Technological innovation and the labor market: The two-way non-reciprocal relationships with a focus on the confectionery industry in Poland

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Abstract

PURPOSE: *The theoretical aim of this study is to explore the nature of the "technological innovation–labor market" relationships presented recently in the literature, based on publications indexed in the Scopus and Web of Science databases. The empirical purpose is to examine these relationships in companies operating in the confectionery industry in Poland.* ***METHODOLOGY:*** *Literature studies, as well as a mixed-method empirical research approach, were used, including an online survey of engineers working in the confectionery industry and the case study method (with interviews and observation).* ***FINDINGS:*** *Publications from the past eleven years have covered the problems of the analyzed relationship but have not taken into consideration the market in Poland or the confectionery industry. More often than the classic literature, these publications present different relationships, not focusing mainly on the issue of unemployment resulting from technological innovation. Meanwhile, empirical studies show that the analyzed relationships are non-reciprocal. Fifty percent of the employees surveyed indicated that implementing technological innovations results in job losses. The remaining respondents were convinced that technological innovation has a neutral quantitative impact on the internal labor market. We identified that technological innovations have an impact on the labor market (both internal and external) more often than changes in the labor market affecting innovations, and that this impact is rather negative. Moreover, empirical research shows that technological innovations are positively connected with qualitative changes in the internal labor market.* ***IMPLICATIONS****: This study emphasizes the need for lifelong learning among employees and for a field for development at educational institutions. It should also draw the attention of top managers to the skills that their employees have now and*

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Received 17 September 2021; Revised 12 December 2021; Accepted 4 January 2022.

should have in the future. ***ORIGINALITY AND VALUE:*** *The paper presents an original typology of the relationships between technological innovation and the labor market, which can serve as the basis for further development and qualitative or quantitative research. The paper also presents pioneering research because previous studies were not based on a complex framework, including different kinds of impacts (from negative through neutral to positive), treating the labor market and technological innovations relative to each other as dependent or independent variables, or highlighting two types of labor market.*

Keywords: *labor market, employment, technological innovation, process innovation, mutual relationships, confectionery industry*

INTRODUCTION

Work has always accompanied people. However, it was not until the 19th century, along with the development of the industrial society, that the terms "work" and "worker" first became a subject of interest for scientists. In those days, attention was mainly paid to the economic side of work (Piwowar-Sulej, 2010). Nonetheless, work can also be considered from the perspective of an individual. It can be approached by a human being as obligatory. Work can also represent a means of satisfying needs. Finally, it can be perceived as a value, an end in itself, and a source of personal development (International Labour Office, 2015). In this manner, work becomes an issue analyzed in the framework of economics, management, and social sciences, such as psychology and sociology.

The concept of a labor market is inseparably correlated with the concept of work. The labor market, in labor economics, covers all issues related to labor supply and labor demand. Through the interaction of workers (suppliers of labor) and employers (demanders of labor), labor sales transactions take place (Graham & Anwar, 2019). However, labor markets – as with the term "work" – are the subject of discussion carried out by researchers not only in the field of economics, but also the other above-mentioned scientific disciplines. Researchers in economics and sociology are especially interested in the external labor market (e.g., Ramskogler, 2021), whereas specialists in management (also using knowledge from psychology; e.g., Hubbard & Purcell, 2001; Jiang et al., 2012) approach it from the perspective of a particular company. They focus on both the internal (organizational) labor market and an employee's perspective.

The 20th-century authors who studied the factors contributing to economic growth – such as Schumpeter (1934) and Solow (1956) – showed that economic growth cannot be explained solely by the increasing application of the factors of production. In particular, Solow (1956) referred

to this as "technical progress." This progress is connected with technological innovation, which generally is reflected in changes in production methods and processes (Brem et al., 2016; Piwowar-Sulej & Podsiadły, 2019; Vonortas & Xue, 1997) and, therefore, can also be called a process innovation.

Various classic studies suggest that technological innovations lead to a reduction in jobs rather than job creation (quantitative changes; Bernhard Dachs, 2018; Blien & Ludewig, 2017; Freeman et al., 1982; Kaur & Nagaich, 2018). The interest in this topic also comes from changes resulting from the introduction of the Fourth Industrial Revolution (De Grey & Rossiter, 2017). As Brynjolfsson and McAfee (2011) stated, technological innovation is still increasing, with more sophisticated software technologies disrupting labor markets by making workers redundant. Papaioannou and Srinivas (2019) highlighted that innovation is not a phenomenon of a neutral-value and that technological growth is not an adequate measure of the success of any policy. They also recommended exploring the relationship between the dynamism of technological innovation in the context of their power (political laden) and values (related to social implications). Therefore, the first purpose of the paper is to explore whether the recent studies discuss the problem of complex (qualitative and quantitative) relationships between technological innovation and the labor market (internal and external). The research question (RQ1) that corresponds to this purpose is:

RQ1: What is the nature of the relationships between technological innovation and the labor market as presented in the recent academic literature, especially in papers published in the last eleven years?

The second purpose of this study is to present the relationships between the implementation of technological innovations and changes in the labor market, focusing on the confectionery industry in Poland. The paper also attempts to answer the following research question (RQ2):

RQ2: What do the analyzed relationships look like from the perspective of companies operating in the confectionery industry in Poland? Are they reciprocal?

The scientific analyses may refer to specific countries, industries, or professions. None of the publications discussing the labor market in the context of technological innovation – indexed in the above-mentioned databases – refers to the situation in Poland. This country gains low scores in the key European measures of innovation, including the Innovation Union Scoreboard

(European Commission, 2020). Only 23% of Polish companies are perceived as being innovative, while the average for the EU is 50% (Wielądek, 2016). Moreover, the instruments supporting innovation, currently used in Poland, cannot be considered as effective. Their low effectiveness is caused, i.a. by the lack of an innovative culture (not only in the manufacturing industry) (Jasiński, 2013b). At the same time, the confectionery industry – although based on manual labor – is one of the fastest developing industries in the food sector in Poland. The value of exports of chocolate and confectionery products amounts to approx. EUR 1.5 billion, while imports are worth approximately EUR 1 billion. For instance, chocolate – a confectionery standard – reaches 111 countries, primarily Germany (Przeździak, 2019). Therefore, the confectionery industry in Poland is an interesting research subject. As Rosenberg (1994) stated, technology and economics should be treated as path-dependent phenomena, which means that findings from one industry may be inappropriate when applied to the other industry.

Apart from analyzing the literature on the subject, a mixed-method approach to empirical research was used. The authors conducted an online survey of 48 engineers, which represented a quantitative research approach, and adopted the case study method, which reflects a qualitative research approach (Guba, 1990). The paper adopts a holistic approach towards analyzing the identified relationships, which means combining the perspective of economics with that of management.

The paper contributes to academic knowledge by a) developing an original concept of two-way relationships between technological innovation and the labor market, b) providing literature analyses and empirical evidence based on a mixed-method research approach, c) formulating implications for practitioners, and d) indicating directions for future research.

The paper is organized as follows. The second part of the paper provides a general description of the research context. In particular, technological innovation is defined and the relationship between it and the labor market, as presented in the classic literature, is shown. Then the labor market in Poland and the confectionery industry are characterized. In the third section, the material and methods are presented. The following section is devoted to a presentation of the research results. The problems explored in the publications indexed in the academic databases within the last eleven years are shown. Then the findings from the survey and the case studies are presented. Next, the authors provide a discussion that answers both research questions. The concluding section highlights the limitations connected with the research, provides practical implications, and postulates directions for further research.

LITERATURE BACKGROUND

One can state that innovation is everywhere, which means language as well as services, products, and technologies. Therefore, innovation is discussed in different scientific disciplines, including social sciences, economics, and management. In general, innovation is a process of formulating, applying, launching, and developing a creative idea and guiding it as it matures and falls (Griffin, 2004). The first sociological theory of innovation comes from Tarde (1902), who evaluated social changes (including economic regime and industry) and for whom innovation meant invention. However, the economist Schumpeter (1941) is considered the inventor of the concept of innovation. He distinguished innovation from invention and identified innovations as introducing new products and new production methods, entering new markets, obtaining new sources of raw materials, and reorganizing industry.

