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Economic Implications of Digital Transformation

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Abstract

In a firm perspective the simple availability of digital systems does not necessarily lead to success. On the contrary, it requires that firms accompany digital resources with the development of best organizational practices which implicates a transformation in term of e.g. organizational changes and innovation. Digital technologies allow companies to improve productivity in two ways: by making hard improvements that dramatically increase the efficiency of intelligent machine and processes, and by making soft improvements that increase the efficiency of people working together. The paper highlights various discussions on the relationship between ICT investment and productivity. However, this framework has outlined a relatively more cohesive body of thought which, by seeking to overcome the controversial concept of the productivity paradox, highlights the existence of a significant relationship, not just between ICT and productivity, but also between certain multiplying variables which represent ICT and other complementary factors..

Keywords: ICT, productivity, digital transformation, ICT management, ICT investment

1. INTRODUCTION

Technological resources intended to communicate and transfer information have already long been part of the work and production processes of almost all modern organisations, altering – sometimes radically – their structure and processes [10] - [53] - [55] - [44] - [38].

In particular, a scenario is emerging where the pervasive use of digital technology will increase competitiveness and efficiency in all sectors given the widespread digital transformation (which has finished in some companies but is still in use in others) in all production sectors [8] - [2] - [43] - [24]. In this way, digital transformation means the integration of digital technology into all areas of a business, deeply changing how organizations operate and deliver value to stakeholders. At the same time it's also a cultural change that requires organizations to constantly challenge the status quo (i.e. customer experience, operational agility, workforce enablement). This is essentially a natural evolution of production processes based on an innovative technological landscape where humans, machines and "things" designed for intelligent system management (for example, manufacturing) are and will be increasingly connected in real time and on a permanent basis. All industrial sectors see data as the main driver to improve productivity, increase product quality, manage predictive maintenance and run remote monitoring. As a result, more and more intelligent remote devices and components are being used, but this also leads to new problems companies have to handle. If on one hand, digital technologies help the firm productivity growth throughout the possibility: 1) to create new products and services; 2) to add information to products and existing services; 3) to improve the existing processes, on the other hand, it is necessary that the adoption of such technologies in firm occurs in a strategic way, integrating - for instance - the intelligent components inside the human work and not limiting itself to a mere substitution of the man with the technology.

This paper aims to analyse the studies which, over the last thirty years or so, have attempted to identify the link, relationship or correlation between ICT investment, considered a sound indicator of investment in intelligent systems, and productivity. This will take into account both aggregate productivity rates and on a micro-economic level (individual companies), in Italy and around the world. This paper is organised as follows: the second paragraph will define the concept of productivity and introduce how ICT can help growth; while the third and fourth paragraphs will show the results of the most significant international studies which have analysed the relationship between ICT investment and aggregate productivity rates on a national level (paragraph 3) and between ICT investment and company productivity (paragraph 4). The latest will examine also the case of Italy (which represents a peculiarity if compared to the other European countries) and we shall see how, unlike the results shown by studies for many western countries, there is no clear evidence of a correlation between ICT investment and increases in aggregate productivity rates. The fifth paragraph and the conclusion in more detail also try to explain this situation and predict what the future holds.Sample text inserted for illustration. Replace with article text, including headings where appropriate.

2. ICT IMPACT ON PRODUCTIVITY

While productivity is a relatively simple concept to define, it appears, however, very difficult to measure (collectively), especially with reference to relationships that link it to the widespread use of ICT. Productivity is closely related to how much capital goods workers have available, as well as to the quality of labour itself, how efficiently resources are allocated and managed, and the level of technological development. In its broadest sense, the concept of productivity involves examining the quantitative relationships (physical quantities and values) between the input and output of production processes, as well as between different factors (tangible and intangible) and different products (goods and services). For individual companies, the analysis of economic productivity aims to ascertain whether it can adequately perform its two main functions, i.e. to generate wealth and to distribute this wealth among the various factors that helped produce it. This paper takes the concept of

productivity in its traditional sense, as the output per hour worked, the performance of which is determined by the increase in invested capital, as well as by improvements in the quality of labour and by total factor productivity.

