VAIC) in high-intangibles European firms can explain changes in the share price better than low-intangibles European firms.

Following Al-Ani and Tawfik (2021), I add the IAs (VAIC) component to the original Ohlson's model to test whether some changes in accounting value relevance occurs by including information on intangibles. This modified version of the model led to developing the following hypothesis:

(H2c) EPS, BVS, and IAs (VAIC) in high-intangibles European firms can explain changes in share price better than low-intangibles European firms.

Finally, I extend this last hypothesis (H2c) to examine the contribution of each VAIC component to the VR of accounting information. Thus, the next hypothesis is built:

(H2d) EPS, BVS, CEE, HCE, and SCE in high-intangibles European firms can explain changes in share price better than low-intangibles European firms.

3. METHODOLOGY AND DATA SAMPLE

My empirical analyses are based on an original sample of 742 publicly traded firms drawn from the Euro Area from 2017 to 2019. I obtained the necessary data from the Orbis database, comprising detailed financial information on more than 400 million companies and entities worldwide[82]. The 3-years sample period has been selected to give more robustness to the analysis. My sample of European market firms is drawn from companies belonging to the Euro Area, with an effort to grant geographical and industrial diversity. Concerning firms' dimensions, this research focuses on medium, large, and very large companies, following the European Commission's indications[83]. The sample is drawn up with public European companies that comply with IFRS. I chose to include only listed companies to ensure

[82] If interested, please refer to: https://www.bvdinfo.com/en-us/our-products/data/international/orbis

[83] I comprehend only companies with a minimum of €10 million balance sheet total and of 50 employees, which is what is required for firms.

as much publicly and freely available reporting data as possible[84]. Moreover, the sample excludes financial firms and institutions, entities using local gaaps, and companies outside the European Economic Area to prevent that a different regulatory framework or divergent accounting practices could influence my analysis. Finally, the sample has been built without including inactive companies, firms in distress, or under liquidation (losses 75% of capital) to spare any distortion due to their exceptional conditions. By excluding 275 non-financial firms with missing data for some of the variables, I come up with a final sample of 467 companies. Once the final sample is obtained, following Xu and Li (2019) and Cordazzo and Rossi (2019) I split it up into two subsamples of high-intangibles and low-intangibles firms, regardless of the industry[85]. Of the total of 490 firm years, the intangible intensity dummy takes on a value of "high-intangible" for 154 companies (20,41% of the sample), and of "low-intangible" for 367 companies (79,59% of the sample). Table 1 shows the summarized sample composition.

Table 1

Sample reduction action	Number of firms
Panel A: distribution of sample firms	
Population of medium-large firms in the Euo Area	742
Firms with missing data	275
Final firms sample	467
Total firm-year observations	1401[a]
Panel B: distribution of sample firms by firm-type	
Firm- type	
High-intangible firms	154 (20,41)[b]
Low-intangible firms	437 (79,59)
Total firm sample	

Notes: [a] 467 x 3 years = 1401 firm-years; [b] the parentheses are percentage

The previously stated hypotheses are tested using multiple regressions analysis[86], applied to both high-intangible firms and low-intangible firms subsamples. Models (1) to (4) compose my first set of hypotheses, examining the impact of IC on the financial performance among high-intangibles and low-intangibles firms.

Model (1) and (2) address the VAIC influence over financial performance indicators, ROA, and ROE.

(1) $$ROA_{it} = \beta_0 + \beta_1 VAIC_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 GROWTH_{it} + \beta_5 REP\_EXP_{it} + \varepsilon_{it}$$

where for firm *i* and year *t*, ROA is the return on assets measured by net income divided by average total assets; VAIC is the Value Added Intellectual Capital coefficient used as a proxy for IAs. While performing this regression, as well as the following ones, I will control for the subsequent variables: SIZE is the natural logarithm of total assets; LEV is the financial leverage

[84] Listed firms are subject to specific reporting requirements that private firms don't have to comply with. For transparency purposes, I also filter the available companies by selecting those with a greater level of traceability looking at elements like mail, fax, website, and phone numbers.

[85] Using NACE REV 2 industry classification, I followed Baruch Lev (2018) computing the intangible intensity of every company to categorize each one into the high- or low-intangible subsample. First, I construct a new variable measured by the ratio of the sum of three balance sheet items, namely "intangibles", "goodwill" and "other intangibles", to total assets. Secondly, I obtain my threshold by computing the intangible-intensity median for every industry.