Different definitions of innovations have been created, some approaching innovation as an absolute novelty, and others as the implementation of a solution developed by another entity (Nelson & Winter, 1985). Currently, the latter approach dominates in the literature on the subject. It is considered that imitation requires work, experimentation, judgment, and imagination. Imitation is innovation because, when combining elements from nature, it combines the best of them and improves nature (Godin, 2008). However, it must be implemented for the first time by a particular company (Fagerberg, 2006; Freeman & Soete, 2013; Kuznets, 1962; Nelson & Winter, 1985). Kemeny (2010) defined technologies as principles and ideas which direct the way goods and services are produced. Although there is a clear definition of technologies, there is no common approach to the definition of technological innovation. For example, Maclaurin (1953) used the terms *technological innovation* and *technological change* interchangeably. In the Oslo Manual (OECD/Eurostat, 2005), two types of innovations were distinguished: technological and non-technological innovations. The first are related to changes in products and processes, while the second are associated with changes in marketing and organization. Geldes et al. (2017) and Höflinger et al. (2018) – following the OECD guidelines – identified technological innovation with technologically innovative products. For Vonortas and Xue (1997) and Brem et al. (2016), technological innovations refer to manufacturing process innovations. For the purpose of this paper, the authors use the following definition: "technological innovation results from the application of knowledge and results in technology through innovations in the production process." It is "a new combination of production means and a change in production factors (input) used to manufacture products (output)" (Piwowar-Sulej & Podsiadły, 2019, p.313).

A construct that can sometimes be the first association that comes to mind when combining technological innovation with the labor market is technological unemployment. Keynes (1963) described technological unemployment as unemployment caused by the discovery of means of economizing the use of labor that outruns the pace at which new uses for labor can be found (for more, see Rifkin,1995; Campa, 2017).

According to some researchers, it is a temporary phenomenon representing either frictional unemployment or a microeconomic one. They claim that modern machinery and modern company organization systems make workers redundant and at the same time reabsorb them in the form of compensation by investing the resources in new industries and services, thus opening new jobs. Another type of compensation is manifested by technological innovations in production processes turning into product innovations and creating new sales markets, services, and, as a result, new jobs. Finally, the implementation of new technology compensates for production costs, allowing a higher supply of cheap goods, thus acting as a purchasing power incentive and simultaneously creating new jobs. There are also authors who disagree with these forms of compensation, presenting a vision of an approaching labor market collapse and the prospect of an end-of-work society (for more, see Vivarelli,1996; Mokyr, Vickers, & Ziebarth, 2015).

From the times of the British industrial revolution, through the displacement of the 1930s in the USA, to the arguments on technological unemployment, numerous individuals have expressed doubts regarding the advantages of using machines and have fiercely refused to implement any kind of modernization in industry (Lipsitz & Bix, 2001; Soete & ter Weel, 2001; Stern, 1937). This was followed by a new approach developed in the 1960s, accepting the introduction of machines in production processes. For example, Marx (1867) described production automation as a process that deprives people of their essential functions in the system. An employee was seen as a component of a machine that functions according to a new work discipline in line with the pace imposed by the machine (Mackenzie, 1998).

This was followed by a debate held in the 1970s, mainly in Europe, as a result of the introduction of microelectronic technologies (Bartlett, 1984; Byrne, 1986). Nowadays, a global debate continues, primarily focused on communication and information technologies and their consequences on the rate of employment and quality of life (e.g., Pianta, 2006; Vivarelli, 1996). Technological innovation has an impact on growth in the IT sector (Freeman & Soete, 1985). Technological innovation usually allows a company to produce the same amount of products with less capital and/or labor (Edquist et al., 2001). Therefore, innovation most often leads to a negative quantitative effect on employment. It is worth mentioning that, historically,

new technologies have primarily been confined to routine tasks, though modern technologies can also reduce the number of non-routine tasks (Frey & Osborne, 2017). The size of this effect depends on the direction of technological change, the type of current technology (the rate of substitution between input factors), and the industry.

DESCRIPTION OF THE RESEARCH CONTEXT

Characteristics of the labor market in Poland

An analysis of the Web of Science and Scopus databases, covering the last eleven years, indicates that scientists focusing solely on the problems of the labor market in Poland discuss the following aspects:

- how the transition process of this post-communist country to a market economy affected the labor market (Witkowska, 2016). One of the conclusions is that in Poland the economic activity rate of women is lower than that observed before the transformation and
- the issue of labor migration to Poland (Kaczmarczyk & Okolski, 2008; Polkowska & Filipek, 2020; Szeptycki, 2016) and classification of the regional labor markets by identifying specific criteria (e.g., the rank of the labor market and the scale of impact) (Sitek & Zuzańska-Żyśko, 2015).

There are also publications comparing the situation in Poland with other countries (Blanchflower, 2001; Lübke & Erlinghagen, 2014; Smith et al., 2008; Tvrdoň, 2016) and emigration from Poland (Bygnes & Erdal, 2017; Janta, 2011; Krings et al., 2013; Levrau et al., 2014).

Useful data on the labor market situation in Poland are provided by Statistics Poland (Central Statistical Office, 2019b). In general, the Polish labor market deals with problems of insufficient workforce resources. At the end of the second quarter of 2019, the number of vacancies in companies employing at least one person exceeded 151,800 and was higher than at the end of the first quarter of 2019 by 9,400 (6.6%). At the end of the second quarter of 2019, 52,100 organizations had vacancies, i.e., 6.7% of all organizations in Poland. The ownership structure with the indication of job vacancies corresponds to the structure of the entire population – private sector enterprises accounted for 91.2%. As with previous quarters, the largest number of vacancies remained in entities operating in the area of industrial processing (22.5%). The companies offering vacancies were most frequently searching for industrial workers and craftsmen – 37,800 (24.9%). Vacancies for operators and assemblers of machines and devices also constituted

a significant share – 24,500 (16.1%), specialists – 24,400 (16.1%), and service and sales employees – 22,800 (15.0%) (Central Statistical Office, 2019a).

The reasons for the insufficient number of people willing to work in Poland include low wages (employee compensation and employers' tax and social security contributions) and the high level of economic emigration to Western European countries. Polish labor costs are still under half of the European average. According to data presented by Eurostat, labor costs in Poland are placed at EUR 10.10 per hour, while the EU average is EUR 27.40 (Eurostat, 2020b). The low level of labor costs results in a continuously growing demand for employees from foreign companies investing in Poland (Hernik, 2018). However, it is worth mentioning that although labor costs in Poland remain one of the lowest in Europe, it is growing rapidly (6% in Poland compared to 2.3% in the EU; Jurczak, 2018).

The growing immigration from Ukraine does not even compensate for the shortage of employees on the Polish market. Currently, Ukraine represents the most important source country for migration to Poland. Poland's popularity as a destination country for Ukrainians is enhanced by numerous factors, such as geographical and cultural proximity. The migration of Ukrainians to Poland is, in most cases, of a profit-making and short-term nature (cyclical, often seasonal). For example, they come to Poland to work in the construction, home care, and agriculture sectors, rather than in industry (Brunarska et al., 2012).

The number of immigrants from Ukraine working in Poland is estimated to be approximately one million. The main basis for such estimates is the number of registered declarations regarding the intention to entrust work to a foreigner in Poland (over 600,000) and the data on the number of Ukrainians taking up illegal employment in Poland as part of the shadow economy. The latter of these values is difficult to determine, but based on the available data, it is estimated that between 30,000 and 270,000 Ukrainians may be working illegally in Poland (Bińkowski, 2017).

The confectionery industry in Poland – its history and current challenges

Over the past thirty years, the confectionery sector of the food industry has been subjected to extensive changes. Until 1989, as a result of the nationalization of the industry and the economic system based on the central state management model, all factories manufacturing confectionery products were affiliated with a state organization. This resulted in an obsolete machine park, limited availability of raw materials for production, confined supply, and a highly reduced and standardized portfolio of finished products (Piwowar-Sulej & Podsiadły, 2020).

The socioeconomic transformations of the 1990s, consisting of the transition from a socialist economy to a market economy, initiated an intensive development of this industry. This was made possible by the investment of domestic capital and as a result of direct investment made by foreign global corporations in the confectionery industry. Regardless of the capital's origin, these investments were focused on privatizing production plants, forming associations, or establishing new production companies – greenfield investments. The high investment level resulted from the vast potential of Poland's confectionery market. Before 1989, the availability of confectionery products was highly limited or even rationed. In the period 1993–1995, the average consumption of chocolate and confectionery products in Poland was 0.36 kg per month per person, which was several times lower than in such markets as Germany, Belgium, Switzerland, Great Britain, and France (Podsiadły, 2019a). Local investors approached it as an opportunity to multiply their capital. At the same time, foreign companies saw a chance to increase the sales of their products by penetrating a new sales market and building a strong brand in the customers' minds.

