MASTER PROGRAM IN ENGINEERING MANAGEMENT

MASTER'S THESIS

UNPACKING THE DETERMINANTS OF IS-BUSINESS VALUE: AN INDUSTRY-LEVEL PERSPECTIVE ON THE EFFECT OF ICT INVESTMENTS IN ITALY

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Turin, Italy
October, 2019

ACKNOWLEDGMENGTS

Given the chance I want to thank my family and friends who provide me a constant support in daily-life activities and hard time challenges.

Special thanks to Professor Paolo Neirotti, who has given me the opportunity to work on a part of his research work and shared the professional knowledge and experience.

I will always be grateful to a member of Professor Neirotti team – Danilo Pesce – who was my supervisor during the work on the thesis. He has provided me with daily guidance and hints regarding the work, effective feedback and personal support.

Last but not the least, I want to thank the Italian State for giving me, as a foreigner, the chance to study in one of the best European technical universities, get a high-level professional knowledge, meet new friends and made some of my dreams come true.

ABSTRACT

After many years of research on the business value produced by Information Systems, the causal relationship between IS investments and business value remain partly a “grey box”. Specifically, there is limited knowledge on how industry-level productivity is affected by the capability of sectors to absorb IS knowledge. This knowledge gap is critical in the current era where IS are acknowledged to unleash growing economic divides between countries and sectors with different capabilities to create IS business value by absorbing IT-based innovation.

In this study, we contribute to disentangle the multifaceted “IS business value” construct by analysing at the industry level the effects that IT spending has on labour productivity and on its components: output growth and input use efficiency. The empirical settings of our analysis are 231 three-digit industries in Italy between 2008 and 2016.

We found that IT-spending significantly affects an overall growth in labour productivity that is triggered by a growth in output and a reduction in employment. On one hand, we found that the productivity growth effects due to employment reduction are more visible in sectors with high digital intensity. On the other, we found that in sectors producing information goods (e.g. software, R&D, consulting) IT-spending is associated with an output growth with a lack of a negative impact over employment.

Our results confirm that industry is a relevant variable in IS research on business value due to the competitive and product-specific forces at play in an industry that shape the diffusion of IS-related innovation. In this vein, our results suggest that skill-biased technological change, standardization and geographical disaggregation of business process are more likely in sectors with a high digital intensity of operations, but not in sectors producing information goods and service

CONTENT

1. INTRODUCTION

Following a definition proposed by ATIS Telecom Glossary and used by (Schryen 2013), "information system (IS) is the entire infrastructure, organization, personnel, and components for the collection, processing, storage, transmission, display, dissemination, and disposition of information." Nowadays, IS can propose to firms various types of innovations starting from automation of information flows within a firm (e.g. ERP) to realization of products across the globe (e.g. e-commerce) (Neirotti and Pesce 2019). These innovations target one goal – bring an extra business value to a firm and its product or service.

Implementation of IS might influence a generation of business value in two main ways (Dale Stoel and Muhanna 2009; Neirotti and Raguseo 2017). The first one leads to increasing of operational efficiency, costs reductions and improvement of business process, which in turn resulted into increased firm's performance. Specifically, it is achieved by adoption of systems facilitating process planning and control, inventory supervising, integration with supply chain partners to control production. These processes together might be combined into single platform (e.g ERP) and, currently, the majority of firms use it. In other words, applying this innovation, firms tend to follow "doing the same with less" principle. On contrary, investments in systems like customer relationship management (CRM), e-commerce, development of servitization drive a principle of "doing new things". The principle is mostly targeted to increasing revenue, enriching competitive position or enter new market segments (Neirotti and Pesce 2019). Thus, it might be stated that IS have crucial strategic and operational relevance for a firm.

However, it is still difficult to capture causal relationships between investments in IS and business value generated. In other words, the creation of business value through IT is a multifaceted construct that remain quite a "grey box". Although the role of digital technologies and the potential benefits of IT in enhancing firm performance is out of discussion, the scope through which IS can offer business benefits is very broad and it encompasses the application of different types of technologies in various functional domains of a company. Moreover, to be achieved, most of the benefits requires complex managerial and organizational capabilities. Due to breadth in the scope of action of IS, there is little evidence on which outcome prevail due to the different efforts in IT investments. Thus, this topic is one of the most discussable in IT and business fields (Schryen 2013).

According to (Schryen 2013), there are many parameters that are influenced by IS investments such as financial measures, organizational capabilities, strategic position and others. Additionally, these parameters might be investigated on three levels: firm, industry and country. Following the conducted work, Schryen identified knowledge gaps, that have to be closed in order to try to get a complete picture of how IS investments bring an economic value to business. One of these gaps is understanding of drivers of a firm's productivity on industry level: how industry type and products can influence IS investments, which in turn have effects on the local productivity.

Productivity is one of the most discussed measure of performance (Brynjolfsson 2012; Goos, Manning, and Salomons 2014; Acemoglu and Restrepo 2017; Neirotti and Paolucci 2013). Probably, is due to the fact that conventionally, changes in productivity are associated with changes in GDP which in turn affects an employment (Brynjolfsson 2012). However, early researches of the topic did not bring clear sign of between high IS investments and increased productivity, creating a "productivity paradox" – "we see increased efficiency due to computers everywhere except in statistics". (Brynjolfsson 1993) later could solve the paradox on the firm level, naming reasons for its creation as different methodologies and measurement tools. Other researches figured out later that IS investments increase productivity in the developed countries. Still, the industry level effects within countries remain unclear. It creates an opportunity for the current work to close the gap.

We live in an age of increasing productivity divergence (Andrews, Criscuolo, and Gal 2015) which is in part unleashed by IS and firms' capabilities to use such resources. Some of these divides are documented by (McAfee and Brynjolfsson 2008) who showed that information intensive sectors experienced increased divides in profitability and winner-take-all dynamics. In other words, companies, which invest more capital into development of IS, have strong chances to become a leader in industry. For instance, a national comparative analysis from Italy found similar results (Neirotti and Pesce 2019). Increasing economic divide in an industry may imply no visible sign on productivity at the industry level. In particular, the relation between IT spending and productivity at the industry level is not trivial. IT can be beneficial to firms with unique capabilities, but can be unproductive from the standpoint of an industry (Figure 1, b) (Brynjolfsson 1993). In detail, at the industry level bandwagon dynamics in IS adoption may cause imitation and high spending in IT also for firms that are poor users of IT (Figure 1, c).

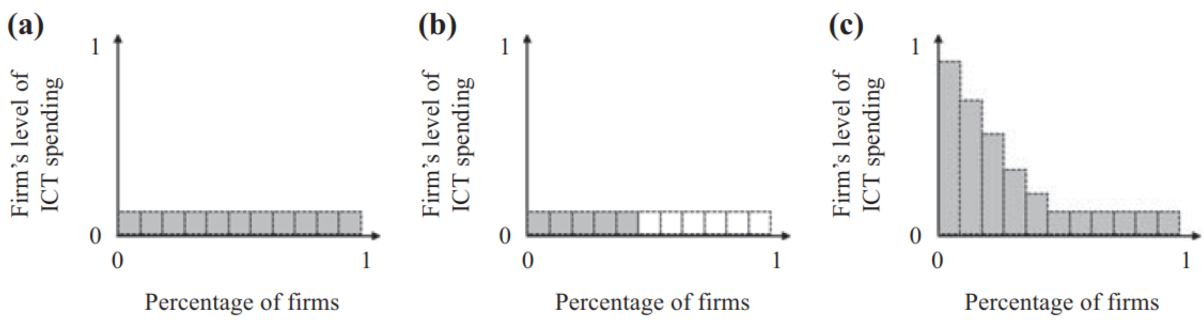

Figure 1. ICT spending distribution within an industry (Source: Neirotti and Pesce 2019)

In this vein, firms unable to respond to an IT-based innovation introduced by some first movers can respond with low prices, which cause a reduction in productivity and an increase in profitability dispersion at the industry level. As such, looking whether IT spending manifests in increased productivity at the industry level can be important to see whether IT penetration in an industry is producing a bigger pie and to assess how the pie is redistributed among firms, and within firms between employers and workers.