The complex nature of this phenomenon means we have to distinguish between productivity and Total Factor Productivity (TFP). Total Factor Productivity divides output by input, extended to new aspects alongside the traditional ones of capital and labour, i.e. training, investment in human capital, incentive schemes, energy, ad hoc managerial procedures, intermediate products and organisational structures [31] - [29] - [16], thereby supporting the handling of the phenomenon of organisational change [7]. As you will see more clearly later on, the concept of TFP surpasses the traditional view where capital and labour are quantitatively identifiable, shifting the focus onto more complicated reasons behind economic growth and the concept of productivity itself.

This is also why the relationship between productivity and the dissemination of information technology has always proven to be a difficult phenomenon to correlate. Melville, Kraemer and Gurbaxani [45] established a theoretical model summarising the areas in which the phenomenon of the value of IT investment has been studied. These areas are: an individual company or a part of it (focal firm), the macro-economic environment (macro environment) and the production sector (competitive environment). The impact of IT resources in terms of value is different on each of these three levels: the more detailed the level of analysis, the greater the possibility of identifying the impact of technology [22].

At company level, the study of how IT resources contribute to economic productivity is analysed through literary contributions that focus on the value generated by IT and by the fit between IT resources and the rest of the organisational structure [45] - [50] . These studies try to find the link between the investment that an organisation makes in IT resources and the increase in its performance [62]. The literary contributions that focus on these aspects have a history of over ten years now.

The use of ICT undoubtedly has an extraordinary impact on a business, in terms of repercussions on organisational structures and competitive strategies. The maximum possible use of ICT in business management has created “digital companies” and led to a transition towards a new paradigm characterised by successful practices resulting from the application of information technology in a large part of their processes. For some time now, we have been entering into what is known as the Fourth Industrial Revolution [41] where the development of smarter monitoring systems and autonomous decision-making processes is combined with the automated features already widely found in industry (as a result of the Third Industrial Revolution), allowing companies to control the entire value chain in real time, while working to optimise it. Nevertheless, the commercial potential of the Fourth Industrial Revolution does not only lie in the optimisation process of companies, but also in the possibility of developing new services for a wide range of applications.

Economists have tried to show that there are various channels through which the processes of adopting and spreading ICT can stimulate economic growth [49] - [15]. One aspect involves the use of ICT which can lead to increases in Total Factor Productivity in companies outside the ICT sector. The use of this technology in production processes helps lower transaction costs and reduce inefficiencies in the use of production factors, making it easier to match supply with demand. Another way in which the effect of ICT can be seen on growth is connected to its production. The swift technical progress and growing efficiency which characterise the companies that produce ICT goods and services are leading to high increases in Total Factor Productivity (TFP) in the sector which has been experiencing particularly lively demand for some time now (the aggregate effect depends on the share of the ICT sector itself in the economic system; in particular, we have seen how the importance of this sector in various countries and its development over time can be among the major factors behind the variations in growth seen in many OECD nations in recent years).

In the United States, Japan and Sweden, the sector producing ICT goods has significantly contributed to productivity growth, while the ICT services sector typically plays a minor role, even though it experienced a period of swift progress midway through the first decade of the twenty-first century [56]. Finally, another important aspect is the potential increase in labour productivity, resulting from ICT investment which increases the capital

available for each worker (capital deepening). This investment, such as those involving any other capital asset, increases the capital intensity of the economic system, stimulating growth.

When the use of ICT has an effect on Total Factor Productivity, any sectors using it more intensively are also likely to experience faster growth. One way of assessing the impact of ICT is therefore to analyse the performance of ICT-intensive areas, such as the financial sector, the business services sector or distribution [60].

As we will see in more detail further on, up until the mid-1990s, on a macro-economic level, the rapid pace of digital technological innovation has not always coincided with major increases in productivity, occasionally seeing a negative correlation between investment in technology and performance [47]. This particularly proves to be the case in the final two decades of the twentieth century (and with data from the 1970s), at a time when Robert Solow began to talk about the "productivity paradox". This situation then changed from the mid-1990s onwards.