An additional investment incentive on the part of foreign businesses was the desire to optimize labor costs. The high unemployment rate in Poland significantly affected the level of Poles' earnings. The high labor supply resulted in reduced labor costs. In 1996, the total labor cost per employee in Poland was USD 5.42, whereas the average cost in the European Union in the same period amounted to USD 33.57. Owing to the investments mentioned above, Poland became one of the key confectionery producers worldwide, ranked eighth among the global exporters of these products in 2017 with a share of 4.8% (Kwil & Podsiadły, 2019). As Domański (2003) stated, foreign investments helped enhance the competitiveness of the Polish industry and narrow the gap between Poland and the European Union. At present, the confectionery sector in Poland is characterized by stability, valued at over PLN 12 billion; including salty snacks and ice cream, the sector is worth over PLN 16 billion, with a predicted order increase of 1%–2% per year (Przeździak, 2019).

Based on Nielsen data (Rogalska, 2017), the confectionery and snack market retail sales grew in 2018 by 5.8% over 2017. According to the statistics, in October 2018, a 4.0% growth year-on-year in the production of chocolate and chocolate products was recorded, bringing the total to 45,200 tons, whereas comparing the monthly production of chocolate and chocolate products between September and October 2018, the increase was 8.9%. In the period from January to October 2018, the production of chocolate and chocolate goods went up by 9.0% year on year, reaching a total of 353,000 tons. The most desirable goods remained within the premium segment; the consumption of pralines increased as well (by approx. 8%), with

cookies as the leading category. Poland is ranked 22nd on the global market regarding chocolate consumption, with each person consuming approx. 5 kg of chocolate per year. For comparison, the data for Switzerland and Germany show twice larger consumption in both of these countries (Przeździak, 2019).

Even though chocolate remains a global bestseller, its manufacturers have to investigate methods for attracting new customers and keeping the current ones. The growing health-oriented trends have been contributing to a stronger consumer focus on products that offer fewer calories, reduced sugar, and additional ingredients such as vitamins and minerals (Pszczoła, 2013). Therefore, manufacturers must focus on meeting their clients' expectations by providing updated alternatives to classic confectionery goods that highlight their health-oriented advantages. They are under pressure to develop innovative and original products in this respect. Several years ago, the production of goods combining caramel and salt was initiated along with new flavors, such as bacon and chocolate. Unusual flavors in the chocolate segment have been gaining popularity in many countries. Chocolate enhanced with bacon, wasabi, salt, or a herbal flavor has an increasing number of devoted fans, primarily in the USA. This trend might also spread to Polish consumers, giving way to unconventional flavors, becoming strong competition for traditional confectionery, since Poles have always accepted novelties (Pszczoła, 2013). Thus, it might be implied that the spectrum of innovative confectionery products will be widened.

There are many challenges affecting the confectionery industry, but three of them seem to be the most crucial. The first challenge for the entire chocolate industry refers to price fluctuations of the upstream product, that is, cocoa beans. It has a direct impact on the production cost. In 2013, the cocoa bean deficit amounted to approx. 70,000 tons. As a result of bad weather conditions, the harvest in the years to follow was also low. Thus, it was expected that in 2020 the deficit could reach the level of 1 million tons and even 2 million tons in 2030. The situation started changing after the 2016–17 season, when cocoa bean production increased by 15%, and harvests were about 600,000 tons higher as compared to the previous season. This sudden change resulted in greater availability of cocoa beans on the market, resulting in a dramatic slump in the raw material price, from USD 3,000 per ton of cocoa beans down to just USD 1,900 (Podsiadły, 2019b). Paradoxically, this situation caused a deficit of cocoa beans, not because of the weather conditions but due to some farmers changing their production profile away from the less profitable crop. A similar situation was observed in the market for other raw materials. Therefore, the confectionery manufacturers continue to optimize production costs so that the fluctuations in raw material prices do not adversely affect their profit margins or the price of the finished product paid by the consumer.

The second challenge is meeting customers' expectations related to environmental sustainability and CSR activities. Consumers pay attention to the information on the confectionery labels. They show great interest in the symbols of social or charity organizations, which indicate that the product was manufactured in accordance with specific rules or that a portion of the profit from its sale has been donated to charity organizations (Didier & Lucie, 2008; Hainmueller et al., 2011; Stenn, 2013). Manufacturers must ensure that the raw materials they use guarantee sustainable development, and they must investigate alternatives to "controversial" raw materials, such as palm kernel oil, for example. For this reason, one of the major challenges faced by confectionery manufacturers is to ensure the continuity of raw material supplies and stable prices (Podsiadły, 2019a).

The last challenge is related to the Polish labor market. The companies have to compete with other companies from the same and other industries in order to obtain the necessary human resources. As mentioned above, the labor market in Poland is now considered an employee's market. The unemployment rate in 2019 was 5% (Central Statistical Office, n.d.). It is estimated that in the following years, the unemployment rate will trend downwards (International Labour Office, 2021).

MATERIAL AND METHODS

The authors used Web of Science (WoS) and Scopus because these two databases include the most academic papers from the entire world. The following queries were used: "process innovation" and "technological innovation" in connection with "labor market." The authors searched the paper topics (in WoS) and the paper titles, abstracts, and keywords (in Scopus). Searching covered publications from the past eleven years because this paper is not a systematic review and the sources used for research on social science fields require more "cutting-edge" research (these research fields change quickly) (Wolf, 2019).

Empirical research aimed at answering the second research question (R2) was carried out with a combination of qualitative and quantitative methods, which is an especially valuable approach in the social sciences (Blien & Ludewig, 2017; Creswell & Tashakkori, 2007; Flyvbjerg, 2006). The adapted sequential, explanatory design allowed both the macro-level of analysis (industry) and the micro-level of analysis (particular companies) to be presented (Figure 1).

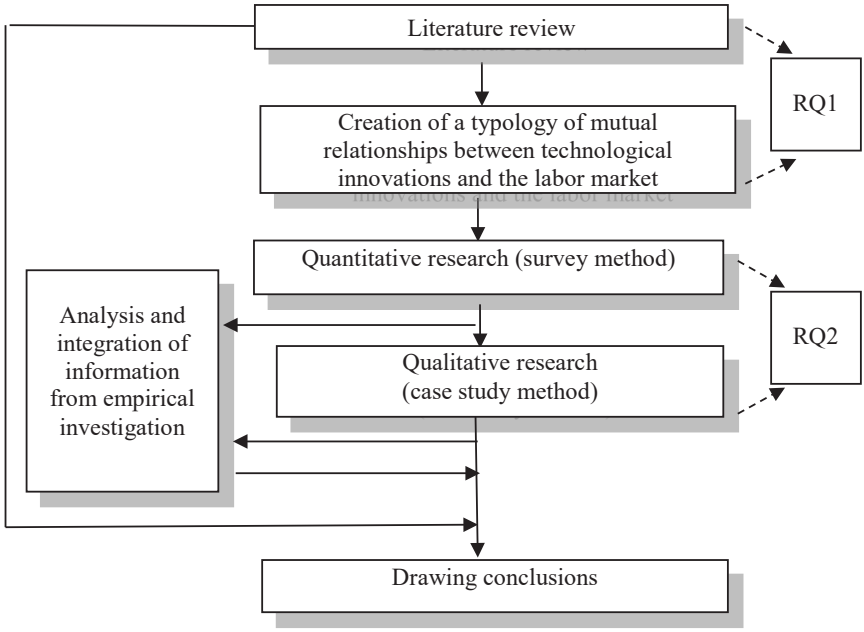

Figure 1. The research processes

From December 2019 to January 2020, a survey using the online questionnaire method was carried out among engineers working in the confectionery industry. It is complicated to measure the size of the general population of engineers working in this industry, as Eurostat provides only general data about the number of scientists and engineers. In Poland in 2019, there were 1,220,600 scientists and engineers (Eurostat, 2020a). The questionnaire was sent to 57 engineers working in the confectionery industry, 48 of whom (from nine different companies) sent back completed questionnaires. A minimum sample size of 30 is necessary for quantitative studies (Lenth, 2001).