To understand whether and how the pie is becoming bigger and how is distributed, IS business value is conceptualized based on two mechanisms of value creation. The first driver of productivity is the input reduction. It is achieved when IT contributes to redesign business processes, better decision making, improved coordination flexibility (Soh, Markus, and Lynne 1995) and is essentially related to concept of "do the same with less". The second driver is output growth, related to when IS supports market-oriented performance, like offering more product/service variety, giving more customization, cutting intermediaries in the value chain, offering new products and services that open new markets (Lucas, Jr. et al. 2013) or that increase the willingness to pay of customers for products: e.g. cars with infotainment services (Onstar), thanks to IT museums become experience realms and apply higher prices (Neirotti and Raguseo 2017). In other words, "doing new things". However, these two drivers should be analysed within a context. Following the identified knowledge gaps and current active investments in IS, the research about effects of a rate of the IS diffusion within industries looks very promising. Also, the latest works emphasized problem of some digital innovations (e.g. Whatsapp, Netflix, Skype) that create pressure on prices within conventional industries (e.g. telecommunications, TV services), having goods in a digital form with very low prices. The growth of these service is hard to capture within productivity statistics but making production of a digital good as an "industry effect" could discover useful insights on modern productivity change. To sum up, the study is going to analyse through which drivers - input reduction or output growth - an industry's rate of IS diffusion and presence of goods in digital form influence the productivity.

The empirical setting for the study is chosen as Italy. Italy is one of the most interesting countries for the analysis among the developed ones for a variety of reasons. Firstly, the country has slower productivity growth compared to other advanced countries since the emergence of the Internet due to the slower penetration of IS and limited spending in ICT (it counts for xx%

of the GDP, according to OECD). Such slow penetration is due to the prevalence of SMEs and the high diversified industrial structure, which limits the supply of industry-specific IS solutions made available by IT vendors. Also, due to hit of economic recession in 2008, the heterogeneity of performance within industries have increased (Landini 2016, Neirotti and Paolucci 2013) and this create an opportunity for more deeper analysis. Secondly, Italy has a quite rigid labour market and a conflictual industrial relation system, with a fragmented structure of labour unions that have marginal role in the governance of firms. This may affect the capabilities of firms to change internal processes (i.e. to change the input) and the ways through which the value created by IS initiatives are shared among employers and workers. Lastly, differences between south and north of Italy in the industrialization rate - south is less industrialized. The de-industrialized south (with many young workers) can become the spot for offshoring digital based services that do not need physical proximity with the customer.

2. THEORETHICAL BACKGROUND

As it was stated before, the researches have investigated multiple relationships between investments made in ICT and firms' resulted performance. Based on these works, Schryen (2013) derived a definition:

"IS business value is the impact of investments in particular IS assets on the multidimensional performance and capabilities of economic entities at various levels, complemented by the ultimate meaning of performance in the economic environment."

In other words, how efficiently the resulted outcome (i.e. due to investments) is used, for example, to enhance a firm's strategic position on the market or increase revenue. However, there are still many blind spots, which do not allow to conclude what specific actions and assets bring particular value to a firm. There are many models "IT Processes", "IT Assets", "Leveraging IS Processes" proposed explaining how the business value might be generated inside operational processes of a firm, but Soh and Markus proposed a "Process Theory" which combines all of them into an elegant one (Soh, Markus, and Lynne 1995). The model is demonstrated in Figure 2 and it shows reasons why ICT investments might be converted to favorable organizational performance.

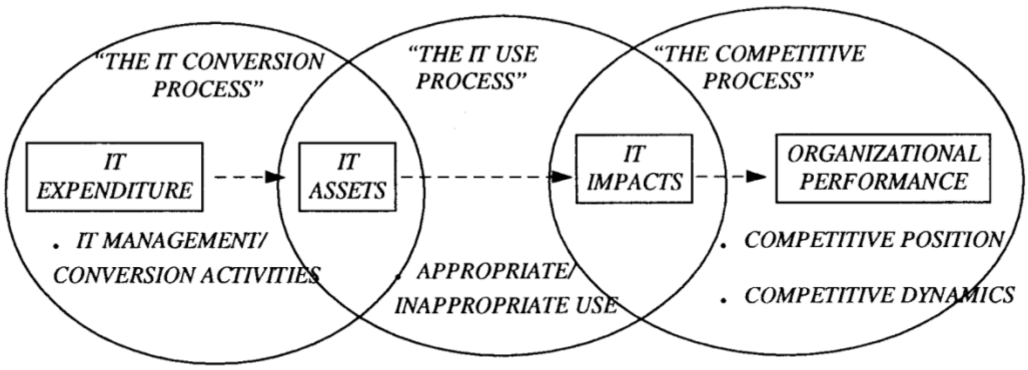

Figure 2. Process theory of a value creation from ICT investment (Source: Soh, Markus, and Lynne 1995)

While “THE IT CONVERSION PROCESS” and “THE IT USE PROCESS” can be considered as internal ones (i.e. performed by a firm), “THE COMPETITIVE PROCESS” is an external one and influenced by industry factors (Soh, Markus, and Lynne 1995). Combining this with a discussion done by Neirotti and Pesce (2019), also considering the knowledge gaps identified by Schryen (2013), discovering how digital condition of an industry shapes organizational performance of the firm helps to understand the last steps of IS business value generation. Most probably, there is also an impact from other factors, but the industrial one might be the strongest in this case (Arrighetti et al., 2014).

In fact, there are various forms through which the organization performance might be evaluated: accounting performance, productivity, product and service innovation and so on. Schryen (2013) has developed a taxonomy distinguishes them based on the IS value they generated – it is presented in the following Figure 3. Within the taxonomy a firm’s productivity is not only the most challenging to capture parameter, but the important one because its aggregation showing a national labor productivity. Moreover, it is the main parameter used by economists to see an economical condition of the country (Brynjolfsson 2012). Similarly, increasing productivity across industries might be a sign that companies work more efficiently than before (Neirotti and Pesce 2019). Thus, analysis of the industry’s influence on the productivity becomes a critical task.