[86] Multiple regression analysis is an expansion of the Ordinary Least Squares (OLS) regression and it is applied where the dependent value is the result of more explanatory variables.

measured by the ratio between the book value of debt and equity; GROWTH is revenues growth computed by taking the difference between total revenues of a certain year minus total revenues of the previous year and dividing it by the total revenues of the previous year; REP_EXP the reporting experience, a proxy of age obtained from the difference between the last closing year of a firm, and its IPO date; and ε denotes the disturbance.

(2) $ROE_{it} = \beta_0 + \beta_1 VAIC_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 GROWTH_{it} + \beta_5 REP\_EXP_{it} + \varepsilon_{it}$

where for firm *i* and year *t*, ROE is the return on equity measured by net income divided by shareholders' equity. Model (3) and (4) break down the VAIC into its three components, CEE, HCE, and SCE, to further investigate the relationship between IAs and financial performance.

(3) $ROA_{it} = \beta_0 + \beta_1 CEE_{it} + \beta_2 HCE_{it} + \beta_3 SCE_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 GROWTH_{it} + \beta_7 REP\_EXP_{it} + \varepsilon_{it}$

where for firm *i* and year *t*, CEE is capital employed efficiency; HCE is human capital efficiency; SCE is structural capital efficiency.

(4) $ROE_{it} = \beta_0 + \beta_1 CEE_{it} + \beta_2 HCE_{it} + \beta_3 SCE_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 GROWTH_{it} + \beta_7 REP\_EXP_{it} + \varepsilon_{it}$

Model (5) to (8) compose my second set of hypotheses, examining the relationship between IC and VR based on Ohlson's model[87]. By keeping the same control variables used in my first set of hypotheses, in line with Al-Ani and Tawfik (2021) I apply a progressive approach for both high- and low-intangible firms. Model (5) includes only the original components of Ohlson's model, which represents the market value of a company as a linear function of its book value of share and earnings.

(5) $P_{it} = \beta_0 + \beta_1 BV_{it} + \beta_2 EPS_{it} + \beta_3 SIZE_{it} + \beta_4 LEV_{it} + \beta_5 GROWTH_{it} + \beta_6 REP\_EXP_{it} + \varepsilon_{it}$

where for firm *i* and year *t*, P is the share price at the end of the year; BVS measures the book value of a company on a per-share basis[88]; EPS is earnings per share[89]. Model (6) exclusively comprehends intangibles, measured with the VAIC proxy, to estimate the relationship between IAs and the VR of accounting information.

(6) $P_{it} = \beta_0 + \beta_1 VAIC_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 GROWTH_{it} + \beta_5 REP\_EXP_{it} + \varepsilon_{it}$

Model (7) tests the original components of Ohlson's model, that is BVS and EPS, with the addition of IAs to see if the VR of accounting information changes.

(7) $P_{it} = \beta_0 + \beta_1 BV_{it} + \beta_2 EPS_{it} + \beta_3 VAIC_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 GROWTH_{it} + \beta_7 REP\_EXP_{it} + \varepsilon_{it}$

To further developing the analysis, Model (8) is created as an extension of Model (7) to see how much each component of the VAIC model contributes to value relevance.

[87] Evidence from previous literature, such as Cordazzo and Rossi (2019) illustrates that the presence of intangible contributes to increasing the VR of accounting information.

[88] BVS is obtained by dividing the overall book value by the number of outstanding shares

[89] EPS is computed by dividing the firm's net income by the overall number of shares outstanding.

