

---

## The impact of e-commerce implementation on the profitability of belgian SMES: a quantitative analysis

**Auteur :** Jacobs, Sarah

**Promoteur(s) :** Torsin, Wouter

**Faculté :** HEC-Ecole de gestion de l'Université de Liège

**Diplôme :** Master en sciences de gestion, à finalité spécialisée en Financial Analysis and Audit

**Année académique :** 2022-2023

**URI/URL :** <http://hdl.handle.net/2268.2/17053>

---

*Avertissement à l'attention des usagers :*

*Tous les documents placés en accès ouvert sur le site le site MatheO sont protégés par le droit d'auteur. Conformément aux principes énoncés par la "Budapest Open Access Initiative"(BOAI, 2002), l'utilisateur du site peut lire, télécharger, copier, transmettre, imprimer, chercher ou faire un lien vers le texte intégral de ces documents, les disséquer pour les indexer, s'en servir de données pour un logiciel, ou s'en servir à toute autre fin légale (ou prévue par la réglementation relative au droit d'auteur). Toute utilisation du document à des fins commerciales est strictement interdite.*

*Par ailleurs, l'utilisateur s'engage à respecter les droits moraux de l'auteur, principalement le droit à l'intégrité de l'oeuvre et le droit de paternité et ce dans toute utilisation que l'utilisateur entreprend. Ainsi, à titre d'exemple, lorsqu'il reproduira un document par extrait ou dans son intégralité, l'utilisateur citera de manière complète les sources telles que mentionnées ci-dessus. Toute utilisation non explicitement autorisée ci-avant (telle que par exemple, la modification du document ou son résumé) nécessite l'autorisation préalable et expresse des auteurs ou de leurs ayants droit.*

---



# THE IMPACT OF E-COMMERCE IMPLEMENTATION ON THE PROFITABILITY OF BELGIAN SMES: A QUANTITATIVE ANALYSIS

Jury:

Supervisor:

Wouter TORSIN

Reader:

Laurent PRUNIER

Master thesis by

**Sarah JACOBS**

For a Master's Degree in

Financial Analysis and Audit

Academic year 2022/2023

# Acknowledgements

---

First and foremost, I would like to express my deepest gratitude to my supervisor, Wouter Torsin, for his guidance, support, and expertise throughout the entire process of my Master Thesis. He was always there to answer my questions, give me feedback, and encouraged me. This has been instrumental in shaping the direction and quality of this research. Thank you for your patience.

I would also like to thank my reader, Laurent Prunier, for taking the time to read this thesis, to evaluate it and to share his feedback with me.

I am also grateful to all the participants who took the time to respond to the survey and share their valuable insights necessary for this study. Their contributions have been vital in ensuring the success and relevance of this research.

Finally, I would like to thank my family and friends for their moral support and understanding during this journey at HEC Liège. Their encouragement, patience, and belief in my abilities have been a constant source of motivation. They helped me to overcome challenges, pursue my academic goals, and without them my educative journey would not have been possible.

Thank you everyone!

Sarah

# Table of Contents

---

1	Introduction.....	1
2	Literature Review .....	2
2.1	E-commerce.....	2
2.1.1	Definition of e-commerce .....	2
2.1.2	History of e-commerce .....	3
2.1.3	Advantages of e-commerce.....	5
2.1.4	Disadvantages.....	6
2.1.5	The recent rise of e-commerce .....	6
2.1.6	E-commerce in Belgium.....	7
2.2	SMEs .....	7
2.2.1	Adoption of e-commerce in SMEs.....	7
2.3	Impact of e-commerce on financial performance.....	9
3	Empirical study .....	11
3.1	Methodology .....	11
3.1.1	Regression model .....	11
3.1.2	Dependent variable .....	11
3.1.3	Independent variables.....	11
3.1.4	Control variables.....	12
3.2	Sample selection.....	13
3.3	Descriptive statistics.....	14
3.4	Main results.....	16
3.5	Principal component analysis.....	17
3.6	ANOVA.....	21
3.6.1	Descriptive statistics by group.....	22
3.6.2	ANOVA Test .....	22
3.6.3	Pairwise test .....	23
3.7	Limitations .....	23
4	Conclusion .....	25
5	Appendices .....	26
	Appendix 1: Definition of variables .....	26
	Appendix 2: NACE Codes .....	28
	Appendix 3: Correlation matrix .....	30
	Appendix 4: Regression Results.....	32
6	References.....	35
7	Executive Summary .....	40

# List of Tables

---

Table 1: Selection procedure of the sample..... 14

Table 2: Descriptive statistics ..... 15

Table 3: PCA Results ..... 17

Table 4: Loadings of Principal Components (Comp.1 to Comp.4)..... 18

Table 5: Regression Model Results with weighted PCA ..... 19

Table 6: Descriptive statistics per group ..... 22

Table 7: ANOVA Results..... 22

Table 8: Pairwise Test..... 23

Table 9: Definition of variables..... 27

Table 10: Industries of the companies ..... 29

Table 11: Correlation matrix ..... 31

Table 12: Main results Regression Model ..... 34

# List of figures

---

Figure 1: Variables' contribution to the Principal Components..... 20

Figure 2: Biplot of variables in the PCA space based on squared cosines..... 21

## List of abbreviations

---

ANOVA	Analysis of Variance
B2B	Business-to-business
B2C	Business-to-consumer
ERP	Enterprise Resource Planning
NACE	Nomenclature of Economic Activities
PCA	Principal Component Analysis
ROA	Return on Asset
SME	Small and Medium Enterprises

# 1 Introduction

---

The digital revolution has significantly transformed the business landscape, and e-commerce has emerged as a vital avenue for companies to expand their market reach and enhance their competitive edge. In the context of Belgian small and medium enterprises, the implementation of digital technologies and e-commerce practices is of particular interest, as it holds the potential to revolutionize their operations and shape their financial performance. This master thesis aims to analyse the impact of digital implementation on the profitability of Belgian SMEs, shedding light on the complex relationship between e-commerce and financial outcomes.

The decision to investigate the impact of e-commerce on the profitability of Belgian SMEs resulted from the growing significance of digitalization in the modern business environment. With the increasing reliance on online channels for commerce, it is essential to explore the extent to which SMEs in Belgium have embraced digital transformation and the subsequent influence on their financial performance. Moreover, while existing literature has addressed the impact of e-commerce on profitability, there is a lack of studies specifically focused on Belgian SMEs, creating a research gap that this thesis seeks to bridge.

For this study, a quantitative research approach was adopted. The primary objective is to provide empirical evidence on the relationship between e-commerce and profitability in the context of Belgian SMEs. To achieve this objective, a survey was conducted among a diverse sample of Belgian SMEs, capturing essential data on digital implementation. Regarding the financial numbers, the data was collected from the Bel-first database, providing access to the accounts of Belgian companies.

The primary model employed in this research is a regression model, aiming to determine the relationship between e-commerce and profitability, while controlling for relevant factors. Furthermore, a Principal Component Analysis (PCA) and an Analysis of Variance (ANOVA) were conducted.

The literature review establishes the foundation for this research by exploring the concepts of e-commerce, its advantages, disadvantages, the state of e-commerce in Belgium and especially in the SMEs. Additionally, we analysed the existing literature on the impact of e-commerce on financial performance. Scholars have highlighted various potential benefits of e-commerce but there are conflicting findings regarding the direct impact of e-commerce on financial performance, with some studies suggesting no significant influence.

It is important to acknowledge certain limitations that may influence the findings of this research. One potential limitation is the response rate, as the number of companies that participated in the survey may not fully represent the entire population of Belgian SMEs. However, efforts were made to maximize response rates, and the final sample size of 254 companies provides a substantial basis for analysis.

In conclusion, this master thesis contributes to the existing knowledge by examining the impact of e-commerce on the profitability of Belgian SMEs. By addressing the research gap and generating empirical evidence. This study aims to guide Belgian SMEs in their pursuit of digital transformation and informs them about the significance of e-commerce for sustainable business growth.

## 2 Literature Review

---

### 2.1 E-commerce

#### 2.1.1 Definition of e-commerce

E-commerce has been defined in multiple ways over the years.

E-commerce can be defined as “the use of the Internet, the Web, and mobile apps and browsers running on mobile devices to transact business. More formally, digitally enabled commercial transactions between and among organizations and individuals” (Kenneth & Guercio, 2017).

Zheng (2009) defined it as “commercial trade activities carried out by electronic methods, the electronicization of traditional trades. The electronic means refer to electronic technologies, tools, equipments and systems, including telephone, telegram, television, facsimile, e-mail, electronic data interchange, computer, the communication network, credit card, electronic money, and Internet. Commercial activities comprise inquiry, offer, negotiation, contract signing, contract fulfilment, payment. In a narrow sense, e-commerce refers to various online commercial activities focusing on commodity exchanges by electronic methods, computer network in particular, by companies, factories, enterprises, industrial undertaking and consumers.”

According to the European Union (2019), e-commerce is defined as “the sale or purchase of goods or services, whether between businesses, households, individuals or private organizations, through electronic transactions conducted via the internet or other computer-mediated (online communication) networks”.

Jain et al. (2021) divided e-commerce into 6 types

- Business-to-business: B2B e-commerce refers to the sale of goods or services through online transactions between companies.
- Business-to-consumer: B2C e-commerce is the term used to describe a company that wants to reach an individual consumer. Retail transactions, travel, and other services, as well as online content purchases, are all included in business-to-consumer (B2C) e-commerce.
- Consumer-to-consumer: C2C e-commerce refers to the trade between private individuals. In contrast to B2C and B2B transactions, no companies are directly involved in the trade. Usually, a third party that provides an online transaction forum conducts this trade. Examples of well-known platforms in the C2C space are the online marketplace eBay and the online travel agency Airbnb.
- Consumer-to-business (C2B): Individuals offer their services or products to businesses that specifically target particular categories of goods or services. E-commerce businesses that rely on crowdsourcing frequently adopt this technique.
- Business to administration (B2A): This section includes all business-to-government online interactions. This includes a wide range of various programs, particularly in the fields of taxes, social assistance, healthcare, and legal records. Spending on e-government has recently greatly increased the range of these service modalities.
- Consumer to administration (C2A): This model refers to e-commerce activities between individuals and the government. This often refers to the areas of education, tax, social security and health

Kenneth & Guercio (2017) add to these types:

- M-commerce, also known as mobile e-commerce. It is the use of mobile devices to facilitate online transactions. Cellular and wireless networks are used in m-commerce to link smartphones and tablet computers to the internet. It enables mobile users for example making



purchases, book flights, access internet information, and use a growing number of financial services.

- Social networks and online social connections serve as the foundation for social e-commerce. Online collaborative shopping tools, social search (recommendations from online verified friends), social sign-on, network notification (sharing of approval or disapproval of products, services, and content), and the rising popularity of integrated social commerce tools like BuyWithMe and Facebook are some of the factors driving the growth of social e-commerce

The terms e-business and e-commerce are often used as synonyms. But in most cases e-business is used in a broader sense than e-commerce. According to Eurostat (2016) it refers to “the use of information and communication technology to support a business strategy. E-business is more than just e-commerce, and involves business processes spanning the entire value chain from purchasing and logistics management to customer service and corporate partnerships - all of them making use of electronic communications.” However, the definitions and restrictions of both e-business and e-commerce are up for dispute. Some say that e-commerce includes all organizational actions conducted electronically that support a firm's market exchanges, including the firm's whole information system architecture (Rayport and Jaworski, 2003). On the other hand, some contend that e-business includes all internal and external operations based on computers, including e-commerce (Kalakota and Robinson, 2003).

We made the decision to use the definition offered by the European Commission for my empirical study on e-commerce. We have chosen to adopt this definition since it is comprehensive and effectively reflects the core of e-commerce as a commercial activity conducted through digital means. Both business-to-business (B2B) and business-to-consumer (B2C) transactions, which are the two main types of e-commerce, are included by this definition. This definition is also widely acknowledged and employed by several organizations, making it a trustworthy and respectable source. Therefore, we can make sure that my research complies with current industry norms and standards by using this concept to my empirical investigation.

