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THE PRODUCTIVITY PARADOX, MYTH OR REALITY?

Liviu-Gabriel CABĂU

This article is considered to be a landmark in both the academic and business literature regarding the Productivity Paradox. Starting with the previous research found in the specialized literature of some reference authors, this article intends to clarify the Productivity Paradox by labeling it either as a myth or as a reality of the economic cycle. This paper approaches the concept of Productivity Paradox in dynamics, starting with the Information Technology cycle and its connection with the Work Productivity. For each studied period: MECHANIZATION (1960-1990), AUTOMATION (1990-2005) and ROBOTICS (2005-2015), there are presented the causes which are inherent in Productivity Paradox, the main problems generated by it and the potential solutions, the focus being on the Strategic Alignment. In the end, this article presents some aspects regarding the implications of the paradox and the possibilities to point it out in the near future. The problem of the Productivity Paradox is a complex one (sometimes a myth, sometimes a reality of the academic environment), with effects that spread in time and that is why it should be treated carefully.

Keywords: work productivity, information technology, productivity paradox, strategic alignment.

JEL Classification: M11, M31, M54.

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1. Introduction

The academic and business media analyzed the Productivity Paradox regularly. Even if there were great expectations from Information Technology to produce “the most powerful technological revolution ever known” (Snow, 1966), the disillusion and the frustration were obvious in titles as “Data overload computers limits Work Productivity” (Zachary, 1991). Even if in 1980’s statistic data were extensively analyzed, there was not enough proof that Information Technology could determine a significant increase of Work Productivity. Some authors (Scharage, 1997 quoted in Brynjolfsson & Hitt, 1998) associated the idea of substantial profits due to computers with “the big lie of the informational era”. Due to the success of some companies such as Dell and Cisco to trade billions of dollars on the Internet and also due to some researchers who have discovered at company level that the investment in Information Technology brings substantial profits, the Mass-media changed its statements: Businessweek proclaimed “the overflow of work productivity due to information technology” (June 14, 1993) and Fortune announced the moment of “Information Technology retribution”.

The business media rushed to announce the Paradox of Productivity, presenting it in an exaggerated way, unlike the academic media which was more discreet in its statements (Roșca & Uscatu 1999). The researchers’ opinions regarding the existence of the Productivity Paradox as well as its right interpretation are quite diverse. Some of them (Attewell, 1996; Brynjolfsson & Hitt, 1998; Mccune, 1998; Powell, 2000; Spithoven, 2003) strongly believe in a Paradox of Productivity in the economic circle, while others (Anonymous, 1996; Woodall, 2000; Korhonen, 2009) refer to it using the past tense, or say it never existed (Darby, 1984; Rothschild, 1993). Also, the factors which facilitated the display of Productivity Paradox presented in the specialized literature differ among themselves, indicating the complexity of the studied phenomenon and the lack of a unanimous opinion.

This article’s goal is to clarify the Productivity Paradox by labeling it as myth or as reality of the economic environment. This article is important to field literature from many points of view. Firstly, it approaches the concept of Productivity Paradox in dynamics (1960-1990; 1990-2005; 2005-2015), unlike other studies which are focused on the 1990’s, starting with the life cycle of Information Technology and its relation with the Work Productivity for each studied period, are presented both in the context - the causes relevant to the Productivity Paradox, the main problems caused by it -, as well as the ways to solve it. Secondly, among the extrinsic causes of the Productivity Paradox presented in the field literature, the author also reveals intrinsic causes left out by many other authors, and maybe with the most powerful impact, the focus being set on the concept of Strategic Alignment. Third, the article is important to the business environment which is directly affected by this phenomenon. Nonetheless, this subject is also researched by the Marketing Science Institute for 2010-2011 (Identification of the opportunities, facilitated by the Information Technology).
2. Information Technology in the Context of Industrial Development

The developments in the Information and Communication Technology field lead in theory to a new paradigm characterized by the shift from the substantial interpretation (Mechanical) to the non-substantial one (IT-based). According to the specialists, the computerization process (the large spread of Information Technology) shows more power, integration and interoperability, being governed also by the Law of Moore (co-founder of Intel Corp. Company), according to which the performances of semiconductors are going to double every 18 months, as we can see in Figure 1.