8) $P_{it} = \beta_0 + \beta_1 BV_{it} + \beta_2 EPS_{it} + \beta_3 CEE_{it} + \beta_4 HCE_{it} + \beta_5 SCE_{it} + \beta_6 SIZE_{it} + \beta_7 LEV_{it} + \beta_8 GROWTH_{it} + \beta_9 REP\_EXP_{it} + \varepsilon_{it}$

4. EMPIRICAL RESULTS

This chapter reports the results of my analysis of IAs' impact on the European firm's financial performance and information VR in the period between 2017 and 2019. Descriptive statistics are shown in Table (2) for Model (1)-(4). The mean value of ROA is 5,6% meaning that every 100 euros invested in assets generate net income for 5,6, achieving a maximum of 32,9 per unit. The mean value of ROE is and 12,4%, which means that the undertaken European firms can provide acceptable returns for their stakeholders. The average score of VAIC is -0,70, revealing that medium-large listed companies in the Euro Area decrease value for -0,70 for every euro spent on intangible resources[90]. SCE (mean value of -1,90) is the component with the strongest relationship with financial performance indicators. With the mean value of 0,93. HCE demonstrates to be the VAIC component contributing the most to wealth creation, compared to CEE (mean score of 0,27). CEE presents a mean value of 0,2705 reflecting physical and financial capital, hence the tangible component. The sum of the mean values of HCE and SCE is -0.98, which is lower than the mean CEE of 0,27. The comparison implies that European firms create more value from tangible resources than from intangible assets and IC. The mean values of control variables are: (13,49) for SIZE; (0,89) for LEV; (0,07) for GROWTH; (20,14) for REP_EXP. Financial performance and intangible resources efficiency may differ depending on a firm being high-intangible intensive or not. The two-subsamples t-test is performed to discover whether the mean change across the two groups. Table (3) exposes descriptive statistics for high-intangibles and low-intangibles firms, finding no significant difference in profitability among the two groups. VAIC and its three components show no statistically significant difference between the two subsamples.

Table 2

Variables	*n*	*Minimum*	*Maximum*	*Mean*	*SD*
ROA	467	-16,810	32,923	5,599	5,976
ROE	467	-77,763	71,797	12,415	14,726
VAIC	467	-100,340	71,581	-0,705	8,309
CEE	467	-0,178	1,741	0,270	0,175
HCE	467	-1,792	39,814	0,934	2,473
SCE	467	-100,359	71,608	-1,909	7,696
SIZE	467	9,612	19,938	13,493	1,954
LEV	467	0,006	7,475	0,891	0,813
GROWTH	467	-0,392	0,976	0,072	0,128
REP_EXP	467	2,504	129,345	20,135	11,335

Table 3

Variables	*High-intangible firms*	*Low-intangible firms*	*Difference t-statistic*
ROA	5,130	5,829	0,235
ROE	11,798	12,719	0,526
VAIC	-0,703	-0,706	0,998
CEE	0,270	0,271	0,989
HCE	1,028	0,888	0,565
SCE	-2,001	-1,864	0,856

***Notes**: *p < 0.10; **p < 0.05; ***p < 0.01*

Table (4) describes the statistics of the variables in my second set of hypotheses reflected in Model (5)-(8). The mean value of P is positive and equal to 43,90. The mean score of EPS is 5,41, meaning that on average a sample company generates profits for 5,41 relatives to its share price. With a mean of 717,89, BVS is highly above the price of the share in the panel firms, showing that, generally, listed

[90] Either way, the VAIC has a high standard deviation, meaning that European firms invest in IAs at different levels.

firms in the Euro Area are more likely to be undervalued. The VAIC mean is slightly negative (-0,71). SC impairs for 1,91 the sample firms' share price for every additional unit they invest in it. HCE and CEE have a positive impact on firms' prices with the mean value of 0,93 and 0,27 respectively. This evidence suggests that European firms create more stock value using tangible resources than IAs[91]. The VR of recorded intangibles may differ depending on a firm being high-intangible intensive or not. Table (5) exposes descriptive statistics for high-intangibles and low-intangibles firms. No significant difference exists in terms of share price between the two subsamples. In opposition with prior literature such as Al-Ani and Tawfik (2021), neither for VAIC nor for CEE, HCE, and SCE, any statistically significant difference between high- and low-intangible firms has been found.