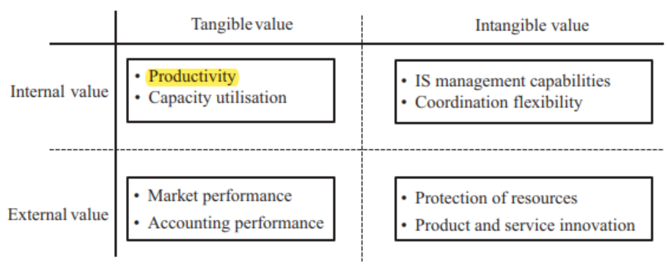

Figure 3. Taxonomy of business value (Source: Schryen 2013)

Firm's productivity and its drivers

According to a conventional definition *the productivity* – is a level of firm's output divided by a given level of labor input. "Output" defined as the amount of unit produced times their unit price. For instance, the change in *value added* or *revenue* is considered as change in "Output". The "Input" is generally associated with an *employment rate* (Brynjolfsson 1993). Thus, companies always try to implement solutions which either increase revenues or reduce the amount of labor force required in order to achieve the increase in productivity.

Productivity within the firm might be analyzed in accordance with Resource-Based View approach. It states that investments in particular asset or development of a specific routine creates an *operational capability* which allows increasing the desired outcome level (Neirotti and Paolucci 2013). Conventionally, new capabilities are created due to active investments in Research and Development and could establish their sustainable long-term development. This effect was mostly visible in Science-based industries. However, starting from 1990s, ICTs become cheaper and affordable, creating opportunities for many firms to increase their productivity (Eicher and Strobel 2009). Following these ideas, *the productivity paradox*, identified by Brynjolfsson in 1993, was successfully solved on the firm-level. Unfortunately, acquiring high-end technologies and their successful implementation within a company cannot guarantee that the firm will get the increase in productivity within industry (Schryen 2013) The Porter's Five Forces theory, which is used to analyze firm's competitive advantage on the industry level, suggests that productivity's drivers should be also looked among all industry forces, because penetration of an ICT into some of them may affect drastically productivity of the industry (Han, Chang, and Hahn 2011).

The major production industries, such as automotive or hardware manufacturing, use ICT technologies very extensively which leads to increase of their overall productivity. In spite their implementation of software-based solutions (e.g. ERP, PLM or supply management systems), the major ICT driving the productivity is automation. Also, these industries have one common characteristic – they have routine-intensive operations. It allows to replace a human labor by robots, decreasing operational costs, number of defects and, consequently, increase the revenue (Goos, Manning, and Salomons 2014, Acemoglu and Restrepo 2017). Penetration of automation in production and administrative work is noticeably associated with increase of unemployment among low-skill and office workers with decrease in their wages (Brynjolfsson 2012, Michaels, Natraj, and Van Reenen 2014, Acemoglu and Restrepo 2017). Moreover, there is a significant correlation between rate of ICT implementation intensity and rate of wages and employment decrease among the workers (Michaels, Natraj, and Van Reenen 2014). In other words, the productivity increase there is associated with input reduction, i.e. "doing the same with less"

ICTs also leads to appearing new type of goods which can effectively increase output of the company, leading to the productivity improvement. One of such goods is information good. It can contain information which brings the value to it and current technologies are able to make the majority of them into digital form (Varian and Arcangeli 2003). The main feature of the information goods is that that have only production costs, but their marginal cost is nearly-zero. It creates an opportunity to bundle them with other products creating more attractive offers for customers (Bakos and Brynjolfsson 1999). Producer even can propose different variants of the product having slight changes, but huge difference in price (Varian and Arcangeli 2003). Also, it may disrupt the conventional strategies about selling and renting durable goods or change the appropriability regimes when a new technology introduced into a market (Kemerer, Liu, and Smith 2013, Hu 2004). In addition, the data generated by a firm in digital form might become a source of supplementary income (Huang et al. 2004). To sum up, companies are able "to do new things".

From the other hand, automation of industries and introduction of digital information goods provide an insight into future of many professions. According to statistical data from USA and OECD members, professions related to ICT (e.g. data analysist, digital designers, programmers and so on) and service (e.g. coaches, nurses, doctors, etc) will be in-demand (OECD 2019, US Department of Labor 2019). Also, there will be a strong need in management professions with vast number of business and technological skills, for example, CIO with entrepreneurial skill (The Economist 2016). The ICT transformation creates new jobs too, for instance, AI engineers or process analysts (Susskind and Susskind 2017, 264–67). These factors clearly indicate that future occupations will be mostly related to digital field and national institutes have to think about education of people to new skills and make a smooth transition from conventional jobs (Joël Blit, Samantha St. Amand, and Wajda 2019). **Error! Reference source not found.** summarizes sources of the all described observations.

Overall, industry shapes the use and the impact of ICT since it is an important variable of the institutional environment in which firms are immersed. There are several ways through which an industry affects firms: supply of equal technologies, same changes of technologies and customer's preferences, endogenous adoption process of ICT, because firms are facing industry-specific business challenges. As a result, various industries have different level of investments in research and implementation of ICT (Neirotti and Paolucci 2013). Thus, there is a quest to identify proper taxonomy showing extensively difference in digital intensity among industries and type of goods produced.

Taxonomy quest: digital intensive and information goods producing industries.

The main challenge in classification of industries regarding their digital transformation rate is finding a proper variable. There were several attempts to identify the proper distinguishing parameter, which become a foundation for the final taxonomy used. For instance, Karmarkar and Apte (2007) following a seminal study of Porat and Rubin (1978) deliberately simplify the matter proposing a dichotomy between material (atom) based and information (bit) based sectors to study how country economies are becoming information intensive. Further, Neirotti and Pesce (2019) characterize the rate of ICT adoption as the ratio of IT spending over the total fixed assets or over sales revenue. In this case, it reflects the extent to which products and processes incorporate information and can be an important predictor of the extent to which industries are subject to the transformational role of ICT. Still, these attempts were not able to provide insides in exact type of resources implemented and limited to one-country level.

However, the digital transformation is an important phenomenon not only form scientific point of view, but from institutional also. Thus, OECD experts have prepared a taxonomy which differentiates industries based on rate of ICTs diffusion and called it *the digital intensity* (Calvino et al. 2018). The digital intensity is determined based on five key digital indicators: ICT investment, purchase of ICT intermediates, robot use, ICT specialists and online sales. There are 36 sectors investigated and classified according to ISIC revision 4 sectoral classification based on OECD members. Later, the analysis of these indicators was transformed into taxonomy with one "global" indicator with 4 levels of digital intensity: low, medium-low, medium-high and high. These levels are the average intensity across countries and years for each sector with quartiles of sectorial distribution to which it belongs. Unfortunately, the available data for the current research has only total values for ICT investments inside industries, without segmentation into the digital indicators. Thus, the taxonomy with "global" indicator was transformed into binary high/low classification, where low & medium low intensity is 0 and medium-high & high is 1.