### 2.1.2 History of e-commerce

The exponential rise of e-commerce has shifted the worldwide market paradigm. This innovative structure, which is based on technical advancement, has ushered in a new era of trade. Businesses are leveraging digital markets to stay relevant and competitive now more than ever. Buying things online has suddenly become a part of their daily business. The internet is the best medium for modern-day customers because of its accessibility, flexibility, and ease (Costa, & Castro, 2021).

To better understand e-commerce and its impact, it is first and foremost necessary to explain when it began and how it has developed over the years.

It is difficult to say exactly when e-commerce started. Electronic funds transfer, or EFT, which allowed money to be transported electronically from one organization to another, is credited with launching the first e-commerce applications in the early 1970s, especially among financial organizations. However, only major firms, financial institutions, and a few other bold businesses used these applications (Turban et al., 2015). Electronic Data Interchange standards were created in the 1980s, enabling businesses to exchange commercial documents and carry out digital business transactions via private networks. (Kenneth & Guercio, 2017). The launch of the World Wide Web in the early 1990s marked a significant turning point in the evolution of e-commerce. This made it possible for businesses to create a text- and image-rich online presence. The Internet started to be used for business purposes and more and more users used the World Wide Web. Additionally, a significant number of so-called dot-coms, or Internet start-ups, emerged. It was then, when the term e-commerce was first used (Turban et al., 2015).

Kenneth and Guercio (2017) split the history of e-commerce into three stages. The first stage is the 'Innovation Phase,' which lasted from 1995 to 2000. The Consolidation Phase, the second stage, runs from 2001 to 2006. The third phase is the reinvention phase, which started in 2007 and lasts until today.

During the time of invention, e-commerce referred to the Internet-based retail sales of relatively basic commodities. Only crude static display advertisements and weak search engines were used for marketing. Most major companies had a basic static website that represented their brands as their online policy, if they had one. A global universe of information, saved on HTML pages made by hundreds of millions of people and thousands of libraries, governments, and scientific institutions, was envisioned as being accessible to everyone on Earth with cheap, affordable computers.

The early developments in e-commerce offered economists a realistic view of a virtually ideal competitive market: one in which buyers have access to all pertinent market data on a global scale, suppliers compete with one another for business on a nearly limitless number of fronts, and information about pricing, cost, and quality is evenly dispersed. Digital marketplaces with near-perfect information were created through the Internet. Additionally, retailers had equivalent direct access to hundreds of millions of potential clients. Marketers were thanks to the new technologies able to segment the market into groups with various demands and price sensitivity. This helped to target the groups with advertising and promotional messaging.

Transaction costs substantially decreased in this almost ideal information marketplace due to the sharp decline in search costs, including those associated with finding pricing, product descriptions, payment settlements, and order fulfilment. The cost of finding clients would also go down for businesses, which eliminated the need for costly advertising. Ads could be tailored to each customer's demands at the same time. Consumers were now able to determine the best price, quality, and availability of most items anywhere rapidly and precisely in the globe. Prices and even expenses had become more accessible to the user.

A so-called friction free commerce emerged, where information is widely available, transaction costs are low, prices may be modified rapidly to accurately reflect the demand, and competitive advantages are removed.

In the early stage of e-commerce, there was a high focus on reaching extremely high market awareness in a short time. Furthermore, there was a broad perception in the beginning that governments and courts would not be able to control or limit the Internet.

From 2001 to 2006, in the phase of consolidation, e-commerce evolved to not only retail goods but also more complicated services like travel and financial services. Personal computers, the main method of accessing the Internet, were becoming more powerful and less expensive. These computers were often used at home or at business. Internet marketing has come to imply deploying rich media and video commercials, behaviourally targeted marketing messages based on ad networks and auction marketplaces, as well as search engine advertising that is tailored to user queries. The online policies of both large and small businesses grew to incorporate a wider "web presence" that went beyond websites and included things like e-mail, display, and search engine campaigns, several websites for each product, and the creation of some restricted community feedback facilities.

In the beginning of 2007, e-commerce has undergone yet another transformation as a result of the explosive rise of Web 2.0 (a collection of software and technologies that support user-generated content, including online social networks, blogs, video and picture sharing websites, and wikis), the increasing use of mobile devices like smartphones and tablet computers, the extension of e-commerce to include local goods and services, and the creation of an on-demand service economy made possible by millions of mobile apps. Mobile devices have evolved into entertainment hubs as well as on-the-go buying platforms for retail products and services, and entertainment content has grown to be a significant source of e-commerce revenue. The growing usage of social networks, word-of-mouth, viral

marketing, and far more potent data warehouses and analytical tools for really individualized marketing have altered marketing.

In an effort to surround the online consumer with coordinated marketing messages, businesses have significantly increased their online presence by expanding beyond static web pages to social networks like Facebook, Twitter, Pinterest, and Instagram.

Uber, Airbnb, Instacart, and Handy are just a few examples of the new on-demand, personal service companies that have emerged as a result of the recent reinvention of e-commerce. These companies have developed profitable marketplaces based on the architecture of mobile platforms by drawing on a sizable pool of idle resources.

### 2.1.3 Advantages of e-commerce

The main advantages of e-commerce on the consumer side are that the consumers can shop any time and from any place. It is no longer necessary to stand in line at the checkout and the way to the store has also become superfluous to the customer. Online shoppers are not restricted to particular business hours and can place orders at any time (Išoraitė & Miniotienė, 2018).

Another advantage are bargains and online discounts. The online retailers work much more with discounts and cheap offers than the stationary trade. Furthermore, it is a lot easier for the buyer to compare prices on different websites, and find the cheapest one (Turban et al., 2018).

Moreover, online buyers can benefit from customer reviews and recommendations while making decisions since they may learn about other people's perspectives and experiences (Išoraitė & Miniotienė, 2018).

Ecommerce companies are able to display a wide variety of products because there are no restrictions on shelf space or shop size. Consumers have a broader selection to choose from than in a shop. Besides, online you often have the possibility to configure a product according to your wishes. (Niranjanamurthy et al., 2013).

The most significant advantage on the organization side is the cost reduction. E-commerce businesses avoid one of the largest expense overheads that retailers must pay because there is no requirement for a physical store. There are lower costs for example for storage, information processing and transactions. It is simpler to analyse the sales data. This enables a better management of stocks, production and distribution (Khan, 2016).

Another advantage for the organizations is that they can improve their marketing. Personal information obtained through tracking and analytics tools can be used to develop comprehensive consumer profiles. This information gives the chance to position more focused advertisements, such as the products that were most recently viewed in your online store (Niranjanamurthy et al., 2013).

The global reach of the organization is also an advantage. The companies may communicate and conduct business with potential clients across national borders, if not internationally. You can also trade automatically 24 hours a day without having to take into account the traditional opening and closing hours of a store (Turban et al., 2018).

Furthermore, starting an online business takes less capital than a conventional business. There is no need to pay for utilities, rent or buy a physical space, hire people, and stock inventory. (Išoraitė & Miniotienė, 2018).

#### 2.1.4 Disadvantages

Consumer privacy is one of the key challenges in this regard. Digital data collection and recording of personal information allows for the creation of customer profiles that include sensitive data like address, email, and bank information. The information that has been kept is vulnerable to data breaches and can be accessed by cybercriminals with bad intentions. Recent high-profile cyber security incidents where consumers' personal information was taken have somewhat weakened stakeholders' confidence. As a result, consumers are at some risk of identity theft and credit card fraud. Additionally, businesses have been accused by several consumer organizations and right agencies for using customer information for tailored ads (Ferrera & Kessedjian ,2019).

In e-commerce, trust is viewed as being crucial. Additionally, its absence can discourage businesses and customers from using digital settings. According to the research, consumers are less inclined to participate in online commerce when they are worried about security and confidence in the transaction (Khan, 2016). In the industrialized world, trust is built on the implementation of impartiality in electronic transactions and the adoption of modern regulations. E-commerce-based transactions suffer in regions with underdeveloped legal and judicial systems due to a lack of security, whether actual or perceived. (Roni Bhowmik, 2012). To grow the e-commerce industry, private and governmental cooperation is required. Collaboration builds trust among individuals, which is essential for the success of e-commerce (Khan, 2016).

Due to the accessibility of e-commerce, there is also a risk of increasing consumerism and impulse purchases. Known issues for small firms implementing e-commerce activities include a significant number of "returned items" and the ensuing stockout, challenges identifying cycle stock, and ultimately lost sales opportunities (Ferrera & Kessedjian, 2019).

Another disadvantage can be that online purchases can take a long time to arrive, and shipping costs might occasionally be higher than the item's cost, especially if the purchase is made from another country. Online purchases may be more challenging to return than those made in physical stores (Išoraitė & Miniotienė, 2018).

#### 2.1.5 The recent rise of e-commerce

The COVID-19 epidemic has sparked daily use of e-commerce among consumers and businesses, marking 2020 as a turning point in the global economy and heralding the progressive displacement of conventional business structures. As the worldwide pandemic drove many physical businesses to close, people increasingly used online shopping to buy the products they needed (Costa & Castro, 2021). The most recent statistics from Statista show that between 2017 and 2022, Europe's e-commerce industry revenue dramatically grew, rising from around 406 billion to more than 827 billion dollars. By 2025, Statista predicts that Europe's e-commerce sales would surpass 1.2 trillion dollars (Statista, 2022).

The growth of mobile devices is also a key driver for the rise of e-commerce. More than ever, consumers rely on their mobile devices to satisfy their shopping needs. The rapid emergence of new disruptive business models, such as last-mile delivery, which depends on quick delivery of items in under an hour, has been strongly linked to this evolution and change in consumer behaviour (Costa & Castro, 2021).

According to the World Economic Forum's research (2020), the rapid growth of a second wave of e-commerce, or quick commerce, has been attributed to the increasing demand for speedier delivery methods. Due to consumers' increasing need for quicker and more convenient business processes, the emergence of q-commerce threatens to upend conventional business paradigms.

Therefore, SMEs must overcome the past and start to see the advantages of implementing and using technology in the future (Costa & Castro, 2021).

## 2.1.6 E-commerce in Belgium

With 90% of its 11.5 million inhabitants utilizing the internet in 2019, Belgium has a highly connected population. This has led to a flourishing e-commerce sector in the nation, with sales exceeding €10.62 billion in 2018 (Ecommerce Europe, 2023). In 2022 the e-commerce sales revenue already reached €12 billion. Even individuals who had previously been dubious about purchasing and selling online were forced to switch their consumption to the digital domain by the 2020 Covid crisis. Nearly two-thirds of Belgians reported making online purchases in 2021, an increase from just over half in the years before to the coronavirus epidemic. In 2022, 63% of alle Belgians reported to have made an online purchase. Looking at the geographical differences within the nation, e-commerce penetration is highest in mostly Dutch-speaking Flanders (67%) compared to French-speaking Wallonia (56%) (Statista, 2022).

## 2.2 SMEs

Small and medium-sized businesses (SME), according to the European Commission, are businesses with less than 250 employees and a revenue of less than EUR 50 million or a balance sheet total of less than EUR 43 million. (SPF Economie, 2022). They represent 99 percent of all EU firms. They contribute significantly to value addition across the board and employ about 100 million people (European Commission, n.d.).

SMEs are essential to Europe's future economic and social stability. Although SMEs are modest on their own, they are numerous and have a significant impact on society, the environment, and the economy as a whole. Small and medium-sized enterprises are the foundation of the European economy and are woven into the fabric of European society. They are a driving force behind innovation and long-term change, and they are essential for providing goods and services to EU citizens both domestically and abroad (Marín, 2019). Furthermore, SMEs have a crucial role in fostering competition and in introducing novel goods and techniques to the market. They are able to quickly adapt to changes in their environment. In the context of globalization and the rise of the informational society, this gives them a significant edge (Robu, 2013).

In Belgium, on December 31, 2020, there were 1,049,163 small and medium-sized businesses liable to VAT. The latter has shown a persistent increasing tendency throughout time, with positive yearly growth rates (SPF Economie, 2022). In addition, it can be seen that online sales on Belgian sites are constantly increasing. In 2021 they increased by 33% (Van Driessche Luc, 2022).

### 2.2.1 Adoption of e-commerce in SMEs

Innovation is acknowledged as a crucial element of the economic growth process of a company, and in this sense, it can be understood as the creation, commercialization, and use of novel goods, processes, and services (OECD, 2000). The capacity of businesses to take advantage of global business possibilities by commercializing new products and processes faster than their rivals is essential in increasing economic prosperity (OECD, 2004).