Table 4

Variables	*n*	*Minimum*	*Maximum*	*Mean*	*SD*
P	467	0,057	2285,650	43,901	131,649
BVS	467	0,000	329489,292	717,891	15246,610
EPS	467	-17,120	1502,120	5,405	69,684
VAIC	467	-100,340	71,581	-0,705	8,309
CEE	467	-0,178	1,741	0,270	0,175
HCE	467	-1,792	39,814	0,934	2,473
SCE	467	-100,359	71,608	-1,909	7,696
SIZE	467	9,612	19,938	13,493	1,954
LEV	467	0,006	7,475	0,891	0,813
GROWTH	467	-0,392	0,976	0,072	0,128
REP_EXP	467	2,504	129,345	20,135	11,335

Table 5

Variables	*High-intangible firms*	*Low-intangible firms*	*Difference t-statistic*
P	34,842	48,359	0,297
BVS	4,125	1069,073	0,479
EPS	1,524	7,314	0,399
VAIC	-0,703	-0,706	0,998
CEE	0,270	0,271	0,989
HCE	1,028	0,888	0,565
SCE	-2,001	-1,864	0,856

***Notes**: *p < 0.10; **p < 0.05; ***p < 0.01*

I proceed to perform the Pearson's correlation coefficient analysis to test the linear correlation of variables in my first and second set of hypotheses. Table 10 illustrates the correlation matrix for the first set of hypotheses. For high-intangible European firms, VAIC has a significantly positive association with both ROA and ROE, consistently with Ousama et al. (2019) and Xu and Li (2019). Regarding high-intangible companies, if CEE and SCE are significantly associated with both ROA and ROE, HCE has no relevant correlation with the two ratios. For low-intangible firms' subsample, VAIC doesn't prove any significant relationship with ROA and ROE, and CEE is the only component statistically and positively associated with both performance indicators. Table 11 illustrates a correlation matrix using Pearson's correlation coefficient for the second set of hypotheses. Consistently with Cordazzo and Rossi (2019), and Al-Ani and Tawfik (2021), for both high- and low-intangible firms, BVS, and EPS demonstrate to statistically improve P, confirming their high explanatory power following Ohlson's model. Unfortunately, no significant association has been found between VAIC and its components and P neither for high- nor for low-intangible firms.

[91] As described in Table 2, the mean values of control variables are: (13,49) for SIZE; (0,89) for LEV; (0,07) for GROWTH; (20,14) for REP_EXP.

Table 10

Variables	VAIC	CEE	HCE	SCE
High-intangible firms				
ROA	0,193**	0,634***	0,1066	0,163**
ROE	0,215***	0,727***	0,0690	0,197**
Low-intangible firms				
ROA	0,0498	0,400***	0,0361	0,0321
ROE	0,0752	0,616***	0,0453	0,0511

Notes *: *p < 0.10; **p < 0.05; ***p < 0.01*

Table 11

Variables	BVS	EPS	VAIC	CEE	HCE	SCE
High-intangible firms						
P	0,664***	0,607***	0,085	0,131	-0,048	0,104
Low-intangible firms						
P	0,166***	0,198***	0,040	0,030	0,002	0,042

Notes *: *p < 0.10; **p < 0.05; ***p < 0.01*

Table 12 presents the regression results of Model (1)-(2) testing the relationship between intangibles and European firms' financial performance. Model (1) addresses ROA, which demonstrates a medium fit with an adjusted R^2 of 51 percent in the high-intangible subsample and 53,5 percent in the low intangible subsample. For high-intangible firms' subsample, VAIC has a positive and significant effect on ROA at 0.10 (*p*-value < 0.10)[92], while no significant relationship is found in low-intangible firms. Altogether, results support H1a. Model (2) concerns ROE, with an adjusted R^2 of 40,6 percent for high-intangible firms and 47,7 percent for low-intangible firms. It shows that the VAIC coefficient is positive and significant just for high-intangible firms at 0.05 (*p*-value < 0.05), equal to 29,6 (t = 2,17). These findings support H1b, highlighting that with one more unit of VAIC, ROE is expected to rise by 0.3107 in high-intangible firms, while leaving it unvaried in low-intangible firms. Additionally, SIZE positively impacts the performance indexes in both subsamples. LEV has a negative influence on European companies' performance. GROWTH is positively and significantly related to ROA and ROE only for low-intangible companies. REP_EXP shows a statistically negative effect on these ratios just for the high-intangible companies' subsample.