![Figure 1. Law of Moore](http://njtechreviews.com/2011/09/04/moore%e2%80%99s-law/)

In practice, these are transposed in important changes (both in the conception, redesign and the use of new products and services as well as in the systems of organization and managing) in business world’s game rules (Iancu, 2005 quoted in Pelinescu). If the material economy had the “atom” as a basis, the Information Technology is based on the “bit”, which can be produced cheaper and sent to worldwide destinations at the speed of light without deteriorating. Material goods which are based on atoms don’t have these features, their production and transportation being expensive, requiring long periods of time and, inevitably, they deteriorate in time. Starting from Toffler’s work (1993), who wrote about the human society transformations, we can identify three big waves (the first one concerning agriculture development, the second one concerning the industry, and the third, the information) - a personal point of view regarding the Information Technology development in the context of industrial development, shown in the next table.
Table 1. The Informational Technology development in context of industrial development

<table>
<thead>
<tr>
<th>Stage</th>
<th>Analized Period</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
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<tr>
<td>IT Orientation</td>
<td>Appearance</td>
<td>Development</td>
<td>Integration</td>
<td></td>
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<td>Production Stage</td>
<td>Mechanization</td>
<td>Automation</td>
<td>Robotics</td>
<td></td>
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<tr>
<td>Production Orientation</td>
<td>Mass-production</td>
<td>Mass-customization</td>
<td>Personalization</td>
<td></td>
</tr>
<tr>
<td>Reasoning Frame</td>
<td>Product Oriented (according to AMA 1935 definition)</td>
<td>Customer Oriented (according to AMA 2004 definition)</td>
<td>Value Oriented (according to AMA 2007 definition)</td>
<td></td>
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</tbody>
</table>

Source: Author research

3. The Productivity Paradox in the Period 1960-1990

The period 1960-1990 is characterized by the prolonging of work force as a result of the development of tools and replacing animal movement force with machines. Mechanization process had a significant contribution to the economic development, having as a consequence the increase of productivity of production factors. The paradigm change implied switching from unique production, a characteristic of handicraft units, to factory organization, with a much larger capacity of production. The Mechanization opened the way to a new organization. Later the concept of “scale organization” was introduced, having good outcomes on the costs of production, which decreased significantly due to scale economies.

Figure 2. The productivity of the “White-collars”

Source: Roșca & Uscatu, 1999:5
All the companies that acquired and implemented Information Technology in this period expected quickly and profound transformations in the work style of their employees, a significant increase of Work Productivity and a substantial profit (Roșca et al., 1999). Although the share of investments made by firms in equipment for Information Technologies got from 7% in 1970 to 40% in 1996 (Anonymous, 1996), a great majority of these has failed in their expectations, the “white-collar” productivity remaining almost constant in this period, as we can see in Figure 2. The articles in the field present a series of causes regarding the Productivity Paradox from this period, like: (1) mismeasurement of outputs and inputs, lags due to learning and adjustment, redistribution and dissipation of profits, mismanagement of Information and Technology (Brynjolfsson, 1992; Spithoven, 2003; Korhonen, 2009); (2) the marginal use of computers in the detriment of the process one (“do the same things differently” versus “do completely different things”) (Anonymous, 1996); (3) the lack of an appropriate culture inside the companies, regarding the Information Technology: “cost center” versus “business enabler” (Papp, 1999), which leads to a misconception on computers: “the illusion of control” and “cognitive conceit” (Attewell, 1996).

We are of the opinion that in this period, in regard to the problem of productivity, the paradox is not justified, given the fact that the effects of Information Technology implementation at company level on productivity (in an appropriate context, a proactive strategy and an existent potential) expands in time and not necessarily on short term. The field literature (David, 1990; Brynjolfsson, 1992; Rothschild, 1993; Spithoven, 2003; Korhonen, 2009) presents a similar case in history (1900-1920) when the percentage of the United States factories, equipped with electrical engines, jumped from 5% to 55%. This was contrary to the obvious advantages the electric engine had over the steam engine. Still, Work Productivity did not increase. It took 40 years for this one to prove its efficiency, during which time the companies, reorganized, readjusted and reinvented themselves, at the level of functions and processes, so they would get the maximum of profits from using the electric engine. The productivity paradox issue cannot be referred to in this period, so it remains a myth.