SMEs are made up of a highly diverse range of business kinds. They are typically thought of as innovative, adaptable, and flexible businesses, and because of this, e-commerce is a suitable fit for them (Al-Qirim, 2007).

Technologies used in e-commerce have the potential to significantly increase firm-level productivity (OECD, 2000). Businesses inside supply and distribution chains that were not previously connected can

establish direct contact using e-commerce applications. E-commerce, according to Zhu and Kraemer (2002), increases information flow while reducing waste and transaction costs.

Nevertheless, a variety of obstacles and limitations have made it difficult for SMEs to use e-commerce, despite the claimed benefits. Doubts regarding security and privacy, the high cost of user assistance, and operating and maintenance costs are the key obstacles (Jahanshahi et al., 2013). Large companies face less financial and infrastructure restrictions when implementing e-commerce, but small and medium businesses encounter resource constraints, notably in terms of financial resources (Sedighi et al., 2018).

There are two primary categories of obstacles to e-commerce adoption among SMEs: internal and external issues. The first is closely related to owners and managers' lack of awareness and digital literacy about technological deployment (Cragg et al., 2002). According to Chuang et al. (2007), managerial experience of the owners/managers is favourably correlated with the level of e-commerce adoption. There are three main characteristics that may be used to categorize the perceived value of e-commerce among SMEs managers: operational assistance, managerial productivity, and strategic decision aids. The operational support factor evaluates how much of a benefit consumers perceive as being related to enhanced client service, cost savings, and distribution channels. The managers productivity factor pertains to the advantage of e-commerce in enhancing managers' productivity and enhancing access to information. The component that helps with strategic decision-making illustrates how e-commerce can help getting in touch with networks and partners and to assist managers in making better strategic decisions (Grandon & Pearson, 2004)

In order to properly use new technology, managers/owners must be aware of it and understand how the business is changing (Costa & Castro, 2021). In addition to that, the advantages of e-commerce should be emphasized. Since many employees, especially in SMEs with a small work force, do not want to change, managers should be among the first to adopt e-commerce applications. In order to be made aware of the advantages and disadvantages of e-commerce, it would be helpful to offer information courses for employees (Ha, 2020).

According to Tan and Tyler (2007), the majority of the issues with e-commerce adoption among SMEs relate to technology readiness, lack of technical understanding, and the distribution of human and financial resources. SMEs frequently have poor endowments of human and financial resources and are consequently less likely to undertake organizational reforms (Mustafa et al., 2019).

Zhu (2004) noted that SMEs face more competitive conditions due to the international nature of the digital market and its fiercer competition. The change from traditional to digital commerce venues is therefore a significant challenge for SMEs.

Regarding external aspects, the business environment is one of the key determinants of e-commerce adoption and, given its importance, should set off policy actions and laws that take SMEs' unique circumstances into account (Abou-Shouk & Eraqi, 2015). Supporting governmental policies for SMEs can have a significant impact on the adoption of e-commerce. Measures, which may include tax breaks, enhancing the e-commerce legal environment, consulting activities, and assisting businesses in learning E-commerce, is a prerequisite for businesses to use the E-commerce model and encourages a quicker application of the paradigm (Ha, 2020).

As SMEs are not uniform, it is difficult for researchers to understand their strategies and foresee successful paths as well as effective policy actions. With the help of technology, consumer and business relationships are becoming increasingly intimate, enabling for more effective supply chains, cost savings, and mobility. With the advent of digital technologies, the world's markets have recently experienced a paradigm change that has placed organizations, sectors, and customers in unanticipated situations. Businesses must therefore modify their tactics to match the increased demand in digital marketplaces if they want to thrive and remain competitive (Bilgihan et al., 2016).

Although some studies view the use of digital platforms as a component of innovation plans, the current environment would seem to indicate that this advancement is essential for SME resilience and future viability (Costa & Castro, 2021).

## 2.3 Impact of e-commerce on financial performance

Bergendahl (2005) noted in his research three cornerstones of e-commerce profitability. Firstly, the firm “serves an existing customer-base” by informing, selling and charging their customers online. Due to investments in online distribution, a business can save operating costs associated with sales, distribution, keeping inventory, ordering and payment, and thus increase their profits. Thus, the second important point is the “cost savings from online operations.” Besides, e-commerce can help increasing the consumer base, which enables to sell more products and boost your income. This effect is described as “net revenues from sales expansion.”

Willis (2004) adds that costs for transactions, search and transportation can be reduced by e-firms. These cost reductions are partially attained through lowering of the quantity of staff needed to complete each business task. Furthermore, through improved supply chain management, e-firms can reduce costs when conducting business. To reduce the quantity of inventory on hand while still guaranteeing that there are enough manufacturing inputs available to meet current orders, e-firms can interface their sales transaction system directly with the production side of their organization. By reducing inventory holding costs and the possible expense of having to slow down or stop the manufacturing line should the company run out of inputs, this implies savings for the corporation. For e-firms, advertising costs can be decreased. This is so that they may promote their goods on electronic channels. Companies may contact more prospective consumers at a reduced cost by using e-infrastructure as cost-effective platforms.

According to the research of Kraemer et al. (2005) it is anticipated that using new information technologies would boost performance by decreasing transaction costs and increasing activity coordination among company partners. Because online transactions are automated, e-commerce (particularly B2B) is anticipated to result in decreased coordination costs as well as productivity and efficiency advantages. E-commerce is also anticipated to ease entry into new markets or market expansion, as well as improved system integration with suppliers and customers. Thus, market impacts, efficiency impacts, and coordination impacts have all been highlighted as three aspects of how e-commerce affects performance.

In the study of Nurlinda et al. (2020) it was found that financial performance is influenced by internal and external factors.

The introduction of e-commerce businesses improved service quality and speed, access to necessary information, and the perception that online businesses benefited more than conventional trading practices as well as the companies' perception that using e-commerce may increase cost effectiveness.

If an organization wants to improve its financial performance, it must provide organizational support for the use of electronic business transactions, skilled personnel, appropriate facilities, and infrastructure, and obviously its own efforts to do so. This study makes it clear that the external environment is one of the factors influencing the adoption of electronic business transactions.

Even if some literature state that there are many cost reductions due to e-commerce, and that the financial performance is positively influenced, others say that it has no significant influence on the profitability of organizations.

According to the regression analysis of Purba et al. (2021), who conducted a study on the effect of e-commerce on financial performance in Indonesia. Neither a rise nor a decline in e-commerce will stimulate a change in financial performance.

Šaković et al. (2020) looked at the mediating effects of three different types of internet sales channels (websites, online marketplaces, and search engines). They conducted their analysis under the hypothesis that different internet channels are directly tied to distinct client categories and are thought to have a diverse influence on business success. They confirmed with their research that e-commerce has a negative impact on business performance based on 863 SMEs from 10 European nations when focusing solely on the direct effect, which is consistent with earlier research as Asghar et al. (2012).

However, due to subsequent studies showing that the impact of e-commerce on business performance depends on the internet sales channels, these conclusions should be regarded with care. In fact, further research demonstrates that e-commerce improves business success when used in conjunction with two categories of online sales platforms, namely websites and marketplaces.

In conclusion, despite a growing corpus of study on the effect of e-commerce on businesses' financial performance, the findings are sometimes uncertain opposing one another. Given this, we established a hypothesis to direct our research into how e-commerce affects the profitability of Belgian SMEs.

***Hypothesis 1: E-commerce has an impact on the profitability of Belgian SMEs***

To verify this theory and learn more about the intricate connection between e-commerce and financial performance, an empirical study is required. Nevertheless, it is evident that e-commerce is a significant aspect of the contemporary business environment and that SMEs who want to continue to be successful and competitive cannot ignore it.



## 3 Empirical study

---

In order to test the developed hypotheses, an empirical study was conducted. The scope of the investigation includes Belgian SMEs. The creation of the database, the variables utilized for the study, and the empirical techniques are all exposed in this part.

### 3.1 Methodology

#### 3.1.1 Regression model

The following models were created in order to gather evidence on the connection between e-commerce and the profitability of Belgian businesses:

$$\text{ROA} = \alpha + \beta_1 \text{ Digital Implementation} + \gamma_1 \text{ size} + \gamma_2 \text{ debt\_equity\_ratio} + \gamma_3 \text{ value\_added} + \gamma_4 \text{ current\_ratio} + \gamma_5 \text{ NACE}$$

#### 3.1.2 Dependent variable

The dependent variable in our model, is the profitability metric. To measure the profitability of the firm, we used the return on asset (ROA). By analysing how effectively a company uses its assets to generate revenue over the course of a year, this ratio demonstrates the financial success of a company. ROA measures a company's management capacity to profit from its assets (Aissa & Goaid, 2016). It is obtained by dividing the profit and loss after taxes by the total assets.

#### 3.1.3 Independent variables

The independent variables measure the degree of digital implementation of the company, in order to understand how well a company is utilizing digital technologies to expand and flourish in the marketplace. 15 variables were used to characterize the digital implementation of the firm. They are divided into 4 big parts: Information, E-commerce fulfilment/Security factors, Technological Readiness, Organizational Readiness.

In the information part, 5 questions were included. The first one is, if the company provides product or service information online. It is a crucial factor to measure digital implementation, since it makes it simple for clients to access and learn about the offers of the companies, whether these are products or services. It can help the company to boost their sales and overall client satisfaction. The second question is about product reviews. Online reviews have become an increasingly significant factor in the decisions the customers take. Positive online reviews can assist to the reputation of a company. Another key variable for measuring digital implementation is the possibility for the customers to make orders online. The fourth variable is about offers that are made using an online service. Finally, the last variable on the information part is about having an online customer support service. It is relevant to maintain customer satisfaction and loyalty. Furthermore, it is a less expensive alternative to traditional customer support channels.

In the second part, which is about the e-commerce fulfilment and security factors, 4 questions were included. These questions concerned the delivery process, the return mechanism, the possibility of

online payment and the availability of security information on transactions and sensitive customer data.

The third part concerns the technological readiness of the company. The organization may function more smoothly and productively by using IT tools and software to automate procedures and boost productivity. A customer relationship management (CRM) tool, for instance, may assist in managing customer interactions and information, enabling more individualized and efficient customer contact. Similar to this, having an ERP system may assist in managing inventory and supply chain procedures, ensuring that items are accessible when required and lowering the risk of stockouts. A corporation must have access to e-commerce support systems like payment gateways and shipment management software in order to successfully conduct business online. Customers may safely and quickly make online purchases with the aid of a payment gateway, and shipping management software can help track orders and guarantee that goods are delivered on time and in excellent condition.

The last part of the questionnaire is about the organizational readiness. Because it may affect how motivated and capable people are to interact with new technology and procedures, employee motivation is crucial. The execution of e-commerce operations may be hampered by employees' resistance to change or a lack of technical expertise. Leadership openness is also essential for a successful transition to digital. The adoption of e-commerce operations inside the organization may be accelerated by leaders who are open to innovative concepts and prepared to invest in cutting-edge technologies. Another crucial factor is the financial readiness of the company. Investment up front is frequently needed for e-commerce operations, for example for the creation of a website or the adoption of new software. The last variable is about the approval of technological advancement, which is important because it affects how willingly the business would spend in new processes and technology. The execution of e-commerce operations may be hampered by a lack of understanding of new technology or by a hostility to them.

Finally, these are all important factors that can impact the success of e-commerce activities. As for my regression model, we decided to use the online offers the company does via an online service as the independent variable.

*<Insert Table 9 about here.>*

### 3.1.4 Control variables

The analysis of earlier literature reveals that there are various factors that influence profitability. When determining if the implementation of e-commerce might affect profitability, several factors should be considered.

The first factor we need to include as a control variable in our model is the size. Doğan (2013) found in his study a correlation between the profitability of a company and size indicators. In other words, when the size of a company grows, its profitability increases. One may argue that because bigger organizations enjoy the economies of scale brought on by higher production quantities, they are able to create goods far more effectively than small businesses. As a measure to control for the size, the natural logarithm of the total assets was used. The assets of the company are changed into a distribution that is more symmetrical and resembles a normal distribution by calculating the natural logarithm of the total assets. This facilitates the analysis and comparison of the data.