Table 12

	High-intangible firms		*Low-intangible firms*	
	Model (1)	*Model (2)*	*Model (1)*	*Model (2)*
Variables	*ROA*	*ROE*	*ROA*	*ROE*
VAIC	0,095* (1,956)	0,296** (2,170)	0,036 (0,881)	0,126 (1,288)
SIZE	0,617*** (7,067)	1,388*** (5,618)	0,581*** (9,164)	1,123*** (7,410)
LEV	-2,522*** (-3,686)	-2,925 (-1,512)	-2,493*** (-6,341)	-2,323 (-2,465)
GROWTH	0,054 (0,018)	-1,445 (-0,174)	6,685** (2,354)	17,119 (2,515)
REP_EXP	-0,053 (-1,319)	-0,2111* (-1,862)	-0,006 (-0,214)	-0,057 (-0,796)
n	154	154	313	313
R^2	0,526	0,425	0,543	0,485
Adjusted R^2	0,510	0,406	0,535	0,477

Notes *: t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

Table 13 presents the regression findings on the relationship between CEE, HCE, SCE, and the financial performance of high-intangible and low-intangible European firms, illustrated by Model (3)-(4). Both regression models have a high-quality explanatory power for high-intangible companies (81,6 percent and 77,9 percent) and low-intangible companies (75,6 percent and 78,6 percent). Looking at high-

[92] This implies that with an additional VAIC unit created by companies in the European market, the firm's ROA is predicted to rise by 0,095 units for high-intangible firms.

intangible subsample, Model (3) illustrates that CEE and HCE are positively associated with companies' ROA, with correlation coefficients of 28,26 (t = 15,86; *p*-value < 0.01) and 0,25 (t = 2,34; *p*-value < 0.05), respectively. For the t-statistics, CEE contribution to the regression model is substantially higher than HCE[93]. No statistically relevant association exists between ROA and SCE. For low-intangible subsample, ROA is positively and significantly influenced by CEE, with a correlation coefficient of 25,6 (t = 16,73; *p*-value < 0.01)[94]. The empirical investigation has failed in detecting any significant correlation between HCE, SCE, and ROA in low-intangible firms. In line with previous literature, like Nimtrakoon (2015), Xu and Wang (2019) the overall findings are in favor of H1c. In Model (4)'s high-intangible subsample, CEE and SCE have a positive and significant impact on ROE at 0.01 (*p*-value < 0.01) and 0.10 (*p*-value < 0.10), respectively. HCE does not affect ROE. The coefficients of CEE in high-intangible European firms, 80,23 (t = 15.99) are greater than those of low-intangible European firms, 68,53 (t = 21,19). The only significant coefficient of SCE in Model (4) is 0,18 (t = 1,95) for high-intangible firms. These findings are consistent with H1d. It is also revealed that CEE is the most relevant value driver for both financial performance indicators, with ROA being positively and significantly influenced by HCE for high-intangible firms; and ROE being positively and significantly related to SCE in high-intangible firms[95]. SIZE reveals its positive impact on the performance indexes in both subsamples of Model (3). LEV negatively impacts influence over both European companies' performance indexes. GROWTH is positively and significantly related to ROA and ROE at 0,05 (*p*-value < 0.01) only for low-intangible companies. REP_EXP negatively influences ROE in high-intangible companies' subsample.

Table 13

	High-intangible firms		*Low-intangible firms*	
	Model (3)	*Model (4)*	*Model (3)*	*Model (4)*
Variables	*ROA*	*ROE*	*ROA*	*ROE*
CEE	28,263*** (15,860)	80,234*** (15,995)	25,604*** (16,730)	68,526*** (21,195)
HCE	0,254** (2,344)	0,309 (1,013)	0,045 (0,455)	0,088 (0,424)
SCE	0,035** (1,103)	0,176* (1,952)	0,001 (0,041)	0,042 (0,610)
SIZE	0,153 (2,477)	0,123 (0,707)	0,2161*** (4,230)	0,154 (1,424)
LEV	-4,932*** (-11,053)	-9,637*** (-7,672)	-5,0852*** (-15,664)	-9,252*** (-13,489)
GROWTH	-1,015 (-0,564)	-4,676 (-0,923)	4,248** (2,057)	10,603** (2,431)
REP_EXP	-0,015 (-0,619)	-0,117* (-1,679)	0,016 (0,739)	0,004 (0,091)
n	154	154	306	306
R^2	0,825	0,789	0,761	0,791
Adjusted R^2	0,816	0,779	0,756	0,786