3. THE PRODUCTIVITY PARADOX

One important aspect of what is now called a real "digital revolution" involves the future economic outlook that it is shaping. This aspect was tackled by Brynjolfsson and McAfee, who attempted to track the trends and main economic implications of rapid technological progress. In fact, the underlying idea is that the acceleration in the progress of new technologies is now an irreversible process which will soon lead to (through an exponential trend) radical changes [8] - [9]. The point of view offered by Brynjolfsson suggests looking at the evolution of ICT from a historical perspective, leading us to tackle the question of its long-term contribution to productivity and other economic variables.

The analysis of labour productivity and total factor productivity trends holds an important place in the debate on the sluggish growth of the European economy and in the related discussion on the decline of the Italian economy. The 1990s saw a slowdown in productivity in Europe which, in view of the surge in the United States, is largely responsible for the stagnation in Europe's convergence with the USA [30].

In particular, data on productivity from various studies on the main industrialised economies shows several of the phenomena that have stirred the debate on the performance of productivity over the last few decades [4]. The first one is the slowdown in productivity growth rates in advanced economies, which happened in the last few decades of the twentieth century: from the late 1960s and all throughout the 1970s and 80s, just when ICT began to spread on a large scale, the United States was experiencing significant slowdowns in labour productivity growth and TFP, following the positive trends that characterised the early post-war years. The arrival of modern IT on the market did not reverse the negative productivity trend, which had begun about a decade earlier. The slowdown in productivity was long thought to be a statistical illusion due to measurement errors linked to growth of the [60] and to fixed base volume indices that tended to overestimate the actual amount of IT investment [51].

Another two particularly important phenomena are the "Solow paradox" and the recovery in productivity in the USA in the second half of the 1990s. The Solow paradox ("the technological paradox") showed how an ever growing expansion in computers (which occurred from the second half of the 1980s) did not correspond to a proportional increase in productivity, either at company level or in national statistics [66].

As shown by various studies, TFP does not appear to be largely affected by these major innovations: the reported average growth rates are not particularly brilliant between 1986 and 1990 or between 1991 and 1995 [4]. Productivity then seems to pick up again, especially in the USA: the particularly high growth rates recorded after 1995 can be attributed to the significant progress in ICT [65] and to the mass roll-out of these innovations in both the manufacturing industry and the services sector, following the fall in prices of semiconductors [35]. Similar trends, albeit with less and varying intensity, were recorded in other European countries [34]. With the exception of Italy and Germany, which experienced a slowdown in growth between 2000-2005, most European countries recorded positive trends from 1995, with particularly high rates for Scandinavian countries [60]. Academics have offered two main reasons to explain the difference in productivity growth rates between the USA and Europe: the

first one refers to methodological issues and focuses on the measuring mechanisms for productivity growth rates, while the second one concerns the contribution of ICT to productivity. It is claimed that the strong growth in TFP in the USA is almost certainly correlated to investment in new technology: in fact, throughout the 1990s, American companies invested significantly more in the widespread use of ICT than their European and Japanese counterparts (it goes without saying that there could be other socio-political contributing factors that explain this discrepancy in TFP, especially for the slowdown in total productivity growth in Europe).

The international comparability of productivity growth rates is complicated by differences in the composition of output, by consumption habits and, above all, by the various approaches adopted when estimating the price of ICT and, more generally speaking, of any products whose quality changes rapidly over time. In fact, it is well-known that many of the productivity measurements typically used cannot account for swift changes in product quality (especially in ICT sectors). There is a general consensus that partial productivity measurements, in particular, should be replaced by broader, more accurate measurements that take into account all the relevant factors. However, it is easy to see that these measurements are much harder to estimate and pose more serious difficulties for international comparisons of productivity growth rates [42].

Consequently, connecting investment in technology and the repercussions on the economic productivity of the national system into one single causal chain appeared to be a difficult, problematic task as it required measuring "information goods" (which are ultimately managed by information technology) and then finding a clear, measurable connection between the choices for adopting ICT by a single economic actor (a consumer or a company) and all the other variables which nevertheless support economic growth. Another complex aspect is the speed of the pace of technological innovation, which makes any analysis based on the use of long-term data statistics very demanding.