Furthermore, it is useful to implement the net added value of the company. Value added is the difference between the output that a business generates via the sale of the goods and services it has traded and the value of the raw materials, commodities, and other goods and services that the business purchased as inputs (Nasrudin, 2022).

Another ratio we use is the debt-to-equity ratio. It is a financial ratio that calculates the value of total debt and financial liabilities against the total shareholder's equity. It indicates the amount of debt a company has relative to its equity.  $D/E \text{ ratio} = (\text{short term debt} + \text{long term debt} + \text{fixed payment obligations}) / \text{Shareholders' Equity}$ . A high ratio indicates that the company has more debt than equity, which can lead to higher financial risks. This would influence the profitability of the company and therefore it is important to include the debt-to-equity ratio as a control variable in the model (CFI Team, 2023).

Another variable we need to include in our model is the current ratio. It is a liquidity measure and shows the capacity of the firm to pay its short-term debts that are due within a year. It is calculated by dividing the current assets by current liabilities. A high current ratio suggests that a firm has the financial capacity to pay off its short-term debts in a timely way since it shows that it has more current assets than current liabilities. Profitability may benefit from this as it lowers the chance of default and fosters continuing goodwill with vendors and lenders. On the other side, a low current ratio can be a sign that a business is having financial problems and may find it difficult to pay its short-term debts, which might have a negative effect on profitability. Therefore, by controlling for any potential confounding effects of short-term liquidity, using the current ratio as a control variable in a regression model can assist to isolate the influence of e-commerce on profitability (Fernando, 2023).

The last control variable we include in our model is the industry of the companies. We used dummy variables to represent the different industries. Therefore, the Nomenclature of Economic Activities (NACE) codes of the companies were used. NACE, is the acronym for the statistical classification of economic activities in the European Community. It is used to categorize economic activities in the European Union (NACEV2, 2023). We divided the industries into manufacturing, service, and construction.

*<Insert Table 10 about here.>*

## 3.2 Sample selection

The Bel-first database was used to retrieve the data needed for this investigation. Bel-first is a product of Bureau van Dijk, a corporation that offers data and financial metrics on private companies. Bel-first served as a crucial instrument in the execution of this study since it was the only database that provided access to data from Belgian private enterprises (Bureau van Dijk, 2023).

We initially set several constraints in order to reach our study sample before delivering the survey. As the research focuses on SMEs, this is the first criterion for delimiting the enterprises. Hence, only small and medium-sized companies received the survey. Also, we exclusively work with Belgian firms, so that was another consideration when choosing which businesses to send the survey to. Since the most recent data on Bel-first is from 2021, another criterion is that the companies have provided data from that year. Furthermore, to send out the survey it is important that the e-mail address of the company was available. The last two criteria that were important are the numbers of the P/L after taxes and the total assets, to calculate the ROA. The survey was written in English, French, and Dutch to remove any potential language barriers for the companies and to generate as many replies as possible.

As shown in the table below, the sample is constituted by a total of 31,456 firms. The electronic survey was sent out to those companies by e-mail, which contained all the information needed to understand the topic. The survey ran from February to May 2023. One reminder was sent out to the companies that had not responded until the first of April. In total, 276 companies responded to the survey and after subtracting the ones where the needed data was still missing, a total of 254 answers were left.

### Selection procedure

Active companies		2.301.050
Medium sized, small companies	915.577	592.371
Only Belgian companies	2.989.256	521.061
Years with available accounts: 2021	573.243	470.173
Companies with e-mail address	96.434	31.570
Total assets, 2021	571.544	31.526
P/L for the period after taxes, 2021	524.806	31.456
= Research population		<b>31.456</b>

*Table 1: Selection procedure of the sample*

*Source: This table is based on figures retrieved Bel-first database*

### 3.3 Descriptive statistics

The mean return on asset (ROA) is 0,0716, which indicates that on average the companies in our sample are profitable. Looking at the digital implementation variables in the 4 different groups, the following conclusions can be drawn. The first 5 variables concern the information part. For DI1, the mean is 0.5945, which means that on average, 59.45% of the sampled businesses offer online access to product information. The standard deviation (sd) for DI1 is 0.492, indicating some variation in the replies, with some businesses offering a lot of online product information while others offer very little. The means of DI4 and DI5 which concern respectively the offers that are made using an online service, and the online support service that is available are with 62,99% and 65,75% rather high. However, the standard deviations show that there are some companies that make a lot of offers online and provide online support services and others not at all. Product reviews (DI2) are with a mean of 15,75% quite low. Regarding the possibility of online orders (DI3), only about 36,61% on average of the companies in the sample offer the possibility to their clients to buy their products/services online. Overall, each of the standard deviations of the variable is not particularly low, indicating some heterogeneity in the responses from the sampled companies. Looking at the variables that concern the organizational readiness towards e-commerce, you can see that on average the staff and the leader are quite motivated towards e-commerce implementation and adoption. The median indicates that most of the staff and leaders are open for the e-commerce adoption. The majority of the respondents also believes that the organization is financially ready to invest in e-commerce and that the technological development is highly accepted in most companies of the sample.

Concerning the technological readiness of the companies, the mean value of DI10 (2,9843) shows that the companies have on average a moderate level of IT tools available, in contrast to the software and e-commerce support systems which on average are rather low.

Regarding the current ratio, the sample companies have on average sufficient current assets to cover their current liabilities, but the standard deviation of 6,7944 indicates that there is a wide variation in the liquidity of the sample companies. The average firm of the dataset has a moderate level of debt relative to equity and a relatively low level of asset turnover. But again, there is a large heterogeneity

in these results. The mean size of the companies is 6,697, which shows that the sample companies are on average relatively large. The table demonstrates that most of the companies in the sample are in the service industry (0,6772). The proportion of companies that belong to the manufacturing industry is 0,2047, and the proportion in the construction sector is 0,0945.

	mean	sd	median	min	max	Q1	Q3
<b>ROA</b>	0,0716	0,1654	0,046	-1,1571	0,806	0,0097	0,1320
<b>DI1</b>	0,5945	0,492	1	0	1	0	1
<b>DI2</b>	0,1575	0,365	0	0	1	0	0
<b>DI3</b>	0,3661	0,4827	0	0	1	0	1
<b>DI4</b>	0,6299	0,4838	1	0	1	0	1
<b>DI5</b>	0,6575	0,4755	1	0	1	0	1
<b>DI6</b>	0,6929	0,4622	1	0	1	0	1
<b>DI7</b>	0,1496	0,3574	0	0	1	0	0
<b>DI8</b>	0,3268	0,47	0	0	1	0	1
<b>DI9</b>	0,4252	0,4953	0	0	1	0	1
<b>DI10</b>	2,9843	1,1523	3	1	5	2	4
<b>DI11</b>	0,3465	0,4768	0	0	1	0	1
<b>DI12</b>	2,6535	1,3652	3	1	5	1	4
<b>DI13</b>	2,7244	1,3494	3	1	5	1	4
<b>DI14</b>	2,78	1,4221	3	1	5	1	4
<b>DI15</b>	3,685	1,1225	4	1	5	3	4
<b>current_ratio</b>	3,9995	6,7944	1,97	0,05	66,1	1,252	4,025
<b>value_added</b>	0,3648	0,3509	0,3062	-1,1058	2,4521	0,1537	0,5263
<b>debt_equity_ratio</b>	1,9929	5,9255	0,7961	-27,6755	61,5447	0,2752	1,9819
<b>SIZE</b>	6,697	1,4311	6,8882	2,1776	9,4002	5,784	7,814
<b>Manufacturing</b>	0,2047	0,4043	0	0	1	0	0
<b>Service</b>	0,6772	0,4685	1	0	1	0	1
<b>Construction</b>	0,09449	0,2931	0	0	1	0	0

Table 2: Descriptive statistics

Source: This table is based on author's calculations run in RStudio

In Table 4, we display the Pearson correlation between the various factors. The correlation coefficients indicate the strength and direction of the relationships between the variables. Among the DI variables, the highest positive correlation is observed between DI13 and DI12 (0.686), followed by DI8 and DI3 (0.516) and DI14 and DI13 (0.586). Conversely, the highest negative correlation is observed between Service and Manufacturing (-0.735), indicating an inverse relationship between these two variables. Additionally, a moderate positive correlation is observed between value added and ROA (0.535), suggesting a potential association between added value and profitability.

The correlation matrix shows that none of the variables are very strongly correlated, which is preferable in the regression analysis to prevent multicollinearity.

*<Insert Table 11 about here.>*

### 3.4 Main results

The table 5 displays the main results of the regression models we run. The regression model was estimated using the R statistical program.

The coefficients of the independent variables reflect the relationship between each of the digital implementation variables and ROA. For example, DI1 has a coefficient of 0.015, DI2 has a coefficient of -0.011, DI3 has a coefficient of -0.036, and so on. These coefficients indicate the direction and magnitude of the effect that each variable has on ROA. For example, for a one unit increase in DI1, ROA increases about 0,015. In the case of DI2, it decreases about 0,011. However, the statistical significance of the coefficients was assessed, and it was found that only DI3 and DI12 were significant at a 10 percent level ( $p < 0.1$ ), while the other independent variables were not statistically significant. DI3, which concerns the capability to do orders online, has a coefficient of -0,036, meaning that with a one-unit increase, the dependent variable ROA would decrease about 0,036. DI12 concerns the motivation of the staff towards the introduction of e-commerce. This coefficient is positive and indicates an increase of 0,012 on ROA.

The constant term in the regression model represents the expected ROA when all independent variables are equal to zero. The constant term varied between -0.007 and 0.041.

Except for value added, none of the control variables evaluated in the regression model exhibit any significant associations with ROA. According to this research, the debt-to-equity ratio, the companies' size, the short-term liquidity, and the industry type do not seem to significantly affect profitability as determined by ROA.

For the various models, R-squared was calculated to evaluate the overall fit of the regression model. The R-squared values vary from 0.311 to 0.321. The R-squared value is a measure of how much of the variance in the dependent variable (ROA) can be accounted for by the model's independent variables. These measures indicate that the independent variables explain approximately 31% to 32% of the variation in ROA. It indicates that the variables considered have a modest amount of explanatory power for ROA.

The overall significance of the regression model was assessed using an F-test, which yielded F-statistics ranging from 13.808 to 14.489. The associated p-values were less than 0.01 for all these values, indicating that the model is statistically significant.

In summary, by analysing the results of our regression models, no direct conclusion whether e-commerce has a positive impact on the profitability of the Belgian SMEs can be drawn. Some of the independent variables show small positive effects on ROA but overall, most variables impact the ROA negatively. However, most of our digital implementation variables are not statistically significant. except from DI3 and DI12, that have a statistically significant impact on a 10% level on ROA in the

context of the surveyed companies. The overall explanatory power of the model is moderate, as indicated by the R-squared and adjusted R-squared values.

<Insert Table 12 about here.>

### 3.5 Principal component analysis

Principal Component Analysis (PCA) is the common term for a method that reduces a large number of potentially correlated variables to a smaller set of variables known as principal components by using mathematical concepts. Large data sets are reduced in dimension via a vector space transform in PCA. The original data set, which can have included a lot of variables, can frequently be understood using just a few variables (the principal components) (Richardson, 2009).

In the context of our research, PCA is utilized to pinpoint the key elements influencing the adoption of digital implementation in businesses. The independent variables that measure the digital implementation in our data are correlated with one another. The principal component analysis determines the most significant elements that account for the majority of the variance in the data. By reducing the size of the data and focusing on the most important elements, a better knowledge of the elements that are most important for successful digital implementation can be accomplished.

15 components have been created. Each component in the data set explains a percentage of the total variance. In the cumulative proportion line, it can be seen, that Comp.1 and Comp.2 explain already 51% of the data. The first 4 components represent nearly 70% of the data and can accurately represent it. The standard deviation indicates the amount of variation explained by each principal component.