Notes *: t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

Table 14 presents the regression results of Model (5) reflecting the original Ohlson's model[96]. The VR of accounting information as EPS and BVS, represented by unadjusted R^2, reaches 71,8 percent for high-intangible firms, and 83,7 percent for low-intangible firms, with a high joint explanatory power

[93] Correlation coefficients underline that for every additional unit of CEE and HCE generated, ROA of high-intangible firms is expected to increase by 28,26, and by 0,25 units respectively.
[94] For every additional unit of CE created by firms belonging to the second subsample, their ROA increase by 25,6 units.
[95] No significant association is found between ROA and SCE as well as ROE and HCE.
[96] The model has a high degree of fit for high- and low-intangible firms, with the adjusted R^2 of 70,7 and 83,3 percent respectively.

for P variations in the European market. There is a significantly positive association between EPS and P, as shown by the correlation coefficients of 7,22 (t=11,31; *p*-value < 0.01) for high-intangible firms, and 21,39 (t = 36,56; *p*-value < 0.01) for low-intangible firms. The association between BVS and P is significantly positive for high-intangible firms, with a correlation coefficient of 0,90 (t = 8,45; *p*-value < 0.01); and significantly negative for low-intangible firms, with a coefficient of -0,096 (t = -36,06; *p*-value < 0.01)[97]. Investors consider EPS and BVS information as value relevant for investment decision-making in both subsamples, supporting H2a.

Table 14

	High-intangible firms	*Low-intangible firms*
	Model (5)	*Model (5)*
Variables	*P*	*P*
BVS	0,904*** (8,454)	-0,096*** (-36,056)
EPS	7,216*** (11,313)	21,385*** (36,565)
SIZE	1,373** (2,363)	-0,964 (-1,305)
LEV	-4,491 (-1,031)	3,654 (-0,797)
GROWTH	34,210* (1,839)	69,9819** (2,1203)
REP_EXP	0,144 (0,568)	-0,052 (-0,149)
n	154	313
R^2	0,718	0,837
Adjusted R^2	0,707	0,833

***Notes** : t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

Table 15 presents Model (6) results, addressing the value relevance of IAs accounting information. The model explanatory power is very low, equal to 35,3 percent in high intangible firms, and 9,7 percent in low-intangible firms. The VR of IAs' accounting information for high- and low-intangible firms is 37,4 percent and 11,1 percent respectively. VAIC to have no significant effect on P for both subsamples, meaning that stakeholders don't account for IAs in their investment decision-making, leading to reject H2b. In high-intangible firms' subsample SIZE significantly improves P at 0,01 (*p*-value < 0.01), while LEV negatively affects P at 0,10 (*p*-value < 0.10). In low-intangible firms subsample GROWTH positively impacts P at 0,10 (*p*-value < 0.10).

Table 15

	High-intangible firms	*Low-intangible firms*
	Model (6)	*Model (6)*
Variables	*P*	*P*
VAIC	0,379 (0,832)	0,695 (1,050)
SIZE	3,488*** (4,259)	2,342 (1,367)
LEV	-12,066* (-1,881)	-11,112 (-1,045)
GROWTH	12,918 (0,469)	127,267* (1,658)
REP_EXP	-0,073 (-0,193)	1,050 (1,306)
n	154	313
R^2	0,374	0,111
Adjusted R^2	0,353	0,097

***Notes** : t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

[97] Thus, for every additional unit of BVS generated the VR of P increases of 0,90 for the first subsample and a decrease of -0,096 for the second one.

Table 16 presents findings from Model (7) addressing the association between share price (P) and EPS, BVS, and IAs accounting information. The overall model has a high fit[98]. Including VAIC, the unadjusted R^2 increases in high-intangible firms from 71,8 percent to 71,9 percent, meaning that changes in P are better explained by Model (7) than Model (5). In low-intangible firms, unadjusted R^2 remains unchanged (83,7). For both subsample EPS has a significantly positive effect on P at 0,01 (p-value < 0.01), with correlation coefficients of 7,21 (t = 11,27) and 21,92 (t = 36,49). The relationship between BVS and P is significantly positive for high-intangible firms' group, with a coefficient of 0,90 (t = 8,38; p-value < 0.01) and significantly negative for low-intangible companies, with a coefficient of -0,096 (t = -35,98; p-value < 0.01)[99]. There is no significant association between VAIC and P for both subsamples, leading to reject H2c.