There is a growing number of academic papers that seek to understand how technical progress can be measured effectively, i.e. reducing the human efforts exerted over the years. The classic approach in these cases resorts to the concept of Total Factor Productivity, a subject covered by countless studies [31] - [29]. According to Hulten [31], its growth represents the part of the increase in output that is not caused by greater input, acting as an indicator of the increase in production efficiency and, in the medium and long-term, of technological progress. The concept of TFP growth becomes particularly interesting following Solow's contribution [63], which also took the name of the Solow Residual. The Solow model specified a neoclassical production function, where the output level was determined by physical capital, labour and an exogenous level of technical progress. The fact that TFP is commonly estimated as a residual value, also using highly complicated econometric techniques, leaves plenty of room for measurement errors [60]. This approach has been criticised on several occasions, to the point where it was called a measure of our ignorance and fell into "disuse" with the slowdown of the 1970s. In other words, TFP is a component of the production function of companies in which residual phenomena are collected (from the efficiency of the companies to managerial skills and the reference institutional framework) and so its variation over time actually accounts for a variety of aspects, ranging from technical progress to learning by doing, as well as the improvement of institutional structures.

Criticism to the Solowian approach, which considers the technical process to be exogenous, produced a series of theoretical contributions considering technology as an endogenous phenomenon and therefore created endogenous growth models. These models seek to explain the growth differences between countries, attributing them to technological progress determined by research and development and by other factors affecting the behaviour of individuals and institutions.

The concept of the "productivity paradox" received support over the years in the belief that IT was a replacement for the workforce, a theoretical perspective that only appeared in certain aspects of the manufacturing sector. However, in the services sector (particularly the financial industry), it went in the opposite direction, instead revealing a boom in the recruitment of new staff (even though it led to a foreseeable downsizing

of the workforce due to the capability of IT and computers to resolve and handle complex operations) and not just in the field of mechanics and industrial automation [59].

Brynjolfsson and McAfee [9] give the example of how the productivity paradox occurred for all past inventions that led to significant social changes. Just think that not even electricity, the benefits of which now seem taken for granted, immediately produced all the advantages that its advocates had expected right after it was introduced in the late nineteenth century. More specifically, David – who, when referring to ICT, called this phenomenon "technological presbyopia" – underlines the fact that exaggerated expectations grew about the impact of the technology in relation to the time required for the positive effects to be felt [21]. He explains the reasons for this delay in the "near-sightedness" of the benefits for economic productivity produced by ICT, arguing that a technology needs to be widespread before you can clearly see the benefits on the economic system. In the case of electricity, for example, the author estimates this threshold at about 50%; if a broad-ranging technology is widespread, the effectiveness of its contribution is linked to the adaptation and modification of the complementary skills of the single individual and of the overall system of actors, which allow it to be used to its full efficiency and effectiveness.

In conclusion, a great deal of empirical research conducted in this subject over the years [14] - [20] - [19] - [33]- [52] - [68] - [67] has proven to a varying extent the effective link between ICT investment and productivity, attributing a large part of the acceleration to growth in ICT investment and therefore making a considerable contribution towards solving the paradox. In short, at least three main explanations have been given in trying to solve the paradox: the importance of errors and the difficulty in measuring the contribution of ICT; the fact that ICT formed a small portion of the total capital stock; as well as the idea that the widespread use of a new technology and the absorption of its benefits require time.

4. FROM MACRO-ECONOMIC TO MICRO LEVEL APPROACH. FOCUS ON ITALIAN CONTEXT

ICT's contribution to company performance has been widely documented in literature [3] - [7] - [10] - [11] - [12]. The results vary depending on the industrial sectors in which the company operates, its size and its home country. In particular, they underline the fact that there is a positive correlation between ICT and business performance and that ICT is more successful when companies jointly adopt complementary services (such as the re-engineering process, the use of highly skilled human capital, and the use of intangible capital) [6] - [18].

