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Characteristics of the Impact of an Innovative Information Economy on Employment

Olga Nikolaevna Denisova, Olga Vladimirovna Karsuntseva

***Abstract*: This paper investigates the impact of information and communications technology on the sphere of employment and explores the relationship between employment and product and process innovations. The latest research has substantiated the fact that effective innovation activity at an organization requires an entire spectrum of skills in all different areas, including engineering, multimedia, computer graphics and design, information technology, and marketing research.**

This paper demonstrates the considerable gap in employment growth rates between production and services sectors. All production sectors have exhibited negative values, with only high-tech production and services posting growth in employment levels. The authors establish the role of scientific-technical progress in professional workforce preparation.

***Index Terms*: employment, innovation-information economy, product innovation, process innovation, scientific-technical progress.**

I. INTRODUCTION

A survey of the literature has revealed that innovation is a key driver of growth in employment in the long run [1]. From a standpoint of growth in employment, innovation-focused firms work better than non-innovators, regardless of which phase of the business cycle it is. They tend to create more during an upturn and lose less during a downturn.

Prior to exploring the interrelationship between innovation and employment in more detail, it may help to identify the differences among product innovations, i.e. presenting new products in the marketplace, and process innovations, i.e. implementing new processes in manufacturing a product (a methodology proposed by the Organization for Economic Co-operation and Development (OECD)). The OECD considers both product and process innovations.

It should be kept in mind that organizations are increasingly investing in nontechnological innovations – above all, organizational and marketing. And, if process innovations are aimed at changes to material goods, which are improved based on technical modifications, organizational innovations appear to be new ways of organizing work which incorporate the development of new business processes and jobs [2], [3].

The type of innovation (technological or nontechnological) does not diminish its economic value for the organization but helps determine the potential for creating new jobs.

Labor productivity plays a key role in issues of employment and economic growth. Empirical data attest to that boosts in labor productivity govern a significant share of growth in employment in many sectors of the economy, including in the area of information technology. The conclusion about the stimulating effect of labor productivity on the state and dynamics of employment is predicated on the optimum hiring criterion. This criterion is based on that, as long as the marginal value of labor is above the rate of pay for an additional worker, the employer will be increasing the number of workers, i.e. the amount of labor employed. This is explained by that the marginal product of labor from a given worker with a higher level of labor productivity is always greater than the same indicator posted by a worker equivalent to the former in count who has a lower level of level productivity. This means that the effect from attracting each additional worker with higher level of labor productivity is greater for the entrepreneur than that from bringing in an additional worker with a relatively low level of labor productivity.

II. METHODS

Growth in labor productivity is a significant factor for declines in unemployment and is a key condition for sustainable economic growth. In today's realities, growth in productivity is also a connecting link between innovations and growth in employment. Since innovation leads to changes in productivity, corresponding changes take place in the sphere of employment as well [4]. However, the interrelationship among productivity, innovations, and employment is not direct, so different forms of innovation may have differently vectored effects on employment [5].

Fig. 1 illustrates the interrelationship between process and product innovations, on the one hand, and changes in the sphere of employment, on the other hand. It is worth examining the impact of technological innovation on employment in greater detail. Technological innovation (e.g., installing new production equipment) normally helps the company turn out the same volume of output with less capital and/or manpower. Consequently, technological innovation leads to boosts in productivity and has a negative effect on employment. The size of this negative effect depends on the technology of production employed, the pace of input substitution, as well as the direction of technological changes. The labor economy effect also varies significantly from sector to sector in the economy.

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* Correspondence Author (s)
Olga Nikolaevna Denisova, Samara State Technical University, Syzran, Russia.
Olga Vladimirovna Karsuntseva, Samara State Technical University, Syzran, Russia.