Table 16

	High-intangible firms Model (7)	*Low-intangible firms Model (7)*
Variables	*P*	*P*
BVS	0,899*** (8,384)	-0,096*** (-35,976)
EPS	7,210*** (11,273)	21,917*** (36,489)
VAIC	0,173 (0,561)	-35,976 (-0,262)
SIZE	1,341** (2,292)	-0,981 (-1,3216)
LEV	-4,447 (-1,018)	3,701 (-0,806)
GROWTH	34,396* (1,845)	69,865** (-2,113)
REP_EXP	0,169 (0,652)	-0,047 (-0,134)
n	154	313
R^2	0,719	0,837
Adjusted R^2	0,705	0,833

***Notes**: t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

Table 17 presents findings from Model (8), which expands Model (7) by decomposing VAIC and examining the relationship between P and BVS, EPS, CEE, SCE, and HCE[100]. The VR reaches 72,9 percent for high-intangible firms, and 83,7 for low-intangible firms. As for Model (7), EPS significantly influence P at 0,01 (*p*-value < 0.01) in both subsamples. Each additional unit of BVS significantly improves P by 0,93 for the first subsample and significantly diminishes P by -0,096 for the second subsample[101]. Concerning VAIC components, with a coefficient of 40.51 (t = 2,20), CEE is the only component having a relevant positive effect on P at 0.05 (*p*-value < 0.05) for high-intangible firms. For both subsamples HCE and SCE have a no-statistically significant influence on P. Being CEE the physical and financial part of VAIC, findings further validate Model (6) conclusion that investors do not consider IAs in their investment decisions within the European market context. Thus, the VAIC implements the overall VR of accounting information in high-intangible firms but, given the only component contributing is CEE, H2d is rejected[102].

[98] The model fit is of 70,5 percent for high-intangible firms and 83,3 percent for low intangible firms.
[99] For both subsamples, from the t-statistic, it emerges that EPS contribution to the regression model is greater than that of BVS.
[100] The adjusted R^2 indicates that the model explains potential variations in European companies' share price for 71,3 percent in high-intangible firms, and 83,2 percent in low-intangible firms.
[101] The association between BVS and P is positively significant for high-intangible firms and negatively significant for low-intangible firms.
[102] Regarding control variables, LEV has a negative effect on P at 0,10 (*p*-value < 0.10) for high-intangible firms, GROWTH positively influence P in both subsamples at 0,10 (*p*-value < 0.10) and at 0,05 (*p*-value < 0.05), respectively.

Table 17		
	High-intangible firms	*Low-intangible firms*
	Model (7)	*Model (7)*
Variables	*P*	*P*
BVS	0,929*** (8.658)	-0,097*** (-35.820)
EPS	7,083*** (11.166)	21,432*** (36.333)
CEE	40,514** (2.198)	-20,777 (-0.841)
HCE	-0,719 (-0.648)	-0,170 (-0.108)
SCE	0,202 (0.617)	-0,093 (-0.180)
SIZE	0,847 (1.284)	-0,690 (-0.837)
LEV	-7,636* (-1.660)	5,825 (1.109)
GROWTH	32,217* (1.747)	71,707** (2.160)
REP_EXP	0,173 (0.672)	-0,066 (-0.190)
n	154	313
R^2	0,729	0,837
Adjusted R^2	0,713	0,832