Kohli and Grover [37] give us an overview of the state of research into the value generated by ICT investment, confirming that:

- ICT only creates value if certain conditions are present;
- the value produced by ICT can be seen in various forms (increases in productivity, improvements in business processes, profitability, an increase in surplus to the consumer's benefit, and advantages in the supply chain);
- the value produced by ICT can be dormant;
- many factors help mediate the value produced by ICT;
- it is difficult to identify a real causal link between a single ICT investment and a specific expression of value.

Considering the company level, there is no doubt that the development and adoption of ICT facilitates the exchange of information between companies (just think of the change in terminology and concepts from "chain" to "cluster") and within companies, allowing them to implement new products, processes and forms of organisation. For example, think of the contribution provided to many innovative processes, such as e-commerce, supply chain management, outsourcing and customer relationship management, but also of the contribution which Industry 4.0 is making and will continue to make to many processes: thanks to big data, IoT sensors (Internet of Things), digital fabrication machines, robots, smartphones and software to manage working environments,

many companies' entire production, distribution and purchase of physical goods chain is transforming and/or will transform into a large system where all the elements are closely connected [64]. It is thanks to new intelligent systems that these connections in a broader sense will be possible, making full use of technological and human resources.

In short, there are two common points at all research levels (firm, industry and macro), now found in literature as subjects to be covered at the same time as investment in technology. The first one is linked to the role of complementary activities, as a set of conditions that must be developed together with decisions and implementation of the technology factor, to be able to create the requirements to extensively fulfil technological potential (for example, complementary activities include the management of organisational change, the development of a participatory culture, decision-making mandates and free access to company information, integrated ERP, horizontal organisational structures, training, etc). The second one involves the condition that increased productivity can undoubtedly be largely attributed to more tech-intensive sectors, not just in services sectors (finance, insurance and real estate), but also in technological manufacturing (biotechnologies and pharmaceuticals) and in all sectors traditionally seen as labour-intensive (for example, crafts), but which are now supported by technology in strictly operational (machinery and management software), commercial (e-commerce, foreign trade and foreign supplies) and administrative terms (relationships with public administration, certified e-mail, etc).

Among the most recent studies, it appears useful to look at the research conducted into the economic trends of 209 Italian sectors where real labour productivity decreased between 2001 and 2014 (with an average annual growth rate of -0.4%), unlike what happened in other major European countries [48]. The biggest gap in productivity growth in these sectors compared with other countries can essentially be attributed to the fact that: unlike traditional sectors which saw a clear fall in employment, information-intensive companies grew more quickly between 2002 and 2011 in terms of employment than revenue; the most information-intensive sectors recorded greater volatility in profits, as a result of greater international competition, which sees Italian companies in these sectors tackle Internet "giants"; high information-intensive sectors are those which recorded the biggest internal discrepancies in profitability between 2004 and 2011.

Closing the managerial gap is at least as important as planning the new investment in infrastructure that is required to support the next technological paradigm [48].

In light of this, most studies into ICT which looked at the Italian context analyse the decisive factors behind its adoption [13] - [26] - [40] - [61] or its complementarity with internal skills linked to labour and organisational changes [28] - [54]. The studies are united in reiterating how investment in ICT and its use would allow companies to make changes in production processes, strategies, organisational structures and external relations. At the same time, this technology requires an adoption method that covers changes in organisation to ensure its effective implementation [39].

For example, as previously highlighted, some researchers have found that, generally speaking, "the most innovative companies are also those which better integrate ICT into their business, and that the companies which use ICT in a sophisticated way tend to be those which have also developed a long-term strategy for managing technology. Moreover, some academics claim that the managerial skills, knowledge and experience developed by small individual entrepreneurs are what "makes the difference" in their ability to get the most out of ICT" [58]. It is therefore vitally important to provide entrepreneurs (or managers) with the tools required to develop in-depth knowledge of the potential of technology, so they can understand how it can help them in their daily work and business, in order to develop coherent investment plans. In other words, all companies (and therefore SMEs as well) ultimately need to be able to develop a view of ICT as a strategic resource and not just as a mere lever for automating administrative work: ICT must be able to integrate with people, freeing up some of their time to use more productively. This way, if used properly, modern digital technologies, characterised by their greater flexibility compared with previous systems, could also support the growth of SMEs.