	Comp. 1	Comp.2	Comp. 3	Comp. 4	Comp. 5	Comp. 6	Comp. 7	Comp.8
<b>Standard deviation</b>	0,4293	0,3438	0,2835	0,2713	0,1992	0,1852	0,1661	0,1596
<b>Proportion of Variance</b>	0,2805	0,1799	0,1223	0,112	0,0604	0,0522	0,042	0,0388
<b>Cumulative Proportion</b>	0,2805	0,4604	0,5827	0,6947	0,7551	0,8073	0,8493	0,888
	Comp.9	Comp. 10	Comp. 11	Comp. 12	Comp. 13	Comp. 14	Comp. 15	
<b>Standard deviation</b>	0,1524	0,1298	0,105	0,0985	0,0852	0,074	0	
<b>Proportion of Variance</b>	0,0354	0,0256	0,0168	0,0148	0,011	0,0083	0	
<b>Cumulative Proportion</b>	0,9234	0,949	0,9659	0,9806	0,9917	1	1	

Table 3: PCA Results

Source: This table is based on author’s calculations run in RStudio

The table below represents the loadings for the first 4 components of the PCA. We can see that each component is influenced by some of the digital implementation variables.

Given that DI10, which addresses the IT tools accessible in the sample organizations, and DI15, which addresses technological advancement, have the largest loadings, Component 1 appears to be closely related to technological growth. This implies that organizations with high scores in this area may have spent more in cutting-edge IT infrastructure and are more open to embracing new technologies.

The second major component (Comp.2) is linked to a number of DI variables, including online orders (DI3), online payment (DI8), and security (DI9). This element could stand for the entire degree of digitization of sales and customer support procedures of a business. Companies that do well in this area may provide clients easier-to-use online ordering and payment, which might increase customer happiness and loyalty.

The highest loading for the third component is DI2, which concerns the product reviews available.

Comp 4 has the highest loadings on DI1, DI3, DI4 and DI6. These variables can be related to the customers' buying experience.

The loadings of component 1 show the degree and direction of the association of each variable with the first main component. Variables that have greater absolute loading levels have a bigger impact on PC1.

These loadings were used to calculate weighted PCA scores for each observation. The weighted PCA scores were then employed as independent variables in a regression analysis to explore their relationship with the adoption of digital implementation in businesses.

	Comp.1	Comp.2	Comp.3	Comp.4
DI1	0,0715	0,1241	0,0683	0,396
DI2	0,077	0,0989	0,675	0,0896
DI3	-0,024	0,465	0,0369	0,134
DI4	-0,0278	-0,3185	0,1218	0,3083
DI5	-0,233	0,0112	-0,2366	0,3723
DI6	-0,3559	0,1175	-0,3603	0,344
DI7	-0,2432	0,1718	-0,3191	-0,4914
DI8	-0,0795	0,3974	0,0886	-0,3708
DI9	0,122	0,3096	0,1103	0,0195
DI10	0,4252	-0,3021	-0,092	-0,1779
DI11	0,1876	0,3203	0,0823	0,0535
DI12	0,3703	0,1926	-0,1582	0,1225
DI13	0,3919	0,2284	-0,1657	0,1033
DI14	0,2115	0,2164	-0,2649	0,1537
DI15	0,4181	-0,1732	-0,2794	-0,0441

Table 4: Loadings of Principal Components (Comp.1 to Comp.4)

Source: This table is based on author's calculations run in RStudio

We wanted to capture the combined influence of the original factors while minimizing multicollinearity by using the weighted PCA scores as independent variables in the regression analysis. Using this method, we can concentrate on the factors that have the greatest influence on the variation in the data. The regression analysis provides insights into the relationship between the weighted PCA scores and the adoption of digital implementation in businesses, shedding light on the key factors that drive successful digital implementation.

$$ROA = \alpha + \beta_1 \text{PCA\_weighted} + \gamma_1 \text{size} + \gamma_2 \text{debt\_equity\_ratio} + \gamma_3 \text{value\_added} + \gamma_4 \text{current\_ratio} + \gamma_5 \text{NACE}$$



According to the regression results, we can see that the coefficient of the PCA weighted is 0,003. Although this could indicate a positive relationship with ROA, it is not statistically significant at a conventional level ( $p > 0,1$ ).

The R-squared result indicates that, overall, the regression model explains around 31.2% of the variation in ROA.

Regression PCA	
	<i>Dependent variable:</i>
	ROA
<b>PCA_weighted</b>	0,003 (0,006)
<b>debt_equity_ratio</b>	-0,001 (0,002)
<b>SIZE</b>	0,001 (0,006)
<b>value_added</b>	0,271*** (0,026)
<b>current_ratio</b>	0,0003 (0,001)
<b>Manufacturing</b>	-0,075 (0,061)
<b>Service</b>	-0,040 (0,059)
<b>Construction</b>	-0,120* (0,065)
<b>Constant</b>	0,006 (0,071)
<b>Observations</b>	254
<b>R<sup>2</sup></b>	0,312
<b>Adjusted R<sup>2</sup></b>	0,289
<b>Residual Std. Error</b>	0,139 (df = 245)
<b>F Statistic</b>	13,877*** (df = 8; 245)
<b>Note:</b>	* $p < 0,1$ ; ** $p < 0,05$ ; *** $p < 0,01$

Table 5: Regression Model Results with weighted PCA

Source: This table is based on author's calculations run in RStudio

The figure 1 below shows the variables projected onto the first two principal components. The squared cosines of the variables are represented by the size of the labels.

The squared cosine is a measure of how well each variable is represented by the principal components. It indicates the contribution of each variable to the formation of the principal components and their importance in capturing the overall variation in the data.

A larger label size indicates a higher squared cosine value, meaning that the variable has a stronger influence on the principal components and contributes more to the variation in the data. In this graph, DI10 has the highest squared cosine value, meaning that DI10 is considered more important and contributing the most to the first two principal components. DI15, DI13, and DI112 also have relatively high squared cosine values. These variables contribute also significantly to the first two principal components, but to a lesser extent compared to DI10.

On the other hand, a smaller label size indicates a lower squared cosine value, suggesting that the variable has a weaker influence on the principal components and contributes less to the overall variation in the data. As shown in this graph, DI1 and DI2 have low squared cos values and a low impact on the interpretation of the first two principal components.

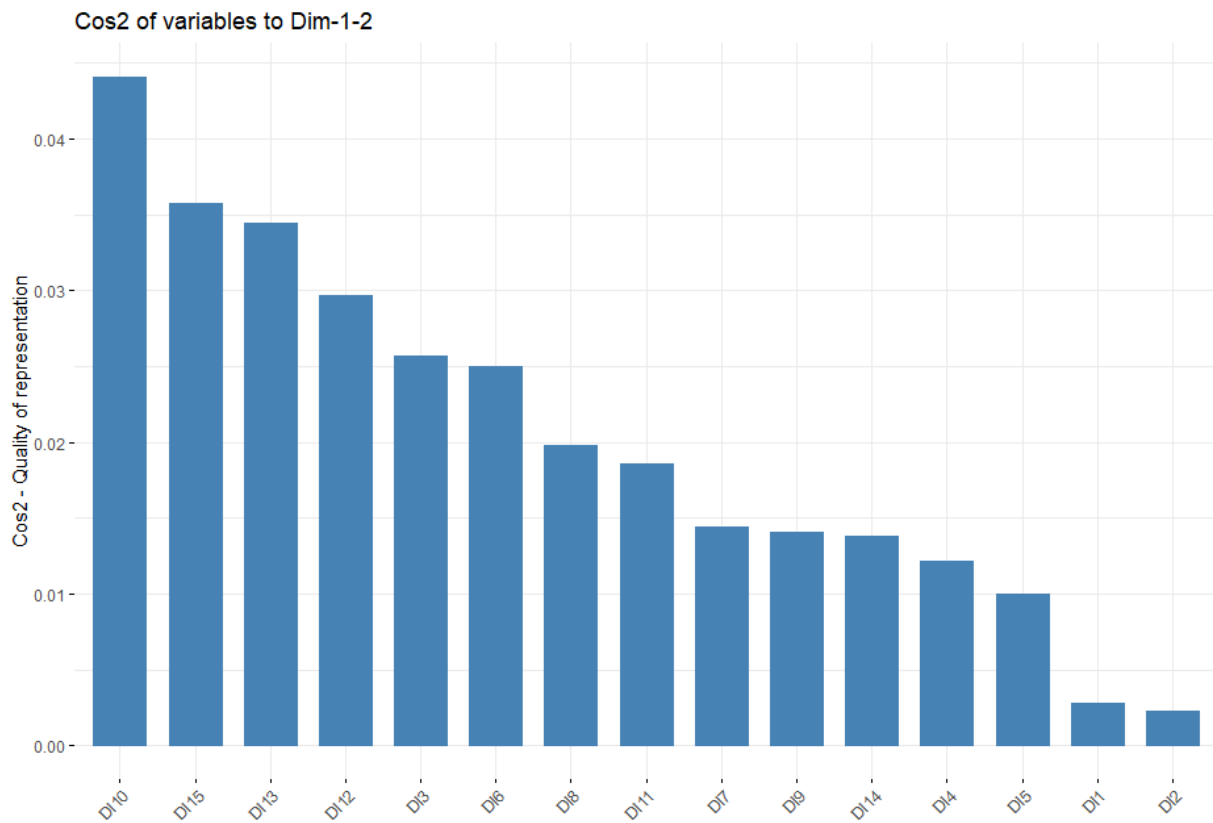


Figure 1: Variables' contribution to the Principal Components

Source: This table is based on author's calculations run in RStudio

Figure 2 visualizes the similarities and dissimilarities between the samples, and shows the impact of each attribute on each of the principal components. The variables that are grouped together are positively correlated to each other.

Variables that are negatively correlated are displayed to the opposite sides of the biplot's origin.

High cos2 attributes are here coloured in green. They indicate a strong contribution to the principal component. As already seen in the graph before, DI10 has the highest cos2 value and the highest contribution to the principal components. This is also represented by the length of the arrow. The higher the distance between the origin and the variable, the better represented that variable is.

The mid cos2 attributes are coloured in orange/ yellow, and those with low cos2 attributes are coloured in black.

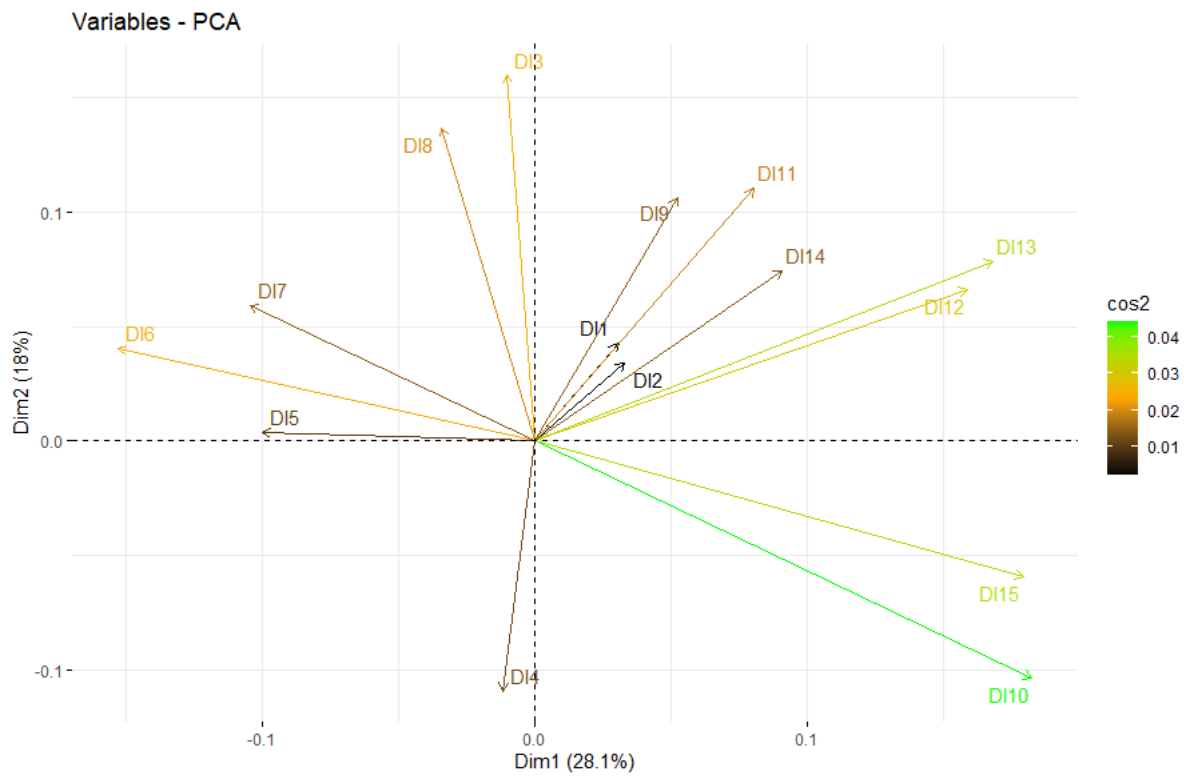


Figure 2: Biplot of variables in the PCA space based on squared cosines

Source: This table is based on author's calculations run in RStudio

### 3.6 ANOVA

Analysis of Variance, or ANOVA, is a statistical method frequently used to compare the means of three or more groups and determine whether there are any appreciable differences between them. The following firm groups are specified in the use of ANOVA in this analysis to assess whether the variance in ROA scores can be attributable to the various degrees of digital implementation across the companies (Kenton, 2022).