Notes *: t-values are in parentheses; *p < 0.10; **p < 0.05; ***p < 0.01*

5. CONCLUSIONS

To sum up, the first objective of my research is to explore the relationship between VAIC (and its components) and the financial performance of European listed companies. I proceed by building four regression models addressing two profitability ratios: ROA and ROE. Model (1) tests the relationship between VAIC and ROA. Model (2) explores the association between VAIC and ROE. By dividing VAIC into its components, Model (3) examines the link between CEE, HCE, and SCE with ROA, while Model (4) assesses the correlation between CEE, HCE, SCE, and ROE. The second objective of this study is to evaluate the VAIC contribution to the VR of accounting information in European listed firms. I proceed by constructing four regression models following the approach established by Ohlson (1995). According to previous studies such as Al-Ani and Tawfik (2021), my analysis proceeds progressively. Model (5) validates the original Ohlson's model testing the relationship between P, EPS, and BVS. Model (6) explores the association between VAIC, and P. Model (7) presents a modified version of Ohlson's model by testing the link between EPS, BVS, VAIC and P. Model (8) represents an extended version of Model (7) examining the correlation between BVS, EPS, CEE, SCE HCE and P. While performing my regressions, I controlled for the firms' size, leverage index, revenues growth, and age. I conclude the first part of my analysis by supporting IC's positive influence on the financial performance of intangible-intensive firms in the European market, thus encouraging European firms to invest more into human and structural resources. I then complete my research highlighting the absence of any relevant relationship between IC and financial reporting quality. In a more digitalized global environment, variations in European firms' share price are still exclusively explained by traditional resources, therefore my findings aim at promoting changes in the conventional reporting to allow an adequate inclusion of IC value in the financial statements.

REFERENCES

53. Al Ani M., & Tawfik O. (2021). *Effect of Intangible Assets on the Value Relevance of Accounting Information: Evidence from Emerging Markets*. Journal of Asian Finance Economics and Business Vol. 8, No. 2, pp. 387 – 0399.

54. Chan (2009). *Impact of intellectual capital on organizational performance - An empirical study of companies in the Hang Seng Index (Part 2)*. Available at: www.emeraldinsight.com/0969-6474.htm

55. Codazzo M., & Rossi P. (2019) *The influence of IFRS mandatory adoption on the value relevance of intangible assets in Italy*. Available on Emerald Insight at: https://www.emerald.com/insight/0967-5426.htm

56. Dabić M., Lažnjak J., Smallbone D., & Švarc J., *Intellectual capital, organizational climate, innovation culture, and SME performance Evidence from Croatia*. Available on Emerald Insight at: www.emeraldinsight.com/1462-6004.htm

57. Dzenopoljac V., Bontis N., & Janosevic S. (2016). *Intellectual capital and financial performance in the Serbian ICT industry*. Journal of Intellectual Capital, Vol 17.

58. International Accounting Standards Board (IASB) (2004). *IAS 38: Intangible assets*. Available from https://www.iasplus.com/en/meeting-types/ iasb/2004

59. Khan S. Z., Yang Q., Waheed A., (2018) *Investment in intangible resources and capabilities spurs sustainable competitive advantage and firm performance*. Corporate Social Responsibility and Environmental Management, Vol. 26, No. 1.

60. Lev B. (2018). *Intangibles*. Available at SSRN: https://ssrn.com/abstract=3218586

61. Malikova, O., Brabec, Z., & Rozkovec, J. (2018). *Financial reporting of intangible assets – evidence on information and communication companies in the Czech Republic*. Journal of International Studies, Vol. 11, No. 2, pp. 327 - 340.

62. Mirza A., Malek M., & Abdul-Hamid M. A. (2019). *Value relevance of financial reporting: Evidence from Malaysia*. Cogent Economics & Finance, Vol 7, No 1.

63. Nimtrakoon S. (2015). *The relationship between intellectual capital, firms' market value, and financial performance - Empirical evidence from the ASEAN*. Available on Emerald Insight at: www.emeraldinsight.com/1469-1930.htm

64. Ocak M., & Findik D. (2019). *The Impact of Intangible Assets and Sub-Components of Intangible Assets on Sustainable Growth and Firm Value: Evidence from Turkish Listed Firms*. Sustainability, Vol. 11.

74. Oliveira M., Balle A., Curado C., Kianto A. (2020). *Knowledge sharing, intellectual capital, and organizational results in SMEs: are they related?* Journal of Intellectual Capital.

75. Ousama A. A., Hammami H., & Abdulkarim M. (2019). *The association between intellectual capital and financial performance in the Islamic banking industry -An analysis of the GCC banks*. Available on Emerald Insight at: https://www.emerald.com/insight/1753-8394.htm

76. Xu J., & Li J. (2019). *The impact of intellectual capital on SMEs' performance in China: Empirical evidence from non-high-tech vs. high-tech SMEs*. Available on Emerald Insight at: www.emeraldinsight.com/1469-1930.htm

77. Xu J., & Wang B. (2019). *Intellectual capital and financial performance of Chinese agricultural listed companies*. Custos e Agronegocio, Vol. 15, No. 1, pp. 273 – 290.