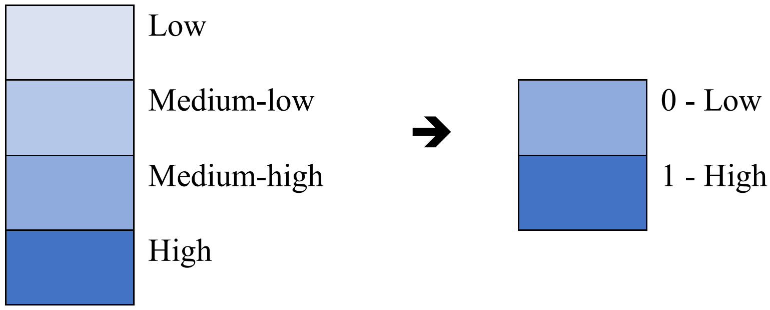

Figure 4. Transformation of digital intensity levels from original taxonomy (Source: Calvino et al. 2018)

Still, there are some limitations of the original taxonomy. The obtained digital intensity does not represent the intensity on firm-level. There might be a case, that some sectorial leaders will contribute strongly to the overall intensity whereas most players may not follow the same digital transformation rate. It might be clearly seen on examples of several Italian companies like Fiat (i.e. car industry), Eni and ENEL (i.e. gas and electrical utilities) and others (Neirotti and Pesce 2019). Nevertheless, the "global" indicator might be used for classification purposes, because it performs relatively well in approximating the sector's intensities (Calvino et al. 2018). Also, the taxonomy might be extended to developed countries, such as Italy, Japan, the Netherlands, Norway, United Kingdom, USA and others. Even the extent of generalization is unclear, it might be stated that some trends found in one can be applied to another. For a further analysis, this taxonomy is used to differentiate sectors to digital intensive and non-intensive, but the intensity itself is characterized according to definition of Neirotti and Pesce (2019).

To study better effect of the information goods on the productivity increase, the industries should be also differentiated based on the production of these goods. There is an opinion that information goods enhance effects of ICT investments into productivity. Following the discussion from Andrews *et al* (2016), a gap in productivity between frontier firms which are on the edge of digital transformation and laggards is reinforced by presence of information goods. To make a segregation of the industries, a combined definition of information good is used: *the good in the digital form that has a value due to information contains* (Varian and Arcangeli 2003, Krugman and Wells 2006, 519–37). Using the definition and a taxonomy developed by Broussolle (2014) for industries in France based on production of information goods, the sectors for analysis of effects of information goods on productivity are also identified.

Eventually, based on these two parameters of industries differentiation, the final taxonomy for our research was developed in order to understand influence of industry's level of digital intensity and presence of information goods on industry-level productivity in Italy for decade from 2008 to 2016.

Table 1. Modified taxonomy of digital intensive and information goods producing industries

Sectors	Digital Intensity	Information Goods
Mining		
Food & Beverages		
Textiles & Apparel		
Wood & Paper prod		
Cook & Ref Petroleum		
Chemicals		
Pharmaceuticals		
Rubber & Plastics		
Metal Products		
Computer & Electronics		
Electrical Equipment		
Machinery and Equipment		
Transport Equipment		
Furniture & Other		
Electricity & Gas		
Water & Sewerage		
Construction		
Wholesale & Retail		
Transportation & Storage		
Hotels & Restaurants		
Media		
Telecommunications		
IT		
Real Estate		
Legal & Accounting		
Scientific R&D		
Marketing & Others		
Administrative Services		
Education		
Health		
Social Work		
Arts & Entertainment		
Other Services		

3. HYPOTHESES

The major measure interesting to a company is a productivity. The term stands for an amount of output per unit of input. In business, the output is measured in amount of revenue of profit generated by, for example, employee which plays a role of the input. There are many ways how a firm can improve the productivity: higher better professionals, organize efficiently business processes, invest in marketing or introduce new technologies in daily operations. It is commonly known, that with faster development of IT industry and technologies, more and more computers, devices, software were introduced into business processes of companies.

Following the discussion of theoretical background, the literature review is targeted to 3 directions: exploring previous works regarding effects of digitalization on employment and wages level; what is changed in the firms' businesses with appearance of information goods and how they shape new market strategies to increase profits; following the increased demand for IT specialists during the last decade, there might be a case that new professions will appear and there might a positive shift of the employment in digital related sectors. The key findings related to these points are summarized in the Table 2. Literature review regarding drivers of a firm's productivityTable 2

At the end of the 20th century majority of economists agreed on one important point: from the beginning of 1990s a productivity growth is driven by IT (Brynjolfsson 2012). Companies started to make investments in ICT: adapting software for business (e.g. ERP, CRM), hiring IT-professionals who will support the technologies, introducing robots into daily operations, going to online sales (Calvino et al. 2018). As a result, a company could roughly increase the productivity in two ways: either increases the output or decreases the amount of input. The increased productivity of firms is directly reflected into an increase of GDP, which was clearly seen on the example of US from 1975 to 2008. Also, high GDP is always associated with high employment in a country. However, starting from 2000s historical relationship between increase in GDP and increase in employment was weakened due to technological change (Brynjolfsson 2012). A very clear example of this effect is a decrease in employment in routine-based industries (Goos, Manning, and Salomons 2014). Technologies like robots, numerically controlled machines, computerized inventory control can perform routine tasks instead of workers, noticeably reduce costs and defects (Brynjolfsson 2012). These workers are blue and white collar, who are middle-skill employees. (Goos, Manning, and Salomons 2014; Brynjolfsson 2012; Michaels, Natraj, and Van Reenen 2014; The Economist 2016; Acemoglu and Restrepo 2017) are clearly identified, that exactly a middle-skill employee is the subject of replacement, because she performs routine-cognitive or routine-manual tasks. For instance, in Italy, an overall change of middling employees in period from 1993 to 2010 is -10,59% from initial 51.04% (Goos, Manning, and Salomons 2014).

Nevertheless, decrease in demand of middle occupations creates a necessity in high-skill and low-skill employees (Goos, Manning, and Salomons 2014; Brynjolfsson 2012; Michaels, Natraj, and Van Reenen 2014; The Economist 2016; Acemoglu and Restrepo 2017; US Department of Labor 2019). On one hand, there is demand for service professions, which do not require strong cognitive skills, but rather communication and interpersonal ones, e.g. personal coach, nurses, barbers (The Economist 2016; US Department of Labor 2019) . On the other hand, the data analysis and visualization, analytics, high-speed communications, programming of robots – action, that have contributions to more abstract and data-driven reasoning, increase the need for highly skilled and educated persons (Brynjolfsson 2012). This separation effect is calling a job polarization (Goos, Manning, and Salomons 2011). One study, that analyzed data from 9 developed countries in period from 1980 to 2004, found that industries having fastest growth in ICT experience the strongest polarization effect (Michaels, Natraj, and Van Reenen 2014). Following the definition of the taxonomy described before, these industries can be called "digital intensive". In fact, the highest *ICT investment/value added* ratio leads to a difference between wages for high- and low-skilled workers across industries (Michaels, Natraj, and Van Reenen 2014). One specific example is demonstrated by (Acemoglu and Restrepo 2017), where effects of robotization from 1990 to 2007 in commuting zones across US was studied. Researches found out that decrease in employment to population ration due to robotization is currently small – 0.18%-0.34% - but it has strong correlation. Following the aggressive scenario proposed by (Boston Consulting Group 2015) and apply model of (Acemoglu and Restrepo 2017), the decrease might reach 1.75% which is around 3.4 million jobs. Moreover, it was figured out that routine tasks have small correlation with robotization (Acemoglu and Restrepo 2017). Thus, we might conclude:

H1. *IT spending effects on labor productivity due to* ***employment reduction*** *are greater in sectors that exhibit a high digital intensity*

The main feature of an information good is a near zero marginal cost. Based on a case of music industry, a recording of music requires work of songwriters, audio technicians, which use complex software and equipment operated by highly paid programmers. It creates high fixed cost of production (Krugman and Wells 2006, 519–37). Nevertheless, because of the digital format, they can be easily stored and transferred anywhere on a vast majority of electronic devices. In other words, making a copy of a song is extremely cheap. The last property of information goods creates a room for new or revised strategies which could increase productivity of a firm through increase of the output.