The difficulty in taking advantage from ICT is intensified by the old age of the Italian managers, which might have hindered firms' ability to adopt new technologies. Management practices greatly affect ICT penetration and exploitation and their empirical investigation seems to prove that the scarce ability of Italian management to adjust to the "new economy" revolution is among the main obstacles hampering firms innovation activity. The main problem for Italian SMEs in the adoption of new technologies originates especially from:

1. lack of strategic vision;
2. difficult to measure the intangible benefits of ICT;
3. rigid organizational structure.

A recent ISTAT survey on the use of ICT by citizens and companies shows an increasingly widespread and advanced use of this technology in economic activities and everyday life. However, this survey reveals two main critical issues: the first one is the wide gap between large and small companies in their level of digitalisation, as measured by the composite Digital Intensity Indicator, which is 11% for high levels of digitalisation in small companies but reaches 47% in large businesses; the other issue is the considerable gap between Italy and other EU countries (especially for the use of e-commerce as a channel for buying and selling goods and services) [32].

According to recent analysis, by optimising skills and technology, intelligent digital resources could boost global GDP [36] but to do this, it is essential to work on three factors that can have a positive impact on productivity: skills, technology and digital accelerators. Italy has to work on these final two factors in particular, given that it has a percentage of digital workers (37%) not far from the average in other countries, while accumulated investment in hardware, software and telecommunications equipment (digital capital stock) only represents 10% of GDP (the United States boasts a digital economy worth 33% of GDP – 43% of the American workforce is digital – followed by 31% in the United Kingdom and 29% in Australia) [36].

The aforementioned recent ISTAT survey shows how, in 2017-2018, Italian companies considered public financing and subsidies, as well as access to broadband connections and infrastructure, as the main driving factors behind digitalisation and stronger competitiveness (the indication of a specific digitalisation strategy appears less significant) [32].

Fortunately, in September 2016, there was a nationwide concrete response to Italy's deficit by the government with the launch of a plan similar to those in other European countries [17]. The plan for 2017 to 2020 was called the Piano Nazionale Industria 4.0 (or the National Industry 4.0 Plan, and now just known as Impresa 4.0) and sets out over €15 billion worth of investment by the government. It aims to promote and significantly lower tax on all work that brings automation and digitalisation to companies [46]. The Plan finds its essence in the main critical issues of the Italian system [69]:

- few major industrial players that can guide the transformation, especially in Italian manufacturing;
- the decreasing amount of fixed industrial investment over the past fifteen years and an increasing number of obsolete pieces of equipment;
- allocation of poor investment and insufficient financing regulation;
- a shortage in the STEM disciplines (Science, Technology, Engineering and Mathematics);
- a lack of adequate connection speeds (>30Mbps) for 70% of businesses;
- Italy's critical position (25 out of 28 EU countries) in the Digital Economy and Society Index.

Starting from this situation, the Plan works along two guidelines: one to directly support digital investment and growth in the network of skills required to successfully spread digital culture 4.0 in the manufacturing industry, and the other to accompany the growth of enabling network infrastructure, such as the Piano Banda Ultralarga (Ultra-Broadband Plan). It is therefore necessary to identify ideas and options to encourage the traditional technological approach to combine with digital innovation in order to form a unicum [69]. The 2019 Budjet Law introduced a new paradigm: promote more SMEs than large companies, the main recipients of the incentives originally designed.

The first results of this plan have been analysed in a recent study by the Industry 4.0 Observatory of the Polytechnic University of Milan across a panel of companies which invested successfully in the digital area from 2010 to 2015. In particular, the Observatory's analysis aimed to understand the actual effectiveness of the Industria 4.0 programme and how the intensity and depth of investment in traditional or digitalised capital goods could be measured. Taking the cost of labour and productivity as reference values, while labour costs increased by 10%, productivity rose by 25%, therefore leading production and revenue to double compared with the cost of individual workers, with an ROI (return on investment) that grew from 3.8% to 6.1%.

Based on the results of the analysis, the outlook is positive and the digitalisation of companies seems to be the right path for economic growth and the development of companies' competitiveness. However, while we are seeing favourable forecasts, we need to wait for confirmation over a longer period of time, when we will be able to get a clearer picture of the direction Italian companies have taken as well as their path towards growth.