We want to investigate possible changes in ROA based on the degree of digital implementation by classifying enterprises into separate groups according to their DI degrees. Group 0 is made up of businesses with poor digital adoption and use, which is represented by low DI. Companies in Group 1 have a moderate DI, which reflects a modest level of digital implementation. The companies in group 2 have a high DI, indicating a high level of digital implementation.

The ROA scores of the three corporate groups will be compared using the ANOVA analysis to see whether there are any statistically significant differences.

This study sheds light on the connection between DI and ROA and helps us understand how the use of digital technology affects the profitability a company. It helps to identify the possible advantages and benefits connected to greater degrees of digital implementation by evaluating the variations in ROA among the different corporate groupings.

If the ANOVA findings show a significant relationship between DI levels and ROA, it is likely that the amount of digital adoption has a substantial effect on the financial success of a company.

### 3.6.1 Descriptive statistics by group

The group 0 that concerns the companies with low digital implementation consist of 104 companies. The mean ROA of this group is 0,07 in comparison to 0,06 and 0,1 for group 1 and group 2 respectively. Group 2 comprises only 37 companies and has the highest mean ROA. The standard deviation (sd) is the highest in group 1, meaning that there is a higher variability in the values of X1 within this group, compared to group 0 and 2 where the standard deviation is a bit lower, but still the values are relatively spread from the mean.

Group	-	vars	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
group 0	X1	1	104	0,07	0,13	0,05	0,07	0,06	-0,51	0,51	1,03	-0,15	4,61	0,01
group 1	X1	1	113	0,06	0,2	0,04	0,06	0,09	-1,16	0,81	1,96	-1,27	13,41	0,02
group 2	X1	1	37	0,1	0,13	0,07	0,07	0,09	-0,04	0,68	0,72	2,65	8,76	0,02

Table 6: Descriptive statistics per group

Source: This table is based on author's calculations run in RStudio

### 3.6.2 ANOVA Test

According to the ANOVA results, the F-value is 0.229 and the corresponding p-value is 0.633. This indicates that the null hypothesis, according to which the means of ROA are the same for each of the three groups, cannot be rejected. In conclusion, we can say from these ANOVA results, that the profitability of the companies in the sample is not impacted by the degree of digital implementation.

The analysis took into account the residuals as well as the Group variable's sum of squares (Sum Sq) and mean square (Mean Sq). The amount of variation in ROA scores that can be explained by the degree of digital implementation was shown by the Sum Sq for the Group variable, which was 0.006. However, the Mean Sq, which was 0.006289, did not substantially differ from the residuals' Mean Sq (0.027451).

This suggests that random variance, rather than the degree of digital adoption, might explain the observed disparities in ROA ratings between the firm groups.

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
<b>data_anova\$Group</b>	1	0,006	0,006289	0,229	0,633
<b>Residuals</b>	252	6,918	0,027451		

Table 7: ANOVA Results

Source: This table is based on author's calculations run in RStudio

### 3.6.3 Pairwise test

The pairwise test results indicate the differences in ROA between the groups.

Between group 0 and group 1, and similarly between group 0 and 2 the result of the pairwise test is 1. This suggests that there is no statistically significant difference in ROA between these groups.

Between group 1 and group 2, the pairwise test result is slightly lower with 0.94 but this suggests that there is also no statistically significant difference in ROA between group 1 and group 2.

The Bonferroni correction is a method that adjusts the significance level to control for multiple comparisons.

In summary, based on the Bonferroni-corrected pairwise tests, there are no statistically significant differences in ROA among the three groups of companies with different levels of digital implementation. This implies that the level of digital implementation, does not appear to have a significant impact on the Return on Assets for the companies in the sample of the research.

	<b>0</b>	<b>1</b>
<b>1</b>	1	/
<b>2</b>	1	0,94

Table 8: Pairwise Test

Source: This table is based on author's calculations run in RStudio

## 3.7 Limitations

This thesis has several restrictions as it looks at how digital adoption affects the profitability of Belgian SMEs. It is important to be aware of these restrictions since they might affect how reliable and generalizable the results are.

Firstly, the sample size of the study consisted of 254 Belgian companies. Although efforts were made to ensure a diverse range of companies were included, the sample size may still be considered relatively small. As a result, caution should be exercised when attempting to generalize the findings to the broader population of Belgian SMEs.

Another limitation arises from the data collection method, which relied on a survey to measure the various independent variables related to digital implementation. The survey is based on self-reported information provided by the participating companies. This self-reporting introduces the possibility of response bias, where participants may provide inaccurate or biased information due to factors such as social desirability or limited awareness of their own digital implementation practices. The survey employed both yes/no questions and Likert scale responses, which were then transformed into numerical values. This method of measurement introduces subjectivity which also may impact the accuracy and reliability of the results.

While some relevant control variables such as company size, current ratio, debt-to-equity ratio, value added, and industry, it is important to note that other important variables that influence the ROA were not included in this analysis as of missing information on the data base. These omitted variables could have an impact on the observed relationship between digital implementation and profitability, leading to incomplete or biased results.

The findings of this thesis are specific to the context of Belgian SMEs and may not necessarily apply to other industries, economic conditions, or cultural contexts. Therefore, the generalizability of the findings beyond the specific context of this study should be approached with caution.

Furthermore, the data utilized in this thesis was sourced from the Bel-first database, which may have inherent limitations. These limitations could include missing or incomplete data, potential measurement errors, or the presence of unobservable factors that could influence the results.

Lastly, the timeframe of the study, spanning from February 2023 to May 2023, captures a specific period. The findings may be influenced by the economic conditions and digital trends during this timeframe, and may not necessarily reflect the long-term impact of digital implementation on profitability.

Considering these limitations is essential when interpreting the findings of this thesis. Future research should aim to address these limitations by employing larger and more diverse samples, utilizing alternative measurement approaches, and incorporating additional control variables to enhance the understanding of the relationship between digital implementation and financial performance in the context of Belgian SMEs.

## 4 Conclusion

---

The objective of this master thesis was to examine the impact of e-commerce on the profitability of Belgian small and medium-sized enterprises. Specifically, the research question focused on whether e-commerce implementation has an influence on Return on Assets (ROA).

The motivation behind this thesis comes from the growth of e-commerce over the last years in Belgium, especially during the COVID-19 pandemic. It is widely recognized that e-commerce offers various benefits to companies, including enhanced competitiveness and adaptability. However, several barriers still hinder SMEs from fully embracing e-commerce.

To address the research objective, a survey was conducted among Belgian SMEs, assessing their level of digital implementation. Financial data, specifically the Return on Assets (ROA), were obtained from the Bel-first database. A regression model was developed, incorporating the ROA as the dependent variable and the digital implementation (DI) variables as independent variables, along with control variables. Additionally, ANOVA and PCA were employed to explore the impact of digital implementation on ROA.

The findings of the regression analysis revealed mixed results regarding the impact of e-commerce on profitability. While some independent variables showed small positive effects on ROA, the majority of digital implementation variables were not statistically significant. Only two of the 15 independent variables were found to have a statistically significant impact on ROA at a 10% significance level. However, the overall explanatory power of the model was moderate, as indicated by the R-squared values.

Furthermore, the ANOVA results indicated that there were no statistically significant differences in ROA among the three groups of companies with different levels of digital implementation. This suggests that factors other than the degree of digital adoption might explain the observed disparities in ROA ratings.

The review of existing literature highlighted various advantages of e-commerce, including cost savings, increased revenues from sales expansion, and improved supply chain management. However, some studies have reported no significant influence of e-commerce on financial performance.

Overall, the literature remains uncertain and inconclusive, with varying perspectives on its direct effect. Therefore, further research is needed to obtain more conclusive results in the context of Belgian SMEs.

Certain limitations of the study should be acknowledged, including the relatively small number of survey responses, which may not fully represent the entire population of Belgian SMEs. Additionally, self-reported survey data and missing information on certain variables might have influenced the findings.

Despite the limitations, the analysis of the existing literature highlights the importance of e-commerce implementation for companies to remain competitive and aligned with the current digital landscape. The advantages of e-commerce cannot be overlooked, as they enable companies to adapt to changing market dynamics.

In conclusion, while this study did not find definitive evidence of a direct positive impact of e-commerce on the profitability of Belgian SMEs, it contributes to the existing knowledge by examining the Belgian context and highlighting the need for further investigation. Future research should address the identified limitations and incorporate additional factors. Such initiatives can provide a more comprehensive understanding of the complex relationship between e-commerce and profitability, and assist Belgian SMEs in making informed decisions regarding digital implementation strategies.

## 5 Appendices

### Appendix 1: Definition of variables

Variable	Definition	
<b><i>Dependent variable</i></b>	Profitability	
ROA	Return on Asset	The return on assets is calculated by dividing the profit and loss after taxes by the total assets
<b><i>Independent variables</i></b>	Digital Implementation	
<i>Information</i>		
DI1	Product Information	It shows if product/ service information is available online
DI2	Product Review	This indicates if product reviews are available online
DI3	Online orders	It signifies if an order can be placed through the website of the company
DI4	Online offers	It illustrates if offers are made using an online service
DI5	Customer support service	Indicates the availability of a customer support service
<i>Transaction</i>		
DI6	Delivery	A delivery of the ordered product
DI7	Return mechanism	A functionality to return products easily
DI8	Online payment	The possibility of online payments
DI9	Security	Online information about security of the transactions/ sensitive customer data
<i>Technological readiness</i>		
DI10	IT tools	Indicates how advanced the IT area in the company is



DI11	Software & e-commerce support	Availability of software and e-commerce support systems
<i>Organizational readiness</i>		
DI12	Motivation staff	It shows how motivated the staff towards the introduction of e-commerce is
DI13	Readiness to risk	Openness of the leader to go from conventional sales methods to sales with online media support
DI14	Financial readiness	Financial readiness to invest in e-commerce
DI15	Acceptance technological development	Openness of the company toward technological development
<b><i>Control variables</i></b>		
SIZE	Ln(Total Assets)	The size of the company is calculated by the logarithm of the total assets
NACE	Industry of the company	Dummy variable indicating the industry of the company
Value added	Net added value/Total assets	Difference between the price of a product/service and the cost of producing it divided by the total assets
Debt_equity_ratio	Debt/Equity	The debt-to-equity ratio is calculated by dividing a company's total liabilities by its shareholder equity.
Current_ratio	Current Ratio	Liquidity ratio that measures a company's ability to pay short-term obligations