With introduction of information goods, many have proposed new pricing and selling strategies or revised conventional ones. According to (Varian and Arcangeli 2003), information goods might be easily "customized" and thus sold at maximum personalized price. Also, selling different versions of the goods is efficient in technology-intensive information goods industries. For instance, movies are sold in "standard" and "collection" versions with significant difference in prices, but without it in marginal cost [ibid]. (Bakos and Brynjolfsson 1999) discovered that high number of information goods are easy to bundle and monopolist of digital goods (e.g. Sky or Netflix) earns greater profits rather than selling them separately. Advantage of large numbers allows "averaging out" customers valuations making bundling strategies very promising [ibid]. Another classical strategy of renting durable good might not be profitable for some durable information goods (e.g. for software with short life-span or non-classical movies). In fact, their utility for consumers is decreasing fast after the first usage. Thus, selling of these types of durable information goods might generate high profit (Hu 2004). Even the common strategy "winner-takes-all", described by (Brynjolfsson 2012), might transform into "winner-takes-some". Due to technological development, there will not be standard wars between digital formats. Audio, video, e-book files have zero conversion cost and vendors (e.g. in e-book industry) have zero storage cost allowing to keep several formats. Also, many tablets or smartphones have inherent conversion software that reduce multi-homing costs. It allows developers to keep specific market's niches (Kemerer, Liu, and Smith 2013). In addition, new professional information goods might appear in digital intensive sectors. (Huang et al. 2004) proposes to sell information about suppliers, sales statistics, transaction costs from ERP to facilitate making of strategic decisions. Thus, following the previously described taxonomy, it might be stated that:

H2. *IT spending effects on labor productivity due to* ***output growth*** *are greater in sectors that exhibit a high digital intensity and that are specialized on information goods.*

Following the discussion, a one can ask: does digitalization only destroys occupations, or it can create them? As any change, technological change also brings new opportunities. According to (The Economist 2016), destruction of jobs takes place where Artificial Intelligence is capable to handle working tasks (mainly routine ones). However, in skill-demanding occupations a computer facilitates or relocates working process, creating a necessity of new skills [ibid]. (need some transition) Digitalization also creates new platforms, software, online services for the conventional professions as doctors, lawyers, taxi drivers. They are developed by traditional professionals in close cooperation with web-designers, software developers and system engineers; still, the leading role is transferring towards these modern occupations (Susskind and Susskind 2017, 117–27). In addition, the development of professional software and its further work creates a mass of data, which can provide critical insides within business processes, if it could be properly interpreted (The Economist 2010; The Economist 2017). Data becomes the information good, generating greater revenues, e.g. Facebook and Google accounted for almost all revenue from online advertisement (The Economist 2017). As a result, new data-centered economy emerges and creates a rising trend for occupations related to information goods (The Economist 2010; (Susskind and Susskind 2017, 264–67). These occupations are data scientist, process analysist, designers and system engineers [ibid]. Additionally, CIO becomes an extremely important player within executive suite (The Economist 2010). It might be stated that if a firm actively invests in technologies to become more digital, it hires IT related people but keeping only the best from traditional professions to make the transition (The Economist 2010; The Economist 2016; Susskind and Susskind 2017, 264–67).

US Department of Labor (2019) has prepared a 10-year horizon prediction of the demand for all occupations based on last trends in 2016. Similar data is available for OECD countries, but *ex-post* for the last 10 years (OECD 2019). Table 5 and Figure 5 in the Appendix demonstrate these observations. Merging the available information from these observations with the taxonomy, it might be concluded that occupations related to digital intensive sectors producing information goods becomes popular comparing with other sectors. In the case of US, they all have more than 10% increase. For EU countries the change is not so significant, but trend lines have positive slopes, whereas number of manufacturing professions is decreasing. Thus, it can be stated that:

H3. *IT spending effects on labor productivity due to employment reduction are lower in sectors that exhibit a high digital intensity and that are specialized on information goods.*

Table 2. Literature review regarding drivers of a firm's productivity

Observation 1: *there is a significant employment reduction in the industries that actively implement automation and ICTs*	
Paper/Book	*Key messsage*
Goos, Maarten, Alan Manning, and Anna Salomons. 2011. “Explaining Job Polarization: The Roles of Technology, Offshoring and Institutions.”	Technological change (i.e. automation) creates a strong job polarization within manufacturing industries. It is especially critical for routine-intensive industries, where decrease of mid-skill workers employment and wages is observed.
Michaels, Guy, Ashwini Natraj, and John Van Reenen. 2014. “Has ICT Polarized Skill Demand? Evidence from Eleven Countries over Twenty-Five Years.”	Paper tests a hypothesis that industries and countries experince faster growth in ICT have higher demand for high skill workers and decreasing demand for middle class workers. Also, it highlights that industreis having high ICT intesity (active introduction of ICT) anticipate greater effect of the polarization.
Acemoglu, Daron, and Pascual Restrepo. 2017. “Robots and Jobs: Evidence from US Labor Markets.”	Authors analyze an effect of increase in industrial robot usage between 1990 and 2007 on US local market. They found that robots may reduce employment and wages noticeably and this decrease does not correlate with production offshoring (e.g. in China).
Brynjolfsson, Erik. 2012. Race against the Machine: How the Revolution Is Accelerating Inovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy.	Provides comments from the expert of research field about effects of digital technologies on productivity regarding future of labor market, firms’ performance, national productivity and new professions.

Observation 2: i*nformation goods create a room for enhancing productivity through firm’s output growth*	
Paper/Book	*Key message*
Brynjolfsson, Erik. 2012. Race against the Machine: How the Revolution Is Accelerating Inovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy.	Information goods support dynamics of “Superstars” or “Winner-take-it-all”. Low marginal cost of the products could give big players to cover almost all niches of a market.
Hu, Yu (Jeffrey). 2004. “Essays on Internet Markets and Information Goods.” Renting versus Selling Durable Information Goods.	Introduction of information goods disrupts conventional strategies of renting and selling durable goods. Nowadays, it may be more beneficial to sell the durable information good, because it generates higher profits.
Kemerer, Chris F., Charles Zhechao Liu, and Michael D. Smith. 2013. “Strategies for Tomorrow’s ‘winners-Take-Some’ Digital Goods Markets.”	For some digital and information goods, there might not be standard wars anymore (as it was before with VHS/Betamax cassettes and Blu-Ray/DVD disks). Everyone can get some portion of a market due to opportunity to change formats and options of digital goods.

Huang, Ming-Hui, Jyun-Cheng Wang, Shihti Yu, and Chui-Chen Chiu. 2004. "Value-added ERP Information into Information Goods: An Economic Analysis."	E-business or some corporations, using ERP, can sell the information from it as an information good, gaining additional profit and exchange information for improvement of operational efficiency.
Bakos, Yannis, and Erik Brynjolfsson. 1999. "Bundling Information Goods: Pricing, Profits, and Efficiency."	Authors state that bundling of large number of unrelated information goods might be profitable. Monopolist of digital goods can obtain greater profits by offering a bundled information goods, rather selling them separately.
Varian, Hal R., and Andrea Arcangeli. 2003. "Economics of Information Technology."	One of interesting ideas is a creation of different versions of a product. During the production process the whole product is created with additional features, but it is sold either solely or with these features. The cost is the same, but the price is different.