5. BRIEF CONSIDERATIONS AND PERSPECTIVES

Over the last few decades, we have seen a proliferation in studies seeking to understand the role played by ICT in relation to productivity and economic growth in companies and the national system. After a brief boom between 1995 and 2000, the performance of productivity in advanced economies has not remained in line with ICT expenditure. More generally speaking, we could say that productivity has been in constant decline since the 1970s in all advanced economies [5].

Various discussions on the relationship between ICT investment (taken as an indicator of investment in intelligent systems, as mentioned above) and productivity have offered mixed, often differing viewpoints. However, this framework has outlined a relatively more cohesive body of thought which, by seeking to overcome the controversial concept of the productivity paradox, highlights the existence of a significant relationship, not just between ICT and productivity, but also between certain multiplying variables which represent ICT and other complementary factors (empirical studies have shown the need to consider, for example, organisational aspects such as specialised human resources, in order to draw more benefits from ICT investment). It has been confirmed, albeit to varying extents, how ICT investment increases competitiveness and productivity, at company and aggregate level, when it is linked with investment in complementary activities, such as: skilled workers, organisational changes and innovation. Policies of promoting communications infrastructure or ICT demand are spreading through the economy, stimulating growth, employment, capital and entrepreneurial resources [23].

We agree when we say that digitalising means increasing productivity at higher levels than labour costs. However, to seize the new opportunity offered by digitalisation (which has characteristics that differentiate it considerably from traditional ICT), we need to understand the reasons for the poor effectiveness of investment in technology in recent years.

Among the various reasons, mention might also be made that companies have made major investment in ICT and in the integration between various tools, but not in the integration between ICT and people, losing its real potential: freeing up some of their time to use more productively. The introduction of ICT has perhaps actually created new constraints and has instead not encouraged the creativity required to increase productivity. Current smart digital resources are more flexible than the previous generation of systems. Companies need to combine this new digital approach with smart simplicity, in order to make use of the potential of technology and their staff (Boglioli et al., 2016). There are two paths in this direction to develop productivity: the introduction of processes and intelligent systems, and greater efficiency among people who work together. Regarding the first path, in 2016, the Boston Consulting Group calculated that €150 billion worth of production improvements could be made in the manufacturing sector in Germany alone. While the capacity to share data, communicate instantly and build or modify applications encourages collaboration and lowers transactional costs [5].

Just think that the potential economic benefits of new technologies estimate that the IoT (Internet of Things) could contribute from 10 to 15 trillion dollars to global gross domestic product (GDP) in the next twenty years

[25]. This is because the network of digital technologies helps customise more goods and services through new production and organisation processes, as well as new business models, especially in industrial sectors. A study published by General Electric in November 2012 concluded that by 2025, increases in efficiency and progress in productivity made possible by a intelligent "industrial Internet" could cover every economic sector, involving about half the world's economy [25] - [57]. More specifically: "the full potential of the Industrial Internet will be felt when the three primary digital elements – intelligent devices, intelligent systems and intelligent automation – fully merge with physical machines, facilities, fleets and networks. When this occurs, the benefits of enhanced productivity, lower costs and reduced waste will propagate through the entire industrial economy" [25] [27].

Even though the current debate is therefore dominated by the need to introduce various digital technologies within company processes and organisations – almost as though certain intelligent equipment could alone resolve the problems and deficiencies built up in recent times (as, for example, was highlighted for the Italian economy compared with other European countries) – it is considered necessary to link the introduction of technological aspects to the concept of labour, production and entrepreneurship, promoting – in other words – training, public engagement, technology transfer, etc. The growth of a country must involve the companies in their relevant context and be facilitated through the creation of collaborative mechanisms. This is the case taking into account the fact that new changes cannot just involve the companies which cannot improve their performances on their own. Greater collaboration is needed between all institutional, professional and entrepreneurial subjects, optimising the relationship between knowledge and innovation, and encouraging aggregation through business networks in order to support new pathways in companies and between companies.

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