Table 9: Definition of variables

## Appendix 2: NACE Codes

1	Crop and animal production, hunting and related service activities	Manufacturing
2	Forestry and logging	Manufacturing
10	Manufacture of food products	Manufacturing
11	Manufacture of beverages	Manufacturing
13	Manufacture of textiles	Manufacturing
14	Manufacture of wearing apparel	Manufacturing
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Manufacturing
17	Manufacture of paper and paper products	Manufacturing
18	Printing and reproduction of recorded media	Manufacturing
22	Manufacture of rubber and plastic products	Manufacturing
23	Manufacture of other non-metallic mineral products	Manufacturing
24	Manufacture of basic metals	Manufacturing
25	Manufacture of fabricated metal products, except machinery and equipment	Manufacturing
26	Manufacture of computer, electronic and optical products	Manufacturing
27	Manufacture of electrical equipment	Manufacturing
28	Manufacture of machinery and equipment n.e.c.	Manufacturing
29	Manufacture of motor vehicles, trailers and semi-trailers	Manufacturing
31	Manufacture of furniture	Manufacturing
32	Other manufacturing	Manufacturing
33	Repair and installation of machinery and equipment	Manufacturing
41	Construction of buildings	Construction
42	Civil engineering	Construction
43	Specialised construction activities	Construction
45	Wholesale and retail trade and repair of motor vehicles and motorcycles	Service
46	Wholesale trade, except of motor vehicles and motorcycles	Service
47	Retail trade, except of motor vehicles and motorcycles	Service
49	Land transport and transport via pipelines	Service
50	Water transport	Service
52	Warehousing and support activities for transportation	Service
55	Accommodation	Service
56	Food and beverage service activities	Service
58	Publishing activities	Service
59	Motion picture, video and television programme production, sound recording and music publishing activities	Service
62	Computer programming, consultancy and related activities	Service
63	Information service activities	Service
64	Financial service activities, except insurance and pension funding	Service
66	Activities auxiliary to financial services and insurance activities	Service
68	Real estate activities	Service
69	Legal and accounting activities	Service
70	Activities of head offices; management consultancy activities	Service
71	Architectural and engineering activities; technical testing and analysis	Service
73	Advertising and market research	Service
74	Other professional, scientific and technical activities	Service

75	Veterinary activities	Service
77	Rental and leasing activities	Service
78	Employment activities	Service
79	Travel agency, tour operator reservation service and related activities	Service
81	Services to buildings and landscape activities	Service
82	Office administrative, office support and other business support activities	Service
85	Education	Service
86	Human health activities	Service
91	Libraries, archives, museums and other cultural activities	Service
93	Sports activities and amusement and recreation activities	Service
94	Activities of membership organisations	Service
95	Repair of computers and personal and household goods	Service
96	Other personal service activities	Service

*Table 10: Industries of the companies*

*Source: NACEV2. (2023). Complete List of all NACE Code. Retrieved May 20, 2023 from <https://nacev2.com/en>*

### Appendix 3: Correlation matrix

Correlation matrix																							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
<b>(1) ROA</b>	1																						
<b>(2) DI1</b>	-0,023	1																					
<b>(3) DI2</b>	-0,040	0,247	1																				
<b>(4) DI3</b>	-0,146	0,395	0,300	1																			
<b>(5) DI4</b>	-0,100	0,247	0,197	0,210	1																		
<b>(6) DI5</b>	-0,085	0,266	0,153	0,342	0,306	1																	
<b>(7) DI6</b>	-0,115	0,232	0,054	0,382	0,197	0,491	1																
<b>(8) DI7</b>	-0,136	0,144	0,0005	0,254	0,070	0,233	0,255	1															
<b>(9) DI8</b>	0,047	0,165	0,252	0,516	0,134	0,220	0,209	0,367	1														
<b>(10) DI9</b>	-0,070	0,354	0,328	0,454	0,214	0,285	0,210	0,242	0,403	1													
<b>(11) DI10</b>	-0,093	0,163	0,137	0,174	0,266	0,134	-0,031	0,073	0,148	0,220	1												
<b>(12) DI11</b>	-0,048	0,281	0,321	0,511	0,164	0,264	0,216	0,182	0,339	0,395	0,298	1											
<b>(13) DI12</b>	0,062	0,384	0,253	0,445	0,278	0,310	0,182	0,212	0,313	0,464	0,449	0,525	1										
<b>(14) DI13</b>	0,010	0,409	0,265	0,416	0,200	0,240	0,162	0,201	0,311	0,460	0,378	0,438	0,686	1									

<b>(15) DI14</b>	0,015	0,324	0,235	0,464	0,254	0,291	0,324	0,244	0,321	0,369	0,292	0,387	0,543	0,586	1									
<b>(16) DI15</b>	-0,038	0,233	0,131	0,184	0,178	0,175	0,133	0,088	0,158	0,313	0,528	0,286	0,462	0,493	0,432	1								
<b>(17) current _ratio</b>	0,027	-0,206	-0,120	-0,151	-0,192	-0,165	-0,047	-0,091	-0,104	-0,050	-0,177	-0,147	-0,186	-0,135	-0,127	-0,185	1							
<b>(18) SIZE</b>	0,017	0,166	0,112	0,083	0,087	0,077	0,129	0,111	0,084	0,064	0,035	0,153	0,056	0,139	0,168	-0,020	-0,034	1						
<b>(19) debt _equity _ratio</b>	-0,051	-0,002	0,057	-0,020	0,114	0,023	0,039	0,039	0,009	-0,063	0,162	0,145	0,121	0,096	0,096	0,062	-0,124	0,157	1					
<b>(20) value _added</b>	0,535	-0,123	-0,021	-0,100	-0,022	-0,075	-0,088	-0,115	0,056	-0,011	-0,061	-0,064	-0,063	0,003	-0,049	-0,034	0,045	0,047	-0,066	1				
<b>(21) Manu facturing</b>	-0,050	0,022	-0,112	-0,041	0,066	0,140	0,253	0,033	-0,083	-0,081	-0,002	-0,021	0,022	0,017	0,058	0,090	-0,054	0,111	0,016	0,027	1			
<b>(22) Service</b>	0,036	0,030	0,067	0,123	-0,111	0,016	-0,076	0,030	0,104	0,134	0,093	0,060	0,059	0,015	-0,024	-0,021	-0,035	-0,071	0,004	-0,150	-0,735	1		
<b>(23) Construc tion</b>	0,014	-0,062	0,082	-0,078	0,080	-0,107	-0,106	-0,060	0,005	-0,033	-0,089	-0,009	-0,096	-0,014	0,012	-0,029	0,084	0,017	-0,018	0,250	-0,164	-0,468	1	

Table 11: Correlation matrix

Source: This table is based on author's calculations run in RStudio

## Appendix 4: Regression Results

Regression														
	<i>Dependent variable:</i>													
	ROA													
DI1	0,015													
	-0,019													
DI2		-0,011												
		-0,025												
DI3			-0,036*											
			-0,019											
DI4				-0,025										
				-0,019										
DI5					-0,014									
					-0,019									
DI6						-0,02								
						-0,02								
DI7							-0,035							
							-0,025							
DI8								0,004						
								-0,019						
DI9									-0,025					
									-0,018					
DI10										-0,01				

											-0,008				
DI11												-0,003			
												-0,019			
DI12													0,012*		
													-0,007		
DI13														0,001	
														-0,007	
DI14															0,007
															-0,006
DI15															-0,001
															-0,008
debt_equity_ratio	-0,0003	-0,0004	-0,001	-0,0003	-0,0004	-0,0004	-0,0004	-0,0004	-0,001	-0,0002	-0,0004	-0,001	-0,0004	-0,001	-0,0004
	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002	-0,002
SIZE	0,0001	0,001	0,002	0,002	0,001	0,002	0,002	0,001	0,002	0,001	0,001	0,001	0,001	0,001	-0,00002
	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006	-0,006
value_added	0,273***	0,270***	0,266***	0,270***	0,269***	0,268***	0,267***	0,271***	0,270***	0,270***	0,271***	0,273***	0,271***	0,273***	0,271***
	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026	-0,026
current_ratio	0,0003	0,00003	-0,0003	-0,0002	-0,00003	0,0001	-0,00003	0,0001	0,00002	-0,0001	0,0001	0,0005	0,0001	0,0003	0,0001
	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001	-0,001
Manufacturing	-0,073	-0,073	-0,063	-0,075	-0,063	-0,055	-0,068	-0,074	-0,066	-0,066	-0,072	-0,078	-0,074	-0,079	-0,072
	-0,061	-0,061	-0,061	-0,061	-0,063	-0,064	-0,061	-0,061	-0,061	-0,061	-0,061	-0,061	-0,061	-0,061	-0,062
Service	-0,038	-0,036	-0,025	-0,041	-0,029	-0,024	-0,033	-0,039	-0,027	-0,03	-0,037	-0,042	-0,038	-0,043	-0,037
	-0,059	-0,059	-0,059	-0,059	-0,06	-0,06	-0,059	-0,059	-0,059	-0,059	-0,059	-0,058	-0,059	-0,059	-0,059

Construction	-0,118*	-0,116*	-0,109*	-0,117*	-0,111*	-0,107	-0,115*	-0,119*	-0,110*	-0,114*	-0,117*	-0,119*	-0,119*	-0,125*	-0,117*
	-0,065	-0,066	-0,065	-0,065	-0,066	-0,066	-0,065	-0,065	-0,065	-0,065	-0,066	-0,065	-0,065	-0,065	-0,066
Constant	0,014	0,017	0,016	0,035	0,019	0,016	0,015	0,019	0,016	0,041	0,018	-0,007	0,016	0,01	0,023
	-0,068	-0,068	-0,068	-0,069	-0,068	-0,068	-0,068	-0,068	-0,068	-0,07	-0,068	-0,069	-0,069	-0,068	-0,073
Observations	254	254	254	254	254	254	254	254	254	254	254	254	254	254	254
R <sup>2</sup>	0,313	0,311	0,321	0,316	0,312	0,313	0,316	0,311	0,316	0,315	0,311	0,319	0,311	0,314	0,311
Adjusted R <sup>2</sup>	0,29	0,289	0,299	0,293	0,29	0,291	0,294	0,288	0,294	0,293	0,288	0,297	0,288	0,291	0,288
Residual Std. Error (df = 245)	0,139	0,14	0,139	0,139	0,139	0,139	0,139	0,14	0,139	0,139	0,14	0,139	0,14	0,139	0,14
F Statistic (df = 8; 245)	13,921***	13,841***	14,489***	14,135***	13,902***	13,984***	14,162***	13,813***	14,156***	14,089***	13,809***	14,369***	13,811***	14,008***	13,808***
Note:	*p<0,1; **p<0,05; ***p<0,01														

Table 12: Main results Regression Model

Source: This table is based on author's calculations run in RStudio



## 6 References

---

- Abou-Shouk, M., & Eraqi, M. I. (2015). Perceived barriers to e-commerce adoption in SMEs in developing countries: the case of travel agents in Egypt. *International Journal of Services and Operations Management*, 21(3), 332-353. <https://doi.org/10.1504/IJSOM.2015.069652>
- Aissa, S. B., & Goaid, M. (2016). Determinants of Tunisian hotel profitability: The role of managerial efficiency. *Tourism management*, 52, 478-487. <https://doi.org/10.1016/j.tourman.2015.07.015>
- Al-Qirim, N. (2007). The adoption of eCommerce communications and applications technologies in small businesses in New Zealand. *Electronic Commerce Research and Applications*, 6(4), 462-473. <https://doi.org/10.1016/j.elerap.2007.02.012>
- Asghar, A. J., Mahdi, R., Khaled, N., Vahid, R., & Bairagi, K. P. (2012). Analyzing the effects of electronic commerce on organizational performance: Evidence from small and medium enterprises. *African Journal of Business Management*, 6(22), 6486-6496.
- Bilgihan, A., Kandampully, J., Zhang, T. (2016). Towards a unified customer experience in online shopping environments: Antecedents and outcomes. *International Journal of Quality and Service Sciences*, 8(1), 102-119. <https://doi.org/10.1108/IJQSS-07-2015-0054>
- Bureau van Dijk. (2023). *Bel-first*. Retrieved May 20, 2023, from <https://www.bvdinfo.com/en-gb/our-products/data/national/bel-first>
- CFI Team. (2023, April 23). *Debt Equity Ratio*. Corporate Finance Institute. Retrieved May 16, 2023, from <https://corporatefinanceinstitute.com/resources/commercial-lending/debt-to-equity-ratio-formula/>
- Chuang, T.T.; Nakatani, K.; Chen, J.C.H.; Huang, I.L. (2007). Examining the Impact of Organisational and Owner's Characteristics on the Extent of e-Commerce Adoption in SMEs. *Int. J. Bus. Syst. Res.*, 1, 61. <https://doi.org/10.1504/IJBSR.2007.014770>
- Clark, D. (2022, August 24). *SMEs in Europe – Statistics & Facts*. Retrieved October 26, 2022, from [https://www.statista.com/topics/8231/smes-in-europe/#topicHeader\\_\\_wrapper](https://www.statista.com/topics/8231/smes-in-europe/#topicHeader__wrapper)
- Corporate Finance Institute. (2022, November 1). *Financial Performance*. Retrieved November 23, 2022, from <https://corporatefinanceinstitute.com/resources/accounting/financial-performance/>
- Costa, J., & Castro, R. (2021). SMEs must go online—E-commerce as an escape hatch for resilience and survivability. *Journal of Theoretical and Applied Electronic Commerce Research*, 16(7), pp. 3043-3062. <https://doi.org/10.3390/jtaer16070166>
- Cragg, P., King, M., & Hussin, H. (2002). IT alignment and firm performance in small manufacturing firms. *The Journal of Strategic Information Systems*, 11(2), 109-132. [https://doi.org/10.1016/S0963-8687\(02\)00007-0](https://doi.org/10.1016/S0963-8687(02)00007-0)