4. The Information Technology and the Work Productivity problem

Work Productivity is considered to be one of the most important indicators for a company when its activity is being taken into account and has always been the target of the attempts to improve. Work Productivity determines after all a country’s standard of living due to the fact that the level of consumption depends directly on the produced goods which are available (Woodall, 2000; Spithoven, 2003). Work Productivity is obtained as the relation between the obtained results (output) and the quantity of work involved (input) which can be analyzed under different forms. Multifactor productivity (the same with the Total productivity of the factors) is calculated as the report between the results obtained by using a certain quantity of production factors (work, raw material, capital, land, technology or management) and the quantity of the production factors used. Even if Multifactor productivity presents difficulties at
quantification level, it is more relevant than the Singlefactor productivity, because it compensates for the substitution between the production factors.

In calculating the productivity, the result is defined as being a certain number of products, multiplied with the unit value, using the real price. To assess this, the calculation of an individual deflationary index is required, trying to find the compensation of the inflation effect. The general form of the Multifactor productivity is given in the formula (1).

\[ MFP = \frac{d(\ln f)}{dt} = \frac{d(\ln Y)}{dt} - \frac{SL \cdot d(\ln L)}{dt} = \frac{SK \cdot d(\ln K)}{dt} \]  

(1)

where: \( MFP = \) Multifactor Productivity; \( f = \) Function of the global productivity; \( Y = \) Output; \( t = \) Time; \( SL = \) Share of input costs which can be assign to the work expenses; \( SK = \) Share of input costs which can be assign to the capital expenses; \( L = \) 1 monetary unit work quantity; \( K = \) 1 monetary unit capital quantity;

Information Technology, as well as Work Productivity can be defined in many ways. Information Technology Association of America stresses the fact that Information Technology is oriented on “studying, projecting, developing, supporting or managing the informational systems based on computers, especially software and hardware applications for computers”. Today, the term, “Information Technology” has expanded, including many aspects of technology and calculation, the concept becoming very popular: data management, networking, hardware engineering for computers, projecting database and software as well as managing and administrating all the systems. In the past years, the Accreditation Board for Engineering and Technology and Association for Computing Machinery from USA have worked together to form standards and accreditation curricula for specializing in “Information Technology” as a distinct area of studying apart from Computer Science and Informational Systems.

Once the computers were introduced into the economy, the relation between Information Technology and Work Productivity was questioned. The Paradox of Productivity implies that there isn’t a relevant boost of Work Productivity due to Information Technology. The starting point in approaching the Productivity Paradox is represented by a simple study, but stimulating at the same time: “America’s Technology Dilemma: A Profile of the Information Economy” carried out by the economist Steven Roach in 1987. He was looking for explanations regarding the growth rate of productivity in the American economy, which decreased considerably from 1973 in a context where the degree of IT equipment for office workers (white-collar in anglo-saxon terminology) had a significant increase between 1970-1980. His final conclusion was that the huge investment in computers was not demonstrated by the degree of economic performance, especially in the area of economy with a large number of staff, indirectly productive. It is also to be noted the statement of Robert Solow regarding the Productivity Paradox made in one of his articles: “we can see the era of computers everywhere, less in the productivity statistics”(Solow, 1987 quoted in Roșca & Uscațu, 1999).
5. Productivity Paradox in 1990-2005

A superior stage of the one shown above is presented in 1990-2005 when the process of Automation replaced man in the labor process which presented a certain danger and expanded (alongside the recorded progresses in calculation technique) by taking on some functions previously performed by man. The articles in the field present a series of causes concerning the Productivity Paradox from this period like: (1) there is a difference (sometimes a big one) between “the offered technology” and “the used technology” (what employees know, how to use by their knowledge, culture and adjusting) (Rosca et al., 1999); (2) the use of computers for recreation and not for advanced instruments, from which firms can benefit: “toys” versus “tools” (Attewell, 1996; Powell, 2000); (3) changes in the income distribution for individuals, who become more reticent in acquiring products or services (Spithoven, 2003).

We consider that an important factor which sustained the Productivity Paradox (seldom mentioned in the field literature) is represented by the lack of policies regarding Information Technology integration with other functions and departments inside the company, in order to obtain a synergy and concerted actions: “group drive” versus unit “drive” (Rothchild, 1993; Attewell, 1996). The solution for this obvious issue is represented by the Strategic Alignment of Information Technology with company strategy. The Strategic Alignment of Information Technology and company strategy has been for a long time the main concern for both practitioners and researchers. This is due to the fact that Strategic Alignment influences positively Information Technology effectiveness, leading to a higher level of profitability (Luftman et al., 1996). Despite the positive effects proved as a result of Strategic Alignment (Bergeron et al., 2002; Avison et al., 2004), just a small number of companies can assert that they have truly made this alignment.