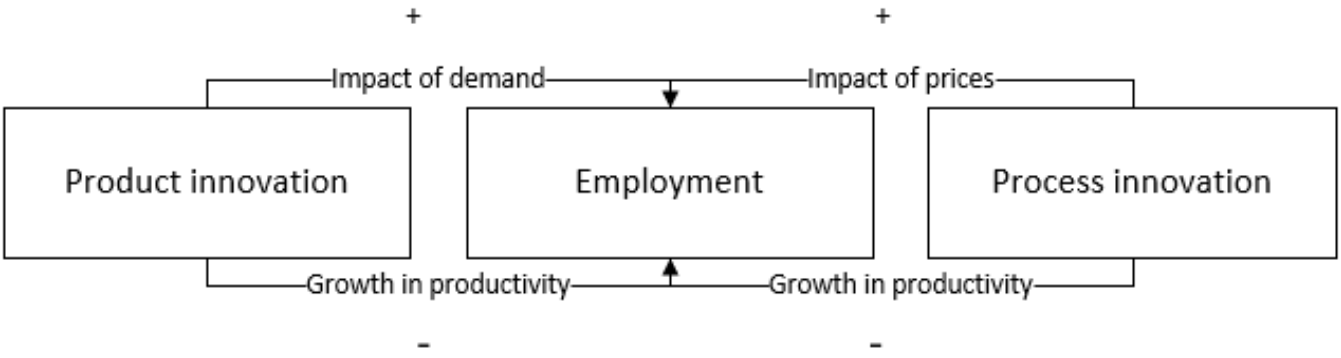

Fig. 1. Impact of product innovations and process innovations on employment

Some researchers [6] have suggested there is great potential for boosts in labor productivity and drops in work time based on the use of information technology for routine activity within the spheres of production and services. A study conducted by S. Lachenmaiera and H. Rottmann [7] reveals the positive effect of technological innovation on the dynamics of employment in highly developed countries. It has been established that innovation in processes helps create more new jobs than that in products.

Another important vector of effect on employment is change in demand. If a company introduces a new product into the market, this new product creates new demand which will depend on price elasticity and the availability of product substitutes or additional products in the market. Demand and productivity are two key channels of influence on employment. However, these are not the only channels available. Technological innovation often enables companies to turn out a new product at significantly lower prices. If drops in the costs of production lead to drops in the price of a product for the client, then this step may lead to overall growth in employment. Empirical data related to the assessment of the price effect have been provided in the studies conducted by S. Lachenmaiera and H. Rottmann [7] and D. Acemoglu, G. Gancia, and F. Zilibotti [8]. The size of the price effect is demand's reaction to change in prices (demand elasticity) and competitors' reaction to drops in prices. The price effect translates the significance of competition policy for the sphere of employment, as it may be assumed that competitors will be forced to adapt their prices to the latest conditions in the market. The production of innovative products often involves the use of new types of raw materials, which make it possible to produce them at less cost and with greater productivity [9], [10]. Thus, product innovation may lead to change in productivity even if it is not linked with process innovation.

III. RESULTS

Boosts in revenue from innovation in the sphere of production are one of the key factors for growth in employment. New products with greater utility and/or lower price will replace existing products that are offered by the company or its competitors. Product innovation can have two types of negative effect: (1) a negative effect for the actual innovator (the so-called "cannibalization" effect); (2) a negative effect for the firm's competitors (the "business theft" effect). Conducting timely assessments of these effects is crucial to the company's activity. For instance, assessing the cannibalization effect helps forecast the financial effect from the launch of a new product (service) and prevent declines in cumulative revenue (i.e., total revenue from the old and new products). In practice, both effects can reduce the effect from product innovation. A good example is mobile phones. It is obvious that demand for older versions of mobile phones by a given firm or particular competitor firms will drop as soon as a new model is introduced into the market. On top of that, a new mobile phone with better functionality can also have a negative effect on sales of related categories of goods, like tablet PCs, digital cameras, electronic navigation systems, and other gadgets.

As evidenced by practice, cannibalization and business theft are quite a common phenomenon. They are virtually inevitable for organizations that turn out new products. The degree of negative impact from these effects depends on the availability of substitutes in the market and the quickness of competitors' reaction. The exception to this is cases when a new product supplements an existing one or when a new product helps expand the firm's product range taking it into new spheres.