Finally, to illustrate the analyzed correlations from the perspective of industrial companies and the labor market in Poland, the authors used the case study method. It is justified to apply a case study as a research method in the following circumstances (for more, see Yin, 2014):

- the initial stage of knowledge development was identified in a given area of research (e.g., contradictory or insufficient results of quantitative research or a small number of publications);
- it is important to analyze the phenomenon in its actual conditions;

- there are vague boundaries between the phenomenon and the circumstances in which it occurs.

In general terms, it is recommended to conduct research based on a multiple case studies (de Weerd-Nederhof, 2001). It is said that a case study should cover at least two to four entities (Perry, 1998). In this study, based on the case study method, four companies – later referred to as A, B, C, and D – were analyzed. All companies represented the confectionery industry.

Company A is placed in the central part of Poland, close to the capital of the country. Due to this, the supply in the labor market is low. The plant employs 486 workers. The main building was constructed in the second half of the 70s in the 20th century but the equipment is continuously modernized according to the new technology and solutions available on the market. The main assortment produced in the plant is various types of soft cakes and biscuits for the Central European Markets.

Company B is situated in the southwest part of Poland in a direct neighborhood of one of the biggest cities in Poland. The plant is located in a special economic zone, which causes a highly competitive labor market and creates challenges in the employment of blue-collar workers with good skills and experience. The factory opened at the beginning of the 90s in the 20th century and it was extended and modernized in the first years of the 21st century. 634 workers are employed in this company. The main product is a variety of chocolate products, like tablets, countlines and pralines, which are exported mainly to the United Kingdom, Ireland, and other countries in Western Europe.

Company C is located in the west part of Poland, also close to one of the biggest cities in Poland, as well being in a special economic zone. The plant was founded at the beginning of the 90s in the 20th century. Approx. 300 workers are employed in the factory. A few years ago, the portfolio of products changed and currently, production specializes in chocolate tablets for France and the Benelux countries.

Company D is in a small town in the southeast of Poland. The plant was built in the 30s of the 20th century. Throughout the history of the factory there have been a few modernizations and changes in the portfolio of the finished goods produced there. Approx. 481 workers are employed in the factory. Currently, the production specializes in various types of biscuits, soft cakes, and in big format chocolate tablets for the Polish market and Germany, France, and the Benelux countries.

For the purpose of the case study, from January to March 2020, unstructured interviews and direct observation of production processes were conducted. The core concept to ask about was – “example(s) of the

implementation of technological innovation and its result(s) for the internal/external labor market." There was no formal structured instrument or protocol. Direct observation is distinguished from participant observation. During the direct observation, a researcher is only watching, not taking part in the observed process.

The respondents were employees from the technology departments of the surveyed companies (engineers, two people from each company). In an individual interview (conducted by one of the authors of the study) which lasted about one hour, the respondents willingly talked about the implementation of innovations in their companies and its results for the internal/external labor market; however, it was more difficult to obtain specific data regarding innovations and employment rates. Because of this, the results are presented only in a descriptive form. The interviews were recorded. An analysis of the recordings was carried out on the day after the interview because, when analyzing qualitative data, it is important that the people conducting the research remember the events. An interpretative approach was adopted in the data analysis. The thematic analysis conducted in this study aimed at answering the following questions:

1) What is an innovation in this case?
2) What are the results from the implementation of this innovation?

Each of the authors prepared their own interpretation of the research results (following the procedure of thematic analysis) (Nowell et al., 2017), and then (to ensure greater objectivity) a mutual verification of the interpretation of the conclusions were made. Further in-depth studies in plants were impossible because of the COVID-19 pandemic.

RESULTS

The relationship "technological innovations vs. labor market" in recent works and empirical research framework

As stated above, an analysis of scientific publication databases was used to answer the first research question (RQ1). The statistics of these publications are presented in Table 1.

Table 1. Statistics of publications discussing the research problem in the past eleven years

Keyword and database	Number of publications in a particular year											
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
„Process innovation" + „labor market" (WoS)	0	0	2	0	0	2	1	1	0	1	0	7
„Process innovation" + „labor market" (Scopus)	0	0	3	1	2	2	1	6	1	3	5	24
„Technological innovation" + „labor market" (WoS)	0	0	0	0	0	2	2	4	3	2	2	15
„Technological innovation" + „labor market" (Scopus)	1	5	3	3	6	6	6	8	13	14	20	85

Source: own study on data base for 2021-01-06.

The analysis of the content of the publication shows that the most frequently discussed problem is the creation of labor demand (quantitative approach to the labor market), combining technological innovations with the labor market. Innovations are indicated as one of many factors influencing a company's demand for labor. The other factors include company structure (organization), labor market flexibility, corporate culture, and the nature of a given sector. As far as a qualitative approach to the labor market is concerned, academic publications cover the problems of properly educating society and developing in employees the competencies required by innovations, including cooperation between humans and machines. The publications indexed in WoS and Scopus do not address the problem of the relationship between technological innovations and the labor market in Poland.

For example, Greenan and Guellec (2000) found that innovating firms and sectors create more jobs than others. Lachenmaier and Rottmann (2011), based on data from German manufacturing companies, reported a significant positive effect of technological innovations on employment growth (higher than product innovations). Technological innovations allow the company to decrease its production costs. As a result, the manufacturer can reduce the price of their product. This activity can lead to overall market expansion and company development, which requires employment growth. Ugur et al. (2018) also proved the positive impact of innovation on employment growth. This impact, however, is small and highly variable.

Capello and Lenzi (2013) analyzed the relationship between implementing innovations and increasing employment for EU Member States. The authors indicated that the impact of innovation varies depending

on the type of innovation. Other issues related to the labor market are also important, e.g., macroeconomic and cyclical conditions, the structure of the workforce, and the dynamics of the labor market and its regulations. The authors concluded that the impact of process innovation on employment is negative in urban areas.

Calvino and Virgillito (2018) emphasized that job creation and reduction are associated with various types of innovative activities, including product and process innovations. They critically assessed the role of technological changes in developing employment dynamics at multiple levels of aggregation and identified various compensation mechanisms aimed at adjusting employment after introducing an innovation. In the summary of their study, the authors distinguished four categories of enterprises after implementing innovations:

- employment and labor productivity both increased;
- labor productivity increased, but the level of employment declined;
- both labor productivity and employment declined;
- labor productivity declined while employment increased.

The paper by Baensch et al. (2018) confirmed that process innovations do not affect employment growth. These findings conflict with the above-presented results obtained by Lachenmaier and Rottmann (2011) and Ugur et al. (2018). In turn, Campos et al. (2019) stated that process innovations have a negative impact on the level of employment. In addition, they found that a higher level of process innovations led to more of a decline in payroll share and to a larger gap between employee productivity growth and an increase of pay.

Díaz et al. (2020) showed that in the case of companies with a high degree of innovation, employment reduction in times of crisis was lower than for non-innovative companies. The positive effect of innovations is particularly visible among highly skilled employees; however, depending on the type of innovation, the impact on employment may vary. The authors emphasized that process innovations can result in job losses due to higher machine performance. However, if lower production costs result in a lower product price, the total demand may increase, which means that job losses would be mitigated.

As far as the qualitative changes in the labor market are concerned, Ilie and Bondrea (2016) analyzed the impact of technological innovations on the availability of jobs and the requirements regarding future employee skills. In turn, Trompisch (2017) ruled out the possibility of overall work automation resulting from the implementation of technological innovations and posed a question about the best model of cooperation between people and machines.

Also, Diaz et al. (2020) addressed the qualitative aspects of human resources in addition to the quantitative impact of innovation on employment. They stated that product innovations are largely responsible for the skill-focused innovation effect. Although they have a positive impact on both types of employees, this effect is much greater for highly qualified specialists.

An emerging topic concerning the impact of technological innovation on jobs and employees' skills is related to environmental management (Piwowar-Sulej, 2021). For example, Orsatti et al. (2020) found that the availability of abstract skills among local employees drives the generation of green technologies. In turn, Sulich and Rutkowska (2020) stated that creating new green jobs can reduce unemployment, highlighting that such jobs are also available for less qualified young people.