Dos Santos, V. F., Sabino, L. R., Morais, G. M., & Gonçalves, C. A. (2017). E-commerce: A short history follow-up on possible trends. *International Journal of Business Administration*, 8(7), 130-138. <https://doi.org/10.5430/ijba.v8n7p130>

Ecommerce Europe. (2023). *Belgium*. Retrieved May 29, 2023 from <https://ecommerce-europe.eu/research-figure/belgium/>

European Commission. (n.d.). *Internal Market, Industry, Entrepreneurship and SMEs*. Retrieved November 14, 2022, from [https://single-market-economy.ec.europa.eu/smes\\_en](https://single-market-economy.ec.europa.eu/smes_en)

European Union. (2019). *Glossary e-commerce*. Retrieved May 5, 2022, from [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:E-commerce#:~:text=E%2Dcommerce%20can%20be%20defined,mediated%20\(online%20communication\)%20networks](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:E-commerce#:~:text=E%2Dcommerce%20can%20be%20defined,mediated%20(online%20communication)%20networks)

Fernando, J. (2023, March 25). *Current Ratio*. Investopedia. Retrieved May 17, 2023, from <https://www.investopedia.com/terms/c/currentratio.asp>

Ferrera, C., & Kessedjian, E. (2019). Evolution of E-commerce and Global Marketing. *International Journal of Technology for Business*, 1(1), 33-38. <https://doi.org/10.5281/zenodo.2591544>

Grandon, E.E., & Pearson, J.M. (2003). Electronic Commerce Adoption: An Empirical Study of Small and Medium US Businesses. *Information & Management*, 42, 197–216. <https://doi.org/10.1016/j.im.2003.12.010>

Ha, V. (2020). Enhancing the e-commerce application in SMEs. *Management Science Letters*, 10(12), 2821-2828. <https://doi.org/10.5267/j.msl.2020.4.027>

Išoraitė, M., & Miniotienė, N. (2018). Electronic commerce: Theory and practice. *Integrated Journal of Business and Economics*. <https://doi.org/10.5281/zenodo.1258437>

Jacob, D. (2022). *Etude statistique sur l'entrepreneuriat e-commerce belge (édition 2022)*. Retis, Belgium.

Jahanshahi, A. A., Zhang, S. X., & Brem, A. (2013). E-commerce for SMEs: empirical insights from three countries. *Journal of Small Business and Enterprise Development*, 20(4), 849-865. <https://doi.org/10.1108/JSBED-03-2012-0039>

Jain, V., Malviya, B., Arya, S. (2021). An Overview of Electronic Commerce (e-Commerce). *Journal of Contemporary Issues in Business and Government/ Vol*, 27(3), 666. <https://doi.org/10.47750/cibg.2021.27.03.090>

Kenneth, C. L., & GUERCIO, C. (2017). *E-commerce 2017: business. technology. society*. Pearson.

Kenton, W. (2022, May 19). *Analysis of Variance (ANOVA) Explanation, Formula, and Applications*. Investopedia. Retrieved May 29, 2023 from <https://www.investopedia.com/terms/a/anova.asp>

Khan, A. G. (2016). Electronic Commerce: A Study on Benefits and Challenges in an Emerging Economy. *Global J. Management and Business Research: B Economics and E-commerce*, 16(01).

Konings, J., & Roodhooft, F. (2002). The effect of e-business on corporate performance: Firm level evidence for Belgium. *De Economist*, 150(5), 569-581. <https://doi.org/10.1023/A:1021393219617>

Kraemer, K. L., Gibbs, J., & Dedrick, J. (2005). Impacts of globalization on e-commerce use and firm performance: A cross-country investigation. *The information society*, 21(5), 323-340. <https://doi.org/10.1080/01972240500253350>

Lorca, P., De Andrés, J., & Garcia-Diez, J. (2019). Impact of e-commerce sales on profitability and revenue. The case of the manufacturing industry. *Engineering Economics*, 30(5), 544-555. <https://doi.org/10.5755/j01.ee.30.5.21254>

Marín, S. (2019). *A Europe for SMEs: Think small first and single market*. EFAA. Retrieved, May 29, 2023 from <https://efaa.com/>

Mustafa, N., Nakov, L., & Islami, X. (2019). The impact of organizational changes on increasing SMEs competitiveness. *Acta Universitatis Danubius. Œconomica*, 15(2), 104-128.

NACEV2. (2023). *Complete List of all NACE Code*. Retrieved May 20, 2023 from <https://nacev2.com/en>

Nasrudin, A. (2022, April 16). *Value added: Meaning, Formula, Importance, Way to create*. Penpoin. Retrieved May 20, 2023, from <https://penpoin.com/value-added/>

Niranjanamurthy, M., Kavyashree, N., Jagannath, S., & Chahar, D. (2013). Analysis of e-commerce and m-commerce: advantages, limitations and security issues. *International Journal of Advanced Research in Computer and Communication Engineering*, 2(6), 2360-2370.

Nurlinda, N., Napitupulu, I., Wardayani, W., Azlina, A., Andina, A., Ulfah, A., & Supriyanto, S. (2020, March). Can E-Commerce Adoption Improve SME's Performance?(Case Studies on Micro, Small and Medium Enterprises with Gojek Services in Indonesia). In *Proceedings of the Third Workshop on Multidisciplinary and Its Applications, WMA-3 2019, 11-14 December 2019, Medan, Indonesia*. <http://dx.doi.org/10.4108/eai.11-12-2019.2290850>

OECD (2000), *A New Economy? The Changing Role of Innovation and Information Technology in Growth*. OECD Publishing, Paris.

OECD. (2004). "Financing innovative SMES in a global economy", in *OECD Conference of Ministers Responsible for Small and Medium-sized Enterprises (SMES) Promoting Entrepreneurship and Innovative SMES in a Global Economy: Towards a More Responsible and Inclusive Globalisation*, Istanbul, Turkey 3–5 June 2004, OECD Publishing, Paris.

Purba, M., Simanjutak, D., Malau, Y., Sholihat, W., & Ahmadi, E. (2021). The effect of digital marketing and e-commerce on financial performance and business sustainability of MSMEs during COVID-19 pandemic in Indonesia. *International Journal of Data and Network Science*, 5(3), 275-282. <https://doi.org/10.5267/j.ijdns.2021.6.006>

Rahayu, R. (2015). *E-commerce adoption by small and medium sized enterprises in Indonesia: An empirical study of influencing factors and the impact of e-commerce adoption on sme performance* [Doctoral dissertation, University of Huddersfield].

Robu, M. (2013). The dynamic and importance of SMEs in economy. *The USV annals of economics and public administration*, 13(1 (17)), 84-89.

Šaković Jovanović, J., Vujadinović, R., Mitreva, E., Fragassa, C., & Vujović, A. (2020). The relationship between e-commerce and firm performance: The mediating role of internet sales channels. *Sustainability*, 12(17), 6993. <https://doi.org/10.3390/su12176993>

Sedighi, A., Sirang, B., & Azerbaijan, I. (2018). The effect of e-commerce on SME Performance. *International Journal of Applied Research in Management and Economics*, 1(2), pp.71-81.

Soana, M. G. (2011). The relationship between corporate social performance and corporate financial performance in the banking sector. *Journal of business ethics*, 104(1), 133-148. <https://doi.org/10.1007/s10551-011-0894-x>

SPF Economie. (2022, 24 February). *Définitions et sources*. Retrieved November 23, 2022, from <https://economie.fgov.be/fr/themes/entreprises/pme-et-independants-en/definitions-et-sources>

SPF Economie. (2022, 24 February). *Statistiques relatives aux PME en Belgique*. Retrieved November 23, 2022, from <https://economie.fgov.be/fr/themes/entreprises/pme-et-independants-en/statistiques-relatives-aux-pme>

Statista. (2022, March). Total revenue of e-commerce sales in Belgium from 2015 to 2021. Retrieved November 14, 2022, from <https://www.statista.com/statistics/827819/online-shopping-expenditure-in-belgium/>

Statista. (2022). *Retail e-commerce revenue in Europe from 2017 to 2025*. Retrieved November 14, 2022, from <https://www.statista.com/forecasts/715663/e-commerce-revenue-forecast-in-europe>

Tan, J., Tyler, K., & Manica, A. (2007). Business-to-business adoption of eCommerce in China. *Information & management*, 44(3), 332-351. <https://doi.org/10.1016/j.im.2007.04.001>

Turban, E., King, D., Lee, J. K., Liang, T. P., & Turban, D. C. (2015). *Overview of electronic commerce*. In *Electronic commerce* (pp. 3-49). Springer, Cham.

Van Beurden, P., & Gössling, T. (2008). The worth of values—a literature review on the relation between corporate social and financial performance. *Journal of business ethics*, 82(2), 407-424. <https://doi.org/10.1007/s10551-008-9894-x>

Van Driessche, L. (2022, March 3). *L'e-commerce de plus en plus incontournable pour les entreprises*. Retrieved May 29, 2023 from <https://www.lecho.be/entreprises/general/l-e-commerce-de-plus-en-plus-incontournable-pour-les-entreprises/10372509.html>

World Economic Forum. (2020). *The Future of the Last-Mile Ecosystem—Transition Roadmaps for Public- and Private-Sector Players*. Retrieved November 14, 2022, from [https://www.c40knowledgehub.org/s/article/The-Future-of-the-Last-Mile-Ecosystem-Transition-roadmaps-for-public-and-private-sector-players?language=en\\_US](https://www.c40knowledgehub.org/s/article/The-Future-of-the-Last-Mile-Ecosystem-Transition-roadmaps-for-public-and-private-sector-players?language=en_US)

Zhu, K. (2004). The complementarity of information technology infrastructure and e-commerce capability: A resource-based assessment of their business value. *Journal of management information systems*, 21(1), 167-202. <https://doi.org/10.1080/07421222.2004.11045794>

## 7 Executive Summary

---

The impact of e-commerce on the profitability of small and medium Belgian companies (SMEs) is the focus of this research study. The primary objective is to analyse whether the digital implementation of companies, particularly through e-commerce, has a significant influence on the financial performance of Belgian SMEs. The research question revolves around the existence of an impact of e-commerce on the profitability of these companies.

The methodology employed in this study involved conducting a survey among numerous Belgian SMEs and subsequently setting up a regression model. The aim was to collect data through the survey and then analyse it using statistical techniques to determine if there is a relationship between the level of digital implementation and profitability. Regression analysis, Principal Component Analysis (PCA), and Analysis of Variance (ANOVA) were used to analyse the collected data.

The existing literature on the impact of e-commerce on financial performance was thoroughly reviewed to provide a solid theoretical foundation for the study. Empirical data was retrieved from the survey responses and the Bel-first database, enabling a comprehensive analysis of the research question.

The regression analysis results revealed that most of the independent variables, including the digital implementation (DI) variables, did not have statistically significant impacts on the return on assets (ROA) of Belgian SMEs. Similarly, the ANOVA results indicated that the degree of digital implementation did not significantly affect the profitability of the companies in the sample.

It is important to acknowledge certain limitations that may influence the findings of this research. One potential limitation is the response rate, as the number of companies that participated in the survey may not fully represent the entire population of Belgian SMEs.

In conclusion, despite the growing body of research on the impact of e-commerce on financial performance, the findings remain inconclusive and sometimes conflicting. This study contributes to the existing literature by examining the Belgian context and highlighting the need for further investigation to explore additional factors, and gain a more comprehensive understanding of the complex relationship between e-commerce and profitability in the context of Belgian SMEs.

*Keywords:* E-commerce, SMEs, Profitability, Belgium, Regression Analysis, Principal Component Analysis, Analysis of Variance