The interrelationship between innovation and the level of employment also depends on which sector it is. Sectors are differentiated across a plethora of factors, many of which are, above all, predetermined by a set of technological characteristics. This, above all, includes the cumulativeness of the knowledge base, means of protection, and potential for deriving economic gain from innovations [11], [12]. Technological differences determine the degree of impact on employment indicators in various sectors (Fig. 2).

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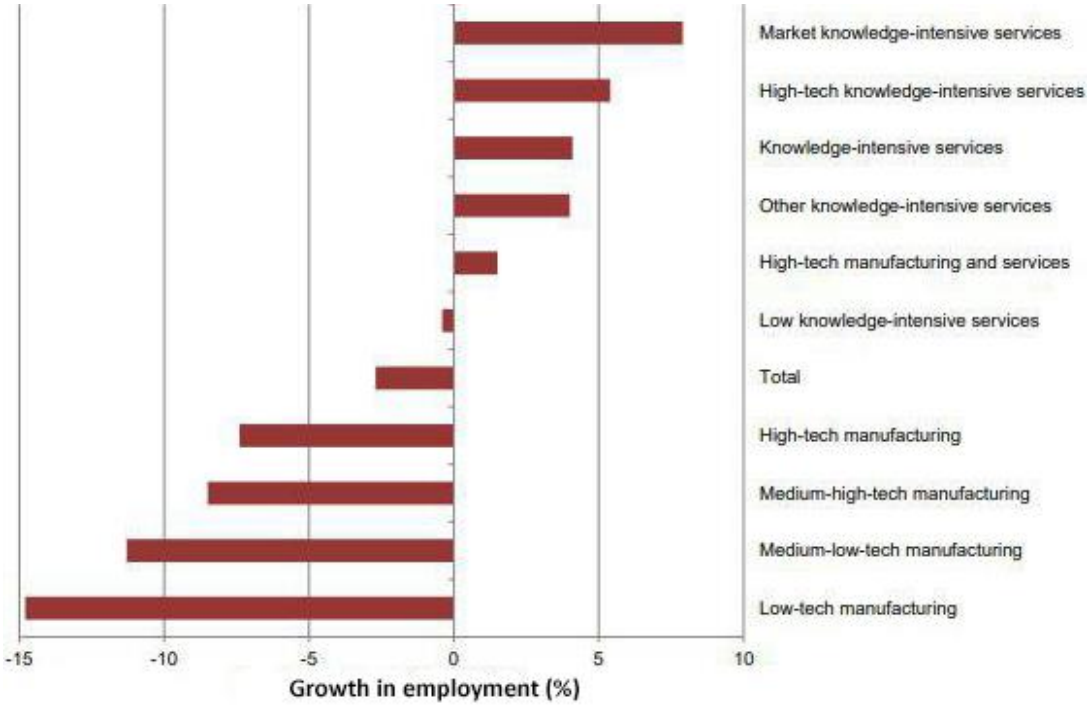

Fig. 2. Growth in employment across sectors depending on the degree to which they are science-driven globally (2017).

The fastest growing and most diversified sector today is knowledge-intensive market services. This sector incorporates the following: legal, accounting, and auditing activity; management (of head offices) and consulting; architectural-construction engineering; technical consulting; testing, analysis, and certification; advertising and marketing research, as well as other professional scientific-technical spheres. This is the fastest growing sectorial group at the moment.

Fig. 2 illustrates the significant gap in employment growth between the production and services sectors. All production sectors are exhibiting negative values, and only high-tech production and services have posted boosts in employment levels. Advanced growth in employment in the services sector, as opposed to the production sector, is confirming the macroeconomic indicators posted by highly developed nations [13].

The question arises as to what distinguishes innovations in the services sphere from those in production and whether or not it is possible to gauge them using the very same indicators. Research indicates that, most of the time, innovations in the services sphere are not technological. They are least based on the use of scientific and fundamental knowledge, are characterized by a greater number of communications, require flexible social skills (soft skill), and are protected less effectively with intellectual property rights than innovations in production [14]. On top of that, innovations in the services sphere are less standardized than production innovations, as they are the result of interaction between the end user and the manufacturer. All this attests to their different innovation trajectories. Thus, innovations are a key factor that determines structural changes in the sphere of employment and have an effect on total growth in labor productivity [15].

There is a need to make an admission here: there are no major differences among the bearers of labor power in level of professional skills, experience, creative characteristics, etc., i.e. labor is homogeneous. This is a deliberate simplification, as people, doubtless, have different levels of education and possess different skills and competencies. The latest research has substantiated the fact that engaging in effective innovation activity in an organization requires an entire spectrum of skills in all different spheres, including engineering, multimedia, computer graphics and design, information technology, and marketing research [16], [17]. Consequently, the more skills are available and are employed in the innovation process, the greater is the likelihood that the firm will prosper. Innovations, in turn, tend to transform the various skills employed. Thus, work at companies focused on information-communications technology (ICT) requires workers with wider skill set than work at firms that employ mechanical technology. ICT facilitates the creation of new jobs and the elimination of jobs that are based on traditional technological paradigms.

IV. DISCUSSION

The implementation of ICT in the various spheres of company activity leads to the automation of routine work and an increase in demand for high-skilled workers with a wide spectrum of competencies. In particular, the automation of processing and payment operations, stock taking, and text processing has already changed the nature of numerous routine office tasks, having over the course of 30 years made many of them rudimentary, with the rest of those tasks resolved today with greater efficiency. In certain cases, ICT has become an indispensable part of work for many professionals (e.g., designers, engineers, and managers). The wide use of ICT has brought about the need to set new requirements for skills required in those occupations and has driven up the demand for them.

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Given that professional skills are an extremely broad category, it may be advisable to conduct their analysis across particular functional tasks. A task is a unit of work activity that produces output. Tasks can be performed by labor (people) or capital (machines, or, in other words, via automation). People employ their skills to perform various tasks. There is no clear division of tasks between people and machines. Scholars D.H. Autor and D. Dorn [18] are of the view that new tasks – those that are related to the development of new products, techniques, or services – must be performed by workers because they are flexible and adaptive. On the contrary, if a task is routine and codified, it is subject to automation. The redistribution of tasks between people and machines is due to boosts in the technical capabilities of modern-day equipment and software. New technological processes can make certain tasks that are currently performed by workers superfluous, but they can also help boost the value and utility of other tasks by boosting their effectiveness. There are certain types of tasks performing which requires certain human qualities: intuition, creativity, situational adaptability, visual and linguistic recognition, and communicating with fellow workers. Thus, new technologies can either replace human labor or supplement it in performing tasks [19], [20].

In today's conditions, dividing tasks into cognitive-routine and nonstandard helps classify jobs more objectively than dividing them into skilled and unskilled [21]. Thus, it may help to differentiate among the following four types of tasks:

- Analytical and interactive nonstandard tasks;
- Analytical and interactive routine tasks;
- Manual routine tasks;
- Manual nonstandard tasks.

V. CONCLUSION

In recent years, demand for routine work has declined significantly, regardless of what kind of work it is – manual work or work more or less related to cognitive activity. As a consequence, demand for medium-skilled workers has declined, whilst demand for high-skilled and low-skilled (accordingly, high-paid and low-paid) jobs has increased. In the literature, this phenomenon is referred to as "technological changes with a routine focus" and is synonymous with work polarization. Information-communications technologies are increasingly replacing humans to do routine work that requires medium-level skill, while, at the same time, serving as a support for high-skilled and low-skilled manual work. This means that organizations will tend to not only seek to hire university graduates who have skills in the area of design, development, and management but will need low-skilled manpower as well (e.g., cleaning personnel, shop clerks, etc.).

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