Examples of papers addressing the problem of innovations' impact on the labor market have been presented above. There are also publications covering the problem of the external labor market's impact on innovations. For example, Wachsen and Blind (2016) and Oliveira and Holland (2017) studied the issue of labor market flexibility. The research conducted by the former pair of authors showed that the impact of labor market flexibility on innovations is not clear-cut and depends on the type of innovation and the characteristics of an enterprise. Oliveira and Holland (2017) pointed out that high innovation can also be achieved in situations of low flexibility in the labor market. In turn, Lorenz (2015) focused on qualitative changes on the internal labor market and their impact on process innovations. He emphasized the great value of discretionary learning in creating process innovations.

Above, more types of correlation between the analyzed variables than in the classic literature are presented. However, they do not cover all possible relationships between technological innovation and the labor market. Therefore, the authors have developed an extended typology of relationships between technological innovations and the labor market (see Table 2), which served as an empirical research framework in this study.

This framework includes different kinds of impacts (from negative through neutral to positive), treats the labor market and technological innovations relative to each other as dependent or independent variables, and highlights two types of the labor market. It extends the range of impacts identified in previous studies.

Table 2. Technological innovations and the labor market – types of proposed correlations

Independent variable	Dependent variable	Quantitative impact	Qualitative impact
Technological innovations	Internal labor market	positive: higher employment in a company as a result of technological innovations	positive: technological innovations help improve employees' skills (more extensive knowledge and competencies)
		neutral: technological innovations have no impact on employment figures in a company	neutral: technological innovations have no impact on the competencies presented by employees
		negative: layoffs in a company caused by technological innovations	
Technological innovations	External labor market	positive: technological innovations reduce unemployment rate in the labor market	positive: technological innovations stimulate job candidates to acquire new competencies (further training)
		neutral: technological innovations have no impact on unemployment figures	neutral: technological innovations have no impact on the competencies presented by job candidates
		negative: higher unemployment in the labor market as a result of technological innovations	
External labor market	Technological innovations	positive: companies introduce innovations in response to quantitative changes in the labor market	positive: innovations introduced in companies result from the competencies presented by job candidates (labor supply quality)
		neutral: companies do not introduce innovations in response to quantitative changes in the labor market	neutral: innovations introduced in companies do not result from the competencies presented by job candidates (labor supply quality)
Internal labor market	Technological innovations	positive: companies introduce innovations in response to quantitative changes on the internal labor market (employees terminating employment contracts)	positive: innovations introduced in companies result from the competencies presented by employees
		neutral: companies do not introduce innovations in response to quantitative changes on the internal labor market (employees terminating employment contracts)	neutral: innovations introduced in companies do not result from the competencies presented by employees

Results of the survey

Although the respondents were familiar with the problem of innovations, the authors explained the questionnaire's basic definitions, such as technological innovation or internal and external labor markets. The respondents were able to choose one response for each group of statements.

Group 1:
a) technological innovations have a higher impact on the internal labor market than the internal labor market has on technological innovations;
b) technological innovations have a lower impact on the internal labor market than the internal labor market has on technological innovations.

Group 2:
a) technological innovations have a higher impact on the external labor market than the external labor market has on technological innovations;
b) technological innovations have a lower impact on the external labor market than the external labor market has on technological innovations.

Then the respondents marked the dominant type of impact (positive/neutral/negative) as in the typology presented in Table 2. Table 3 presents the choices made by the respondents. As far as relationships between technological innovations and the internal labor market are concerned, an equal number of respondents selected Statement A and Statement B. It is difficult to assess the impact of the analyzed variables. A completely different situation resulted when the respondents chose statements from Group 2. According to 100% of the respondents, technological innovations have a higher impact on the external labor market than the external labor market has on technological innovations.

Table 3. Respondents' choices regarding the impact between technological innovations and two types of labor market

Group of statements	Statement	% of answers (n=48)	% of answers for a given question
1	a. technological innovations have a higher impact on the internal labor market than the internal labor market has on technological innovations	50%	100%
	b. technological innovations have a lower impact on the internal labor market than the internal labor market has on technological innovations	50%	

Group of statements	Statement	% of answers (n=48)	% of answers for a given question
2	a. technological innovations have a higher impact on the external labor market than the external labor market has on technological innovations	100%	100%
	b. technological innovations have a lower impact on the external labor market than the external labor market has on technological innovations	0%	

Regardless of the answer given by the respondents to the above-presented issues, they were required to present their perspectives on the relationships between the variables. The results are shown in Table 4.

Table 4. The types of relationships between technological innovations and the labor market according to the respondents

Independent variable	Dependent variable	Quantitative impact	% of answers	Qualitative impact	% of answers	% of answers related to a given relationship
Technological innovations	Internal labor market	negative	50.00%	positive	87.50%	100%
		neutral	50.00%	neutral	12.50%	
		positive	0.00%			
Technological innovations	External labor market	negative	50.00%	positive	87.50%	100%
		neutral	37.50%	neutral	12.50%	
		positive	12.50%			
External labor market	Technological innovations	positive	50.00%	positive	87.50%	100%
		neutral	50.00%	neutral	12.50%	
Internal labor market	Technological innovations	positive	50.00%	positive	75.00%	100%
		neutral	50.00%	neutral	25.00%	

According to the respondents, technological innovations can have a negative or neutral quantitative impact on the internal labor market. The qualitative impact related to this case was considered positive by 87.5% of the respondents. Half of them declared that technological innovations have a negative quantitative impact on the external labor market, but as many as 87.5% stated that the qualitative impact is positive. No matter which type of labor market was analyzed as the independent variable, its quantitative impact on technological innovation is assessed equally as positive and neutral. The qualitative impact of the labor market on innovations is seen as positive by the majority of respondents.

Brief presentation of the case studies

As part of the case study in Company A, as an example for the implementation of technological innovation that impacted the internal or external labor market, the engineers shared a situation about the manual task of replacing rolls of packaging material. During a continuous improvement workshop on the line, a "bottleneck" was identified in the production process, which adversely affected the key performance indicators. The issue stemmed from replenishing packaging material in the packaging machine. The responsibility for this operation rested on the duties of the operator of the packaging machines. It often happened that a machine required a new roll when the operator was making an adjustment to the parameters of another packaging machine. Due to this, production from the first machine was halted for 2 to 10 minutes, depending on the type of adjustments being made to the other machine. The first proposal for an improvement was to employ an additional operator, who would only be responsible for replenishing the rolls of packaging material. A test covering temporary workers was performed and indicated as follows:

- this position is not very attractive to workers – a low number of candidates;
- potential candidates expected their salary to be on the same level as that of a regular operator – a significant increase in labor cost;
- the duties were very boring – no possibility for development, as it was a simple and repetitious operation;
- it often looked like the operator responsible for replenishing the rolls was not working and due to this the operator was assigned other activities, which causes the same delays in production as in the original situation.

In order to streamline the roll change operation, it was decided to implement technological innovation in this area that would eliminate the need for the additional headcount. The proposed solution was to purchase a robot for replenishing the packaging machine in a shorter time than previously performed by an employee. Implementing this technological innovation did not affect the employment level in the company, because an employee was trained to perform both maintenance and service tasks for the robot.

In Company B, one of the biggest issues on the packaging line dedicated to assortment boxes of chocolate praline were the losses in the general efficiency of the line and negative deviation on the consumption of the plastic trays used for picking the chocolate pralines. During a shopfloor observation on the line, the project team noted that one of the biggest challenges for

employees is manually placing the plastic trays on the conveyer belt. This material is delivered in carton boxes and stacked. Employees must unpack the trays from the carton box, then separate each individual tray from the stack and place the tray on the conveyer belt. Due to the design of the tray, it often happens that the trays are stuck to each other and it is hard to separate them. This causes the following issues:

- employees further down the line are unable to put chocolates on some trays – decreasing the output of the line, a negative impact on the general efficiency;
- two or more trays are placed on the belt – a negative deviation of consumption of the material in the bill of material.

The operation of placing plastic moldings on the conveyor belt was performed manually by two employees, but during critical blockages, in this process stage, a third worker was occasionally needed – support from an employee from another packaging stage process. As a result of changes in the labor market (lower labor supply and higher labor costs), the company's management decided to purchase a pick and place robot dedicated to the plastic trays. Due to the situation in the labor market the profitability of the investment, described as a return on investment (ROI), was approved. Apart from reducing the demand for labor, the robot improved production line efficiency by performing the work more efficiently than an employee. The packing line staff was reduced by two people and the management of the new equipment was entrusted to the operator responsible for the carton erector machine, which is installed near the new equipment. There was no negative impact on the ergonomy of the employee's work.