To stress this aspect, we have to take into account the elements which are the basis in obtaining these performances: (1) the goal, determined by strategy; (2) the means, determined by Information Technology; (3) the capabilities of the human factor (abilities and knowledge). Investing in strategy is not justified if there is a means that can do it justice. Investing in strategy is not justified if there is no direction to it, a goal in the basis of which to create an added-value to goods or to a service. Investing in these two is not justified if the human factor is not available which can be capable (to possess abilities and knowledge) of managing properly to achieve the goals set. The recent massive investments were more present in Information Technology zone “software before strategy”, which led to a higher failure level rate in implementing IT solutions, thus at a very low performance. What companies must understand is the fact that the most important change is under no circumstances the technical one. The real change must reside in a change in the behavior of the employees who finally use the technology in terms of perception and capacity of accepting and adjusting to the changes inherent to the post implementation.
In conclusion, the importance of Strategic Alignment of company strategy and Information’s Technology, reside in the creation of extra-value, as a consequence of the synergy and the concerted actions, between the components from above, value which is more important and bigger than the sum of values created individually (The principle 1+1=3). Therefore, there is a competitive advantage and a superior performance finalized in an increased productivity. We can discuss about a productivity paradox as a reality of the economic environment if the companies are not strategically aligned.


The extensions of the use of computers and robots and the massive communications development are aspects specific to the period 2005-2015. Fully automated factories that are plentiful nowadays, the advantages generated by the introduction of Robots determining their expansion on a large scale. Among the benefits, there are workquality, higher productivity (without the intervention of the human factor), continuous use 24 hours a day, and lack of wage claims and strikes. Society assists with the penetration of automatic in the wide range products. The term “Informational society” is brought up very often, the production structure of the countries changes and services tend to become dominant in the structure of gross domestic product. The new economy implies both globalization and regionalization, as well as the acceleration of innovation. There are fundamental changes in the production systems and in those regarding the market, management, attitude toward risk and uncertainty. Also, in this period serial productions are abandoned and personalized products appear, individualized at the request of the user.

The design of products becomes modular, being associated with a full package of services, which means almost a binding in the conditions of automatic incorporated in new products. The causes related to the Productivity Paradox from this period coincide with the ones from the period previously analyzed, the focus being set on the concept of Strategic Alignment. Some authors (Powell, 2000) state that in the near future this Productivity Paradox will not be manifested, given the fact that the present generation of students is contemporary with the personal computer and for them the transition toward Information Technology does not exist, because they spent their childhood with it.

In our opinion, the Productivity Paradox will tend to reappear in the economic environment (if it will not be held into account the fact that the Productivity Paradox was created for tangible goods, and now we are dealing with intangible goods), because Information Technology will not be found directly in productivity (as it was between 1990-2005), its intervention being helped by some qualitative parameters. These qualitative parameters (flexibility, dependability, trust, creativity, a quicker reaction in dealing with a client, a better coordination with the provider) do not always lead to a growth of the quantity produced, but they help for the merchandises to be delivered in time and customized as required by the client. It is about a “quality time” with the
customers (Stephen, 1993). So long as it imposes a new orientation and the efforts will be focused on measuring the value in its new shape (for example the capacity to create instead of trying to adjust the old methods of measuring productivity, based on the quantitative thinking specific to the industrial era) this apparent paradox can be dealt with from the beginning. We can discuss about the Productivity Paradox as a reality of the economic environment if the companies are not strategically aligned. Also, the Productivity Paradox tends to manifest itself under different shapes (“new paradox view”) in the context of intangible goods and of a digital economy based on knowledge if it is not well understood.

7. Final Conclusions

A technology is evaluated only by the consequences of its utilization it by the employees in the context in which they are going to be trained, psychologically prepared and led to performance through a staged and well-aimed management. The fact that the companies are not strategically aligned, and the idea that the acquisition of Information Technology coincides with the use of it, represent a major cause of the Productivity Paradox.

As it was shown in the stages analyzed above, the problem of the Productivity Paradox is a complex one (sometimes a myth, sometimes a reality of the academic environment), with a ripple effect over time, which is why it should be addressed carefully.

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