Observation 3: *digital transformation and development or adaptation of information goods create new types of job occupations*

Paper/Book	*Key message*
US Department of Labor, USA. 2019. "Fastest Growing Occupations," Employment by detailed occupation, 2016 and projected 2026.	The database demonstrates a number of people employed in different occupations in 2016 and expected one in 2026. Manufacturing occupations have a strong declining trend. High-skill professions, managers, IT engineers and service occupations have a constant increase.
OECD, Stat. 2019. "Population and Employment"	The data shows number of people employed (aggregated by major industries) from 2008 to 2018 in European countries. There is the same trend regarding the occupations, but it has slower rate.
The Economist. 2016. "Automation and Anxiety."	The article highlights professions which are under a high risk of automation. At the same time, it mentions the professions which are in-demand such as digital designers, IT engineers, system analysts and managers with technical skills.
The Economist. 2017. "The World's Most Valuable Resource Is No Longer Oil, but Data."	Here is described a domination of IT giants (e.g. Google, Facebook) in a modern business, because they have a huge access to information about potential customers. However, there is also a need for new professions as data miner or data analyst, who could extract useful insights from the available mass of information.
The Economist. 2010. "Data, Data Everywhere."	The article supports the idea that the world economy becomes data-centered. The role of CIO inside firms goes beyond only technical solutions within a firm and it is a valuable player among managing officers. Also, it supports the article above that data scientist is emerging and extremely needed profession.
Susskind, Richard E, and Daniel Susskind. 2017. The Future of the Professions: How Technology Will Transform the Work of Human Experts.	The book describes current changes in occupations due to digital transformation within industries and mentions new emerging professions such as AI engineers or process analysist. Also, it tells that there will be a transition period when mixed occupations will appear, e.g. people with background in financing could update their skills and become IT specialists in finance sector.

4. METHODOLOGY

Data

This study combines industry-level data on national accounting statistics collected from the Italian Bureau of Statistics (ISTAT) and an aggregation of firm-level data from AIDA, a Bureau Van Dijk dataset that collects financial report data on all the Italian enterprises. Our final data set for this study consists of 255 industries and around 1.3 million firms for which complete data on key variables of interest were available from 2008 to 2016. Data on IT investments in software were available from ISTAT exclusively for this time period. The dataset is an updated version of database from (Neirotti and Pesce 2019). The results are based on the three level-digit level of ATECO (Classification of Economic Activity). The ATECO is a national version of NACE Rev 2 (Nomenclature of Economic Activities) classification which is a standard for all EU countries. Overall, the dataset covers all the industries presented in economies of developed countries, except financial sectors, because their accounting methods are different from other industries.

Variables

Further, the dataset is combined with information from the taxonomy about sectors considering as digital intensive and those which produce information goods. It allows investigating these parameters as "dummy" ones with binary values. Having dataset for 8 years for almost each economical sector in Italy, a regression model might be constructed based on 2079 observations. This number is significant enough to develop a statistically reliable model with solid results. Generally, the approach for the model development is similar to one conducted by Neirotti and Pesce (2019). Following the discussion of hypothesis, the research focus is the exploration of single effects of digital intensity and production of information goods, as well as their combined influence, on labor productivity within an industry. These is achieved by analyzing these effects on parameters of the productivity: input (i.e. *change in employment*) and output (i.e. *change of* *value added and of revenue*). Finally, the combined influence of the intensity and presence of information goods is investigated on labor productivity which is represented as *value added per employee*.

Control Variable

During evaluation of the effects from the digitalization and production of information goods on industries productivity's performance the number of firms within an industry was taken as a control variable. In order to facilitate the work, the number was analyzed in a logarithmic form. This variable might play a role when industry has a significant amount of firm with small and medium sizes. In these industries, the digitalization rate might be slow affecting the productivity. On the contrary, industries with small number of players might facilitate introduction of new ICT technologies in order not to lose competitive position. The additional descriptive statistics of the control variable is presented in Table 3

The regression model

In order to construct the regression model, the dependent variables (Y_i) will be *change in employment*, *change of value added and of revenue* and *value added per employee.* Whereas the independent ones are digital intensity (x_{int}), presence of information goods (x_{ig}) and their interaction ($x_{int}x_{ig}$) representing as "dummy" variable. As the result, the next equation is showing the regression model:

$$Y_i = \beta_{int}x_{int} + \beta_{ig}x_{ig} + \beta_{int+ig}x_{int}x_{ig} + \epsilon$$

The t-test with 95% confidence interval is conducted, which demonstrated that the majority of findings are statistically significant, and results are reliable. The results of the test and the regression model analysis are demonstrated in the Table 4. Also, the descriptive statistics of the investigated parameters is demonstrated in Table 3.

5. FINDINGS

Table 3 presents descriptive statistics of the key variables.

Table 3. Descriptive statistics of the analyzed parameters

		Descriptive Statistics		
	Industry type	Mean	Standard Deviation	Frequency
IS investment over revenue *(deflated values, 2008 = base year)*	Material based + Information intensive sectors	0.0012	0.0032	1,683
	Information goods sectors	0.0037	0.0053	341
Employment *(log values)*	Material based + Information intensive sectors	9.9637	1.5542	1,696
	Information goods sectors	9.4125	1.4746	342
Number of firms *(log values)*	Material based + Information intensive sectors	7.7994	2.2621	1,697
	Information goods sectors	8.4720	2.2614	342
Average firm size *(log values)*	Material based + Information intensive sectors	2.1598	1.6569	1,697
	Information goods sectors	0.9405	1.8209	342
Value Added *(log deflated values, 2008 = base year)*	Material based + Information intensive sectors	20.6967	1.4830	1,687
	Information goods sectors	21.9266	1.7555	342
Revenue *(log deflated values, 2008 = base year)*	Material based + Information intensive sectors	22.2691	1.6176	1,697
	Information goods sectors	21.5672	1.7574	342
Value Added over employees *(log deflated values, 2008 = base year)*	Material based + Information intensive sectors	10.9779	0.5717	1,687
	Information goods sectors	11.2842	0.7148	342
Value Added over revenue *(deflated values, 2008 = base year)*	Material based + Information intensive sectors	0.3069	0.1575	1,687
	Information goods sectors	0.4465	0.1481	342

Table 4 presents the results of the panel regression models with industry time and fixed effects.

Table 4. Results of the regression model analysis based on the ISTAT data

	(1)	(2)	(3)	(4)
	Input reduction	Output growth		Labour productivity
	Employment Annual growth rate [log] b/se	Revenue Annual growth rate [log] b/se	Value Added Annual growth rate [log] b/se	Value added per employee b/se
L. [Dependent Variable]	-0.013***	-0.019***	-0.021***	-
	(0.00)	(0.00)	(0.01)	
L. IT spending / Revenue	-1.607*	3.320**	2.007	2.058*
	(0.93)	(1.32)	(3.99)	(1.40)
Information Goods	0.018†	0.027†	0.024	0.065*
	(0.01)	(0.02)	(0.02)	(0.12)
L. IT spending / Revenue x Information Goods	1.886**	4.285	3.913**	3.725**
	(1.59)	(2.21)	(2.64)	(2.59)
log_firms	0.007***	0.003†	0.007**	-0.055***
	(0.00)	(0.00)	(0.00)	(0.01)
_cons	0.044***	0.212***	0.284***	11.404***
	(0.03)	(0.07)	(0.08)	(0.12)
R-sqrd	0.2965	0.3976	0.3265	0.3979
N	1787	1784	1774	1776

The first hypothesis states: "IT spending effects on labor productivity due to **employment reduction** are greater in sectors that exhibit a high digital intensity". The first column of Table # shows that the coefficient of employment annual growth rate in the industries having high spending in ICT (i.e. digital intensive industries) is negative and noticeable (coefficient = -1.607, $p<0.1$). At the same time, there is the increase of the both output variables: revenue annual growth rate (coefficient = 3.320, $p<0.05$) and value-added annual growth rate (coefficient = 2.007, $p<0.15$). Still, the increase in revenue growth rate is more significant than in value-added one. Following these observations, the labor productivity (i.e. value-added per employee) increases remarkably during the investigated period (coefficient = 2.058, $p<0.1$). Thus, it might be stated that the H1 is supported.

The H2 predicted that ICT investments' effects "on labor productivity due to **output growth** are greater in sectors that exhibit a high digital intensity and that are specialized on information goods". When the condition that a sector produces an information good was added to the model, the output growth was increased. However, in this case the statistical significance is stronger for value-added growth annual growth rate (coefficient = 3.913, $p<0.05$) than for revenue growth rate (coefficient = 4.285, $p<0.15$). Nevertheless, the H2 is supported by the results.

The last hypothesis states: "IT spending effects on labor productivity due to **employment reduction are lower** in sectors that exhibit a high digital intensity and that are specialized on information goods". In fact, the labor productivity has a significant and solid increase in sectors with information goods rather than without them (coefficient = 3.725, $p<0.05$). However, the input's behavior is opposite: for industries with information goods there is strong and statistically significant increase of employment annual growth rate (coefficient = 1.886, $p<0.05$). Thus, the H3 is also enforced.

6. DISCUSSION

Main findings

The study was dedicated to investigation of ICT investments' effects on a sector's productivity within industries of Italy in period from 2008-2016. The effects are conditional on industry type. The industries are classified according to their digital intensity and presence of information goods. Overall, the results of the study are based on the analysis of 255 industries and around 1.3 million firms having in total 2071 observations used in the statistical analysis.

Particularly, the research was targeted to contribute into solution of "grey box" about how ICT investments transformed into business value of the company. As Schryen (2013) identified, the "grey box" might be overcome by closing the specified knowledge gaps. One of such gaps is industry effects on a its productivity. Following the current trend on digitalization, the influence of the rate of digital technologies introduction within an industry was taken as a research target. However, active implementation of digital technologies drives the appearance of new products – information goods, that are in digital form and their value is based on the information they are incurred. Thus, according to the above-mentioned classification, it has become possible to study solely effects of these parameters as well as their combined contribution to the productivity of an industry. The question was by what means the productivity will be affected: is there "doing the same with less" decrease or "doing new things" increase, change in an input and output of a firm respectively. Following the literature review, there was discovered points of concrete analysis. First one, the digitalization might change the level of employment, i.e. input. So, it might be more visible in the high digital intensive sectors. The second one is that information goods might create room for revenue increase, i.e. output growth. The final point is that employment creation in the digital intensive sectors producing information goods might be more visible, because the demand for a good digital-related specialist is high.

7. CONCLUSION

The results show that both high investments in ICT and production of information goods significantly increases productivity within a sector. Moreover, if a sector produces information goods and is in the digital industry, the effect is even stronger. Specifically, the increase in productivity of a sector in highly digital intensive industry is achieved by increase of the output (i.e. revenue and value added, "doing new things") and decrease of the input (i.e. employment reduction, "doing the same with less"). On the other hand, increase of productivity in digital intensive sector operating with an information good is driven by greater increase in the output variables with even the increase in the employment level.

Research implications

Prior researches in the area of ICT investments' effects on the productivity were attempts to solve "the productivity paradox", which could be overcome on the firm level. Also, there were successful studies about impacts of ICT on the national level and economy growth according to review made by (Schryen 2013). However, there is a small number of researches dedicated to investigation of how industry itself shapes effects of ICT investments on firms' productivity (Han, Chang, and Hahn 2011; Neirotti and Pesce 2019)

The study is targeted to close the gap and enrich the current literature about how the ICT investments changes productivity of a sector if it is digital intense and if it produces information good or both. Moreover, it attempts to discover what drives the change of productivity: input reduction or output growth due to digitalization. The conventional vision (Goos, Manning, and Salomons 2014; Brynjolfsson 2012; Michaels, Natraj, and Van Reenen 2014; The Economist 2016; Acemoglu and Restrepo 2017), regarding to all industries, is that digitalization destroys jobs occupations and reduces operational costs (i.e. "doing the same things with less") and creates room for new business process or products increasing firm's revenue (i.e. "doing new things") (Hu

2004; Huang et al. 2004; Kemerer, Liu, and Smith 2013). However, our data shows that these two factors disentangle industries and the effect of ICT is different among them. For instance, industries actively investing in ICT and producing information goods, in contrary, have a strong and increasing demand for professionals with digital skills. Also, the research was focused on Italy, which has a slower growth of the economy comparing with other developed countries as, for instance, Germany or Netherlands. Nevertheless, it might be concluded that the ICTs do have a strong sociological impact, despite of the economic condition in a country, and their broad implementation should be controlled by the state. In addition, the modified taxonomy, used to differentiate industries regarding their level of digitalization and production of information goods, might be used by other researches in case of having aggregate country-level data only about investments in ICT within an economical sector.

Following the main purpose of ICT introduction into business – developing new capabilities and improving operations – the case of Italy from the study proves that type of an industry could enrich effects of ICT in bringing internal tangible business value (i.e. the productivity) to a firm. However, as it was already mention by previous national studies (Neirotti and Paolucci 2013; Neirotti and Pesce 2019), the high digital intensive sectors have only several major players, which invest vast amount of capital into IS technologies. Consequently, it might force the other industry players to imitate their actions, but due to smaller financial resources, path dependency and firms' sizes, positive effects of ICT implementation on the productivity might be vanished there. Still, there is a some number of startups and new SMEs that are trying to use ICT in order to apply new business logic or product/service architecture (i.e. the output growth), but their effect of "efficient" use is hard to capture (Neirotti and Pesce 2019). Thus, following this pattern, other researches could study the creation of IS business values in countries similar to Italy with higher specificity.

Implications for practice

The practical outcomes of the research might assist managers in taking strategic decisions regarding implementation of ICT and growth of the productivity. Still, the results of new ICT introduction into operations of a firm will mainly depend on the size of the firm. Big corporations, for instance, could think about introduction of robots to increase the productivity and, following the study, it will be driven by employment reduction. Thus, a proper resignation plan has to be developed and operational processes have to be updated. On the other hand, managers from SME could use the study as an argument to accelerate introduction of less radical ICT (e.g. CRM, ERP and etc), because it could improve business processes making them more efficient and increasing the captured value. In addition, the study shows that it is strategically beneficial for companies operating in digital intensive sectors to find ways of producing information goods or to find options to be bundled with them. If the firm decided to produce an information good, it should be ready to hire professionals with new digital skills (e.g. graphic designer, software developer) or invest resources into trainings and education of the current personnel. Still, these actions are going to depend on industry structure and should consider firm's path dependency, internal competition, solid analysis of appropriability regimes.

In the pursuing for the productivity growth, firms will not think about unemployment professionals and, consequently, the state should take an action here. Even the economy of Italy is not growing fast and automation's effects are not so clear, it is obvious that in the near future a significant part of jobs might be automated. Thus, in order to avoid increase of unemployment rate, policymakers should protect workers or provide opportunities to learn new skills. From the side of employer, the state could change a taxation police regarding introduction of robots into operational activities. As a result, it may slow down the rate of automation and create a transition period for workers to develop new skills. In parallel, the state should provide opportunities for people to learn new competencies, for example, making some MOOC's (massive open online courses) certificates legally valid or provide a financial support for professional courses. The state might promote entrepreneurial skills such as critical thinking, creativity and problem solving within schools and motivate students to study digital skills. From the point of view of the output growth, the state should support the investments in ICT of firms within industries in order to make industries more homogeneous. It might decrease the tendency of winner-takes-it-all dynamic, because it has a risk of monopolies creation with higher prices for consumers and deadweight losses for society. Especially, attention should be paid to industries with high digital intensity producing information goods, because they have very low variable costs (Joël Blit, Samantha St. Amand, and Wajda 2019).

Limitation and directions for the further research

Investigating the topic, our research has some limitations which could be a foundation for the future analysis. The available data form ISTAT provides one-country industry level overview. However, this data is aggregated and do not allow to understand the competitive dynamics within industries. Thus, it creates a room for the further within industry research, but in the settings of Italy. However, the results might be extended to countries having the same economic conditions.

Next limitation is that data does not differentiate the types of investments made: in robots, in software, in ICT workers and so on. It has only overall spending in ICT which cannot provide a within industry firm-level situation. In other words, it quite hard to capture competitive dynamics inside. More detailed disaggregation of investments could give a deeper understanding of the industry's specific productivity drivers and value creation factors in Italy. The baseline for the further research might be an original taxonomy from (Calvino et al. 2018) and early studies from (Neirotti and Paolucci 2013; Neirotti and Raguseo 2017; Neirotti and Pesce 2019).

It is also important to document that decline in employment has the main logic in IT use. Nowadays, the major group suffering from automatization is middle-skill workers (Brynjolfsson 2012, Goos, Manning, and Salomons 2014, Michaels, Natraj, and Van Reenen 2014, Acemoglu and Restrepo 2017) because currently automation facilities and technological development makes possible to replace only them. However, later it can shape the emerging wave of IT investments (based on collaborative robotics, machine learning and artificial intelligence) that can lead to automation taking place even in high-skill settings and in decision-making processes. However, this argument might be a topic of a long-term analysis, because current technologies are not enough advanced in order to replace human beings in these fields.

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9. APPENDIX

Table 5. In demand occupations in 2016 and projected in 2026

Digital intensive sectors **(with Information Goods)**	Examples of occupation	US Labor Statistics Department	
		Occupations 2016, thousands	Change in 2026, %
Wood and paper production	Paper goods machine setters, operators, and tenders	94,60	-9,0
	Printing workers*	267,30	-11,9
Computer and electronics	Computer hardware engineers	73,60	5,5
	Electronics engineers	136,30	3,7
Electrical equipment	Electrical engineers	188,30	8,6
	Miscellaneous electrical and electronic equipment mechanics, installers, and repairers	256,50	4,8
Machinery and equipment	Mechanical engineers	288,80	8,8
	Industrial machinery installation, repair, and maintenance workers	477,70	6,7
Transport equipment	Transportation and material moving occupations*	10 274,20	6,2
	Electrical and electronics installers and repairers, transportation equipment	13,90	2,9
Furniture and other	Woodworkers*	279,30	1,2
Wholesale and retail	Wholesale and retail buyers, except farm products	123,30	-2,5
	Sales representatives, wholesale and manufacturing*	1 813,50	5,2
Media	Actors, producers, and directors*	198,50	**12,0**
	Miscellaneous media and communication workers*	101,10	**15,1**
Telecommunications	Television, video, and motion picture camera operators and editors*	59,30	**12,7**
	Audio and video equipment technicians	83,30	**12,9**
IT	Software developers and programmers*	1 714,00	**17,8**
	Computer and information analysts*	700,50	**11,8**
Legal & accounting	Insurance claims and policy processing clerks	308,50	**11,1**
	Legal support workers*	425,10	**11,2**
Scientific R&D	Operations research analysts	114,00	**27,4**
	Computer and information research scientists	27,90	**19,2**
Marketing and other	Marketing managers	218,30	**10,1**
	Market research analysts and marketing specialists	595,40	**23,2**
Adminsitrative services	Administrative services managers	281,70	10,1
	Office and administrative support occupations*	23 081,20	0,6
Arts and entertainment	Archivists, curators, and museum technicians*	31,00	**13,5**
	Set and exhibit designers	14,60	**10,3**

*Summary of related occupations

**Others servcices are excluded due to many possible examples

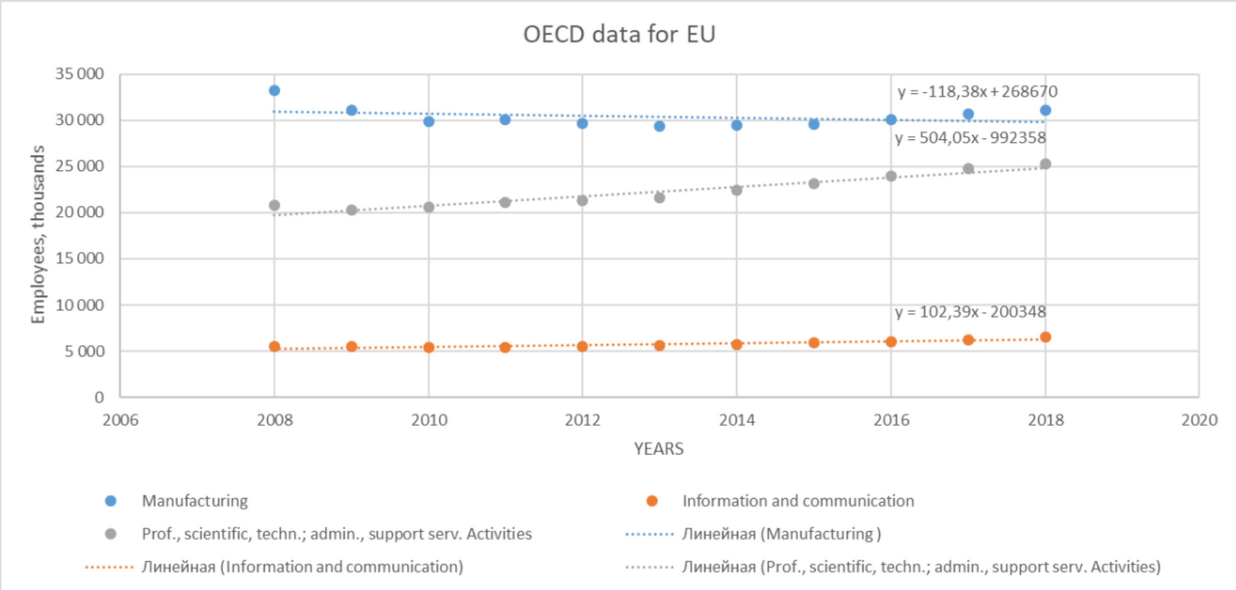

Figure 5. Occupational trends of OECD members