In Company C, the main challenges were linked to a reduction in demand for the finished goods produced in the factory. As a part of the network of a global producer of confectionery, the prospects for the future of this facility were not so good. The location of the plant was not perfect from the perspective of the local or national labor market, but taking into consideration the European network of factories, the location was attractive due to lower labor costs when compared to Western European countries. Central office management took the decision to reorganize the supply chain for the chocolate bars and transfer the production of chocolate bars from another plant, located outside of Poland, to the analyzed company. In-depth analysis showed the potential risks of using the current equipment installed in the plant for the production process. The main challenges for the old line were:

- low precision of dosing the chocolate;

- low quality of products due to the old ways of packing, installed machines cause the issues with scratching the surface of the chocolate or their breaks;
- old software, which does not allow the implementation of new tools linked with the Statistical Process Control;
- not an ergonomic workplace.

In line with the plan to transfer production and increase production volume, it was decided to install the next generation of the production line to manufacture chocolate bars instead of modifying the old production line. The new line increased the demand for labor and created 90 new jobs. Working on this line is more accessible than the old one; it increases production efficiency by introducing universal production modules that communicate with each other. In addition, the new line allows the production of additional products, and thus people working in such conditions perform more diversified tasks than they did working on the old line.

In Company D, it was decided to change the design of the chocolate carton box packaging in response to complaints from the market that traders have a challenge merchandizing the big chocolate bars properly on store shelves. After consumers take the first few tablets from the carton box, the remaining tablets often fall over in the carton box and the product loses its visibility. It was also observed that the tablets are cracking when they fall over, resulting in a quality issue that is not acceptable to consumers. Based on this feedback, the research and development team invented a new carton equipped with a special elastic band, ensuring a good chocolate display on the store shelf. As a result, an additional operation had to be included in the process. An additional process stage was added for the manual stretching of an elastic band before putting the chocolate bars into the carton box. This operation impacted the process efficiency and impaired work ergonomics. A lot of mistakes were observed during the manual stretching of the elastic band, which created a bottleneck at this stage of the process. The plant's location ensured the labor supply was at a good level and at an attractive cost. Based on that, a lot of action was taken by the Continuous Improvement department to improve this stage of the process and continue with a manual work solution. For example, an additional tool was developed, some kind of fork, to support the manual stretching of the elastic band. Unfortunately, a lot of challenges were still observed, and finally, it was decided to replace the old carton-forming machine with a device that would allow all packaging stages to be performed automatically. Thus, it was possible to reduce the staff the line by three people because the new machine could not only stretch the elastic band but also pack the tablets inside the carton box.

In order to organize the information collected in the case studies, the authors used the previously developed typology of the two-way relationships between technological innovation and the labor market (Table 5).

Table 5. Relationships between technological innovations and the labor market in the companies under study

Independent variable	Dependent variable	Quantitative impact	Was it observed as part of the case study?	Qualitative impact	Was it observed as part of the case study?
Technological innovations	Internal labor market	negative	Yes – in Companies B and D	positive	Yes– in Companies A, B, C, and D
		neutral	Yes – in Company A	neutral	No
		positive	Yes – in Company C		No
Technological innovations	External labor market	negative	Yes – in Companies B and D	positive	Yes – in Company C
		neutral	Yes – in Company A	neutral	No
		positive	Yes – in Company C		No
External labor market	Technological innovations	positive	Yes – in Company B	positive	No
		neutral		neutral	No
Internal labor market	Technological innovations	positive	No	positive	
		neutral		neutral	

DISCUSSION AND CONCLUSION

As presented above, the authors of early scientific publications focused mainly on the problem of technological unemployment. An analysis of publications from the last eleven years indicated greater diversification of the issues referring to the relationship between innovation and the labor market. However, it is worth noting that the published results are occasionally quite contradictory. This applies, for example, to the impact of labor market flexibility on the innovation of enterprises (Oliveira & Holland, 2017; Wachsen & Blind, 2016). There is also a discrepancy between results about whether the impact of technological innovation on the labor market is positive or negative (Baensch et al., 2018; Lachenmaier & Rottmann, 2011; Neves et al., 2019; Ugur et al., 2018).

The survey results showed that no respondents observed a positive quantitative impact of technological innovations on the labor market. Although the respondents were highly skilled employees, 50% of them perceived a potential threat from implementing technological innovations in the form of layoffs. At the same time, in two of the four companies covered by the case study, a negative impact of innovations on the level of employment

was diagnosed. Referring to the typology of companies presented by Calvino and Virgillito (2018), two cases are "enterprises in which, as a result of implementing innovations, an increase in labor productivity was observed; however, the level of employment showed a decline." The results obtained from both methods of empirical research were similar.

It is worth emphasizing here that the changes occurring in the external labor market resulted in the implementation of innovations in only one company. The results of surveys also indicated that innovations have a higher impact on the labor market than changes in the labor market have on innovations (especially in the context of the external labor market).

In each case, the observed reduction in employment referred to line workers only. Their jobs, characterized by the lowest skills requirements, are simultaneously the most routine and intensive ones. As Acemoglu and Autor (2011) stated, the "routine-biased technological change" means the substitution of routine human work by machines and leads to technological unemployment. Similar findings have also been presented by Frey and Osborne (2017), Gregory et al. (2019), and Hardy et al. (2018). For the highly qualified engineers who were the respondents of the survey, the implementation of innovations each time meant a new professional challenge, a unique project offering an opportunity for development. In each company, technological innovations positively affected the qualitative changes in the internal labor market, which is in line with the survey results. As Lachenmaier and Rottmann (2011) stated, technological innovations can lead to a reduction in a products' price, which further leads to market expansion and the company's development, which requires more employees. A positive quantitative change in employment was observed only in Company C, but other factors unidentified by the empirical research could have contributed to this result. In the other companies in the study, this effect may appear after many years.

The paper attempts to answer questions about the nature of relationships between technological innovation and the labor market, with a focus on the confectionery industry. The literature on the subject shows that technological innovations have a general impact on the demand for work and the nature of tasks performed by employees. In the classic literature, the focus was on the issue of technological unemployment. Publications from the past eleven years also presented a positive impact of technological innovation on the labor market, though the results obtained by different authors are not consistent and do not refer to the industry in question.

This study emphasizes that there are more different relationships between technological innovations and the labor market – especially when focusing on two types of labor market (internal and external). Previous studies were not based on a complex framework, including different kinds

of impacts (from negative through neutral to positive), treating the labor market and technological innovations relative to each other as dependent or independent variables, or highlighting two types of labor market. Therefore, this paper contributes to knowledge development by filling this research gap.

Both the survey and the case study demonstrate that innovations have a higher impact on the labor market than vice versa (especially in the context of the external labor market, resulting in more unemployed people). As far as the internal labor market is concerned, technological innovations do not create new jobs. This raises the question of the future of the labor market from the perspective of the Fourth Industrial Revolution. Theoretically, the number of jobs for unqualified people should be reduced, whereas the demand for highly skilled people should increase (Piwowar-Sulej, 2018). The surveyed businesses reported changes only in the employment size of line workers; no increase in the employment of engineers was recorded. Perhaps the implemented innovations were not advanced enough to require more employment of highly qualified personnel. This problem should be the subject of further, more in-depth research. It would also be interesting to determine the relationships between innovations and the labor market regarding sectors other than the confectionery industry.

The above-presented findings also provide implications for policymakers. Previous studies emphasized that innovation should be placed at the center of the Polish public policy agenda and that new, more effective public instruments are required (Bukowski et al., 2012, Jasiński, 2013a). Moreover, they associated innovation mainly with financial profits. Various consequences and scenarios should be studied while designing and executing an innovation policy. In particular, it is worth determining the impact of technological innovation on the labor market. This would be in line with a sustainability approach, which emphasizes that both businesses and countries should treat the economic, environmental, and social goals and consequences as equally important. This study also makes managers (not only working in Poland and in the confectionery industry) aware that the results of technological innovation go beyond the organization's boundaries. In addition, the answers collected in the survey point to the respondents being aware of the impact of technological innovations on the requirements for future employees. This awareness among the respondents will not only facilitate their work in projects aimed at implementing innovations, but will also protect them against unemployment (not technological, but general unemployment). Within the framework of the case study, it was identified that technological innovations have an impact on the labor market more often than changes in the labor market affect innovations and that this impact is rather negative. Although the reduction in jobs applies to people with lower qualifications,

no more qualified employees are being employed at the current stage of enterprise development. This emphasizes the need for lifelong learning among employees and for a field for development at educational institutions. It should also draw the attention of top managers to the skills that their employees have now and should have in the future (Piwowar-Sulej, 2021). Through appropriate HR development, they may increase the impact of the internal labor market (its qualitative dimension) on innovation.

At this point, it is worth emphasizing the limitations resulting from the research. Firstly, while searching the databases, the authors used terms related to the labor market and technological innovation. In further analyses, a wider scope of terms can be used, for example, those associated with the Fourth Industrial Revolution and employee competencies. This can result in a more complex description of the possible relationships between two types of labor market and technological innovation.

Although the use of multiple methods can neutralize or cancel out some of the disadvantages of certain methods (Creswell et al., 2003), the empirical study conducted in the form of a survey is not representative. Also, a case study method based on a non-random sample selection (as in this paper) prevents the researcher from using the results to make generalizations covering the general population. However, case studies may become generalizing studies if the issue of generalization, which means gaining and accumulating knowledge rather than formal generalization, is concerned. A case study may also be central to scientific development via generalization as a supplement to other methods. To overcome this limitation, further research based on the case study method may use a representative random sample or critical cases, which will be decisive for formal generalization (Flyvbjerg, 2006).

Other factors not included in the study may influence the phenomenon under study. As indicated in the introduction section, production processes based on manual work can be the basis for creating a luxury brand of a product. Therefore, a challenge for scholars is to provide further in-depth studies covering various antecedents of innovation and to overcome difficulties in collecting data resulting from the Covid-19 pandemic.

In addition, the focus here was on the confectionery industry. The typology of the relationships between technological innovation and the labor market presented in the paper can serve as the basis for further development and qualitative or quantitative research. For example, it may be extended by the relationships between technological innovation and working conditions (another aspect of a company's internal labor market related to, e.g., health and safety) as presented by Papaioannou and Srinivas (2019) and may include mediating/moderating variables, such as the participation of labor unions (Ulph & Ulph, 1989).

Acknowledgments

The project is financed by the Ministry of Science and Higher Education in Poland under the programme "Regional Initiative of Excellence" 2019 - 2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN. The authors would like to thank the four anonymous reviewers for their thoughtful comments and efforts towards improving this manuscript.

References

Acemoglu, D., & Autor, D. (2011). Skills, tasks and technologies: Implications for employment and earnings. In O. Ashenfelter & D. Card (Eds.), *Handbook of Labor Economics* (pp. 1043-1171). Amsterdam: Elsevier. https://doi.org/10.1016/S0169-7218(11)02410-5

Baensch, L., Lanzalot, M. L., Lotti, G., & Stucchi, R. (2018). *Do labor market regulations affect the link between innovation and employment?: Evidence from Latin America*. Working Paper. https://doi.org/10.18235/0001199

Bartlett, B. (1984). Is industrial innovation destroying jobs. *Cato Journal*, *4*(2), 625–650.

Bernhard Dachs. (2018). *The impact of new technologies on the labour market and the social economy*. Science and Technology Options Assessment. Retrieved from https://doi.org/10.2861/68448

Bińkowski, J. (2017). *Ukraińska imigracja do Polski. Analiza zjawiska w kontekście sytuacji na rynku pracy,* Warszawa-Wojnowice: Kolegium Europy Wschodniej im. Jana Nowaka-Jeziorańskiego we Wrocławiu

Blanchflower, D. G. (2001). Unemployment, well-being, and wage curves in Eastern and Central Europe. *Journal of the Japanese and International Economies*, *15*(4), 364–402. https://doi.org/10.1006/jjie.2001.0485

Blien, U., & Ludewig, O. (2017). *Technological Progress and (Un)employment Development.* Bonn: IZA Institute of Labor and Economics.

Brem, A., Nylund, P. A., & Schuster, G. (2016). Innovation and de facto standardization: The influence of dominant design on innovative performance, radical innovation, and process innovation. *Technovation*, *50–51*(April–May), 79–88. https://doi.org/10.1016/j.technovation.2015.11.002

Brunarska, Z., Grotte, M., & Lesińska, M. (2012). Migracje obywateli Ukrainy do Polski w kontekście rozwoju społeczno-gospodarczego: Stan obecny, polityka, transfery pieniężne. *CMR Working Paper*, *60*(118), 6–34.

Brynjolfsson, E., & McAfee, A. (2011). *Race against the machine: How the digital revolution is accelerating innovation, driving productivity, and irreversibly transforming employment and the economy.* Lexington, Mass: Digital Frontier Press.

Bukowski, M., Szpor, A., & Śniegocki, A. (2012). *Potencjał i bariery polskiej innowacyjności*. Instytut Badań Strukturalnych. Retrieved from https://

innowacyjnaradomka.pl/wp-content/uploads/2012/09/Potencjal-i-bariery-polskiej-innowacyjnosci.pdf

Bygnes, S., & Erdal, M. B. (2017). Liquid migration, grounded lives: Considerations about future mobility and settlement among Polish and Spanish migrants in Norway. *Journal of Ethnic and Migration Studies*, *43*(1), 102–118. https://doi.org/10.1080/1369183X.2016.1211004

Byrne, E. F. (1986). *Microelectronics and Workers' Rights*. Dordrecht: Springer.

Calvino, F., & Virgillito, M. E. (2018). The innovation-employment nexus: A critical survey of theory and empirics. *Journal of Economic Surveys*, *32*(1), 83–117. https://doi.org/10.1111/joes.12190

Campa, R. (2017). Technological unemployment: A brief history of an idea. *ISA ESymposium for Sociology*, *7(1)*, 1–16.

Capello, R., & Lenzi, C. (2013). Innovation and employment dynamics in European regions. *International Regional Science Review, 36*(3), 322–353. https://doi.org/10.1177/0160017612462874

Central Statistical Office. (2020). *Stopa bezrobocia rejestrowanego w latach 1990–2019*. Retrieved from https://stat.gov.pl/obszary-tematyczne/rynek-pracy/bezrobocie-rejestrowane/stopa-bezrobocia-rejestrowanego-w-latach-1990–2019,4,1.html

Central Statistical Office. (2019a). *Main directions of emigration and immigration in the years 1966-2018 (migration for permanent residence)*. Retrieved from https://stat.gov.pl/en/topics/population/internationa-migration/main-directions-of-emigration-and-immigration-in-years-1966-2008,2,1.html

Central Statistical Office. (2019b). *Popyt na pracę w II kwartale 2019 r*. Retrieved from https://stat.gov.pl/obszary-tematyczne/rynek-pracy/popyt-na-prace/popyt-na-prace-w-drugim-kwartale-2019-roku,2,34.html

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of Mixed Methods In Social And Behavioral Research* (pp. 209-240). Thousand Oaks, CA: Sage.

Creswell, J. W., & Tashakkori, A. (2007). Editorial: Developing publishable mixed methods manuscripts. *Journal of Mixed Methods Research*, *1*(2), 107–111. https://doi.org/10.1177/1558689806298644

De Grey, A., & Rossiter, J. (2017). *The Next Step: Exponential Life*. New York: BBVA-Open Mind.

de Weerd-Nederhof, P. C. (2001). Qualitative case study research. The case of a PhD research project on organising and managing new product development systems. *Management Decision*, *39*(7), 513–538. https://doi.org/10.1108/EUM0000000005805

Díaz, G. A., Barge-Gil, A., & Heijs, J. (2020). The effect of innovation on skilled and unskilled workers during bad times. *Structural Change and Economic Dynamics*, *52*, 141–158. https://doi.org/10.1016/j.strueco.2019.09.012

Didier, T., & Lucie, S. (2008). Measuring consumer's willingness to pay for organic and Fair Trade products. *International Journal of Consumer Studies*, *32*(5), 479–490. https://doi.org/10.1111/j.1470-6431.2008.00714.x

Domański, B. (2003). Industrial change and foreign direct investment in the postsocialist economy. *European Urban and Regional Studies*, *10*(2), 99–118. https://doi.org/10.1177/0969776403010002001

Edquist, C., Hommen, L., & McKelvey, M. (2001). *Innovation and Employment*. London: Edward Elgar Publishing.

European Commission. (2020). *European innovation scoreboard*. http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards/index_en.htm.

Eurostat. (2020a). *Employed HRST by category, age and occupation*. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hrst_st_nocc&lang=en 28-07-2020

Eurostat. (2020b). *Labour cost index by NACE Rev. 2*. https://ec.europa.eu/eurostat/databrowser/view/teilm100/default/table?lang=en

Fagerberg, J. (2006). *Innovation: A Guide to the Literature*. London: Oxford University Press.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, *12*(2), 219–245. https://doi.org/10.1177/1077800405284363

Freeman, C., Clark, J., & Soete, L. L. G. (1982). *Unemployment and Technical Innovation: A Study of Long Waves in Economic Development*. London: Frances Pinter.

Freeman, C., & Soete, L. L. G. (1985). *Information Technology and Employment*. Brussels: IBM.

Freeman, C., & Soete, L. (2013). *Economics of Industrial Innovation*. London: Routledge.

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, *114*, 254–280. https://doi.org/10.1016/j.techfore.2016.08.019

Geldes, C., Felzensztein, C., & Palacios-Fenech, J. (2017). Technological and non-technological innovations, performance and propensity to innovate across industries: The case of an emerging economy. *Industrial Marketing Management*, *61*, 55–66. https://doi.org/10.1016/j.indmarman.2016.10.010

Godin, B. (2008). Innovation: The history of a category. *Project on the Intellectual History of Innovation Working*. Working Paper, 1, 1-67.

Graham, M., & Anwar, M. A. (2019). The global gig economy: Towards a planetary labour market? *First Monday, 24(4)*. https://doi.org/10.5210/fm.v24i4.9913

Greenan, N., & Guellec, D. (2000). Technological innovation and employment reallocation. *Labour*, *14*(4), 547–590. https://doi.org/10.1111/1467-9914.00146

Gregory, T., Salomons, A., & Zierahn, U. (2019). *Racing With or Against the Machine? Evidence from Europe*. Bonn: IZA Institute of Labor and Economics.

Griffin, R. W. (2004). *Podstawy zarządzania organizacjami.* Warszawa: Wydawnictwo Naukowe PWN.

Guba, E. G. (1990). *The Paradigm Dialog*. Washington: Sage Publications.

Hainmueller, J., Hiscox, M. J., & Sequeira, S. (2011). Consumer demand for the fair trade label: Evidence from a multi-store field experiment. *MIT Political Science Department Research Paper, 9B*, 1-57, https://doi.org/10.2139/ssrn.1801942

Hardy, W., Keister, R., & Lewandowski, P. (2018). Educational upgrading, structural change and the task composition of jobs in Europe. *Economics of Transition*, *26*(2), 201–231. https://doi.org/10.1111/ecot.12145

Hernik, K. (2018). *Koniec ery bezrobocia? Sytuacja i perspektywy rynku pracy w Polsce*. Forbes. Retrieved from https://www.forbes.pl/gospodarka/sytuacja-i-perspektywy-rynku-pracy-w-polsce-koniec-ery-bezrobocia/6vj3vbv

Höflinger, P. J., Nagel, C., & Sandner, P. (2018). Reputation for technological innovation: Does it actually cohere with innovative activity? *Journal of Innovation & Knowledge*, *3*(1), 26–39. https://doi.org/10.1016/j.jik.2017.08.002

Hubbard, N., & Purcell, J. (2001). Managing employee expectations during acquisitions. *Human Resource Management Journal*, *11*(2), 17–33. https://doi.org/10.1111/j.1748-8583.2001.tb00036.x

Ilie, L., & Bondrea, I. (2016). Changing labour market needs and the challenges for academic leadership. *ECMLG 2016 - Proceedings of the 12th European Conference on Management, Leadership and Governance* (pp. 80-87). Bucharest, Romania.

International Labour Office. (2015). *Localizing the Decent Work Agenda*. Turin: International Labour Organization.

International Labour Office. (2021). *World Employment and Social Outlook*. Turin: International Labour Organization.

Janta, H. (2011). Polish migrant workers in the UK hospitality industry. *International Journal of Contemporary Hospitality Management*, *23*(6), 803–819. https://doi.org/10.1108/09596111111153484

Jasiński, A. H. (2013a). *Innowacyjność w gospodarce Polski. Modele, bariery, instrumenty wsparcia*. Warszawa: Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego.

Jasiński, A. H. (2013b). Instrumenty polityki innowacyjnej: Czy grają w Polsce? *Zagadnienia Naukoznawstwa*, *49*(1(195)), 3–23.

Jiang, K., Lepak, D. P., Hu, J., & Baer, J. C. (2012). How does human resource management influence organizational outcomes? A meta-analytic investigation of mediating mechanisms. *Academy of Management Journal*, *55*(6), 1264–1294. https://doi.org/10.5465/amj.2011.0088

Jurczak, K. (2018). *Koszty pracy w krajach Unii Europejskiej*. Retrieved from https://wynagrodzenia.pl/artykul/koszty-pracy-w-krajach-unii-europejskiej

Kaczmarczyk, P., & Okolski, M. (2008). Demographic and labour-market impacts of migration on Poland. *Oxford Review of Economic Policy*, *24*(3), 599–624. https://doi.org/10.1093/oxrep/grn029

Kaur, R., & Nagaich, S. (2018). Effects of product and process innovation on employment in Indian innovative firms. Retrieved from https://doi.org/10.2139/ssrn.3334819

Kemeny, T. (2010). Does foreign direct investment drive technological upgrading? *World Development*, *38*(11), 1543–1554). https://doi.org/10.1016/j.worlddev.2010.03.001

Keynes, J. M. (1963). Economic possibilities for our grandchildren. In *Essays in Persuasion* (pp. 358-373). New York: Harcourt Brace.

Krings, T., Bobek, A., Moriarty, E., Salamońska, J., & Wickham, J. (2013). Polish migration to Ireland: 'Free Movers' in the New European Mobility Space. *Journal of Ethnic and Migration Studies*, *39*(1), 87–103. https://doi.org/10.1080/1369183X.2012.723250

Kuznets, S. (1962). Inventive activity: Problems of definition and measurement. In *The Rate and Direction of Inventive Activity: Economic and Social Factors* (pp. 19–52). Princeton: Princeton University Press.

Kwil, I., & Podsiadły, K. (2019). *Innovations in the chocolate manufacture as part of Polish confectionery industry* In P. Maresova, P. Jedlicka, & I. Soukal (Eds.), *HED - Hradec Economic Days* (pp. 23–34). Hradec, Check Republic. https://doi.org/10.36689/uhk/hed/2019-02-002

Lachenmaier, S., & Rottmann, H. (2011). Effects of innovation on employment: A dynamic panel analysis. *International Journal of Industrial Organization, 29*(2), 210-220. https://doi.org/10.1016/j.ijindorg.2010.05.004

Lenth, R. V. (2001). Some practical guidelines for effective sample size determination. *The American Statistician*, *55*, 187-193, https://doi.org/10.1198/000313001317098149

Levrau, F., Piqueray, E., Goddeeris, I., & Timmerman, C. (2014). Polish immigration in Belgium since 2004: New dynamics of migration and integration? *Ethnicities*, *14*(2), 303–323. https://doi.org/10.1177/1468796813504100

Lipsitz, G., & Bix, A. S. (2001). Inventing ourselves out of jobs? America's debate over technological unemployment 1929-1981. *The American Historical Review*, *106*(4), 1388-1389. https://doi.org/10.2307/2693032

Lorenz, E. (2015). Work organisation, forms of employee learning and labour market structure: Accounting for international differences in workplace innovation. *Journal of the Knowledge Economy*, *6*, 437–466. https://doi.org/10.1007/s13132-014-0233-4

Lübke, C., & Erlinghagen, M. (2014). Self-perceived job insecurity across Europe over time: Does changing context matter? *Journal of European Social Policy*, *24*(4), 319–336. https://doi.org/10.1177/0958928714538215

Mackenzie, D. (1998). *Knowing Machines: Essays on Technical Change*. Cambridge: MIT Press.

Maclaurin, W. R. (1953). The sequence from invention to innovation and its relation to economic growth. *Quarterly Journal of Economics*, *67*(1), 97–111. https://doi.org/10.2307/1884150

Marx, K. (1867). *Capