A review on the role of ETC in affecting employment – The case of the Medical Industry

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Technology has brought a dramatic change in the employment structure of various sectors, both by displacing jobs and by creating new skill demands and opportunities. Such a dynamic is explored in detail in *Beyond R&D: the role of embodied technological change in affecting employment* (Pellegrino et al. 2019), in which technological change is classified into two parts: process innovation (manifested by Embodied Technological Change), said to be labor-saving, and product innovation (the output of Research and Development), said to be labor-friendly. While process innovation may reduce employment, economic analysis shows that price and income effects can offset this reduction, though such compensation mechanisms, as well as other factors that affect the impact of technology on employment, depend on a number of properties and circumstances and thus need further examination.

The paper empirically evaluates the impact of technological innovation on employment, noting how the majority of previous studies focused exclusively on R&D as the sole innovation input, neglecting ETC, even though it is an investment input often responsible for about 50% of the firm's innovation expenditure. Motivated by such gap in the existing literature, the study conducted an empirical test using data from a survey on the expenditures of Spanish businesses between 2002-2013, a dataset wide enough to implement lags, endogeneity controls and alternative instrumentations. Furthermore, both R&D and ETC were considered as proxies of innovation investments, and the microeconometric data was analyzed at both broad and detailed level.

Through the study, it became clear that the two drivers of technological progress diverge significantly in their employment impacts, for instance in terms of sectoral belonging: neither shows significant impact on employment if the entire research sample is considered, but R&D demonstrated a visible labor-friendly impact on high-tech firms. Similarly, in relation to firm size: for large firms, R&D and ETC show no significant impact, while for small and medium enterprises (SMEs), ETC emerges and shows a labor-saving effect. Although the authors emphasize caution when utilizing said conclusions for policy-making purposes, the primary observations point towards focusing R&D incentives on high-tech industries to benefit from its labor-friendly effects, while directing policies such as training and re-training programs towards SMEs, where ETC is more dominant, in order to mitigate losses in employment there.

The medical field, in particular, is a sector constantly changed by technological innovations that revolutionize healthcare delivery, with much discussion regarding how said new technologies can impact the healthcare workforce. For instance, CoBots, or collaborative robots, are being used in the medical industry to assist in surgical procedures, increasing precision and time-saving rates. Considering that these robots lack autonomous decision-making capabilities, they rely exclusively on guidance from healthcare clinicians. The expertise of these professionals is essential in making critical decisions pertaining to medical procedures, managing potential complications, and ensuring patient safety. As a result, these technological advancements are considered to be labor-friendly, given that they enhance the efficiency for healthcare workers rather than replace them.

Bronsoler et al (2020) stress that information and communication technologies can also have a positive impact on clinical productivity and labor-demand, having observed a number of aggregate data and hospital-level event studies and concluded that IT innovations can not only increase the demand for workers but also lower the entry-barrier for hiring and that, in fact, said innovations should be stimulated and supported on administrative and legislative levels in order to compensate for their often slow rate of adoption (caused by factors such as physicians' attitudes and skills, privacy laws, fragmentation, and weak competition). A state-of-the-art example of AI-powered information technology is ChatGPT, a powerful Large Language Model (LLM) that is gaining attention from prestigious medical institutions and has recently shown great performance in the United States Medical licensing. D. Succi et al (2023) evaluated its use in the identification of appropriate imaging procedures for breast cancer and breast pain. The results showed that the tool was accurate and suitable for assisting radiological decision-making and improving the clinical workflow, generating positive impacts due to its labor-friendly nature.

However, there is no guarantee that these innovations will remain labor-friendly. As technological advancements continue to rapidly progress, they can potentially evolve into autonomous equipment that have the ability to analyze data, make decisions, and perform tasks independently with the aid of constantly-developed AI tools. Walker (2016), for instance, argues that robot assistants and analytical programs stand to dramatically reduce the need for both physicians and surgeons on a per-capita basis, threatening not to simply assist their work, but effectively replace them entirely, in a

discussion that has existed within the industry for decades (see Kassler 1993; Eckberg 1998). This represents a classic economical phenomenon, where time plays a significant role in changing the economic impact of an innovative tool on a particular industry by making it transition from labor-friendly to labor-saving, similar to the rise of ATMs as supplemental instruments to bankers, and eventually replacing them.

Innovation is a natural tendency in the medical industry, and even if some technological advancements lead to unemployment, the pressure for more technological changes not only persists, but may even intentionally favor labor-saving innovations. Thoma-Lürken et al (2015) showcase such situation in a study about the long-term care industry, which predicts an increase in demand paired with a decrease in the availability of a skilled workforce in the future. For settings such as that one, there is a clear push (and resource allocation) towards innovations that replace human workers, and the labor-saving outcome is explicitly a positive, ethically desirable goal, as it represents the possible solution to a problem of service and quality of life for patients.

Qureshi and Syed (2014) argue that the shift towards labor-saving technologies in healthcare is inevitable, but, most importantly, that it must be regulated in a way that considers employment and employee motivation as essential benefits of a company's strategies. Therefore, there is a strong recommendation towards management initiatives to increase workers' skills - both at the personal level (human resources) and at the legislative level (policy makers) - in a similar line of thought to what was previously discussed with respect to Pellegrino et al (2019). This investment in human resources will not only equip employees to work in tandem with robots but also motivate them to embrace technological changes.

In conclusion, it is noted that both faces of technological innovation (the labor-friendly and the labor-saving) appear in the healthcare industry, and that the importance of effective socioeconomic management for either face of innovation process cannot be overemphasized. The effective management of technological change in medicine requires collaboration among various stakeholders, including government regulators, health care providers, and patients, which must all be willing to balance competing interests and priorities with the ultimate goal of improving the quality of treatment while minimizing the disruption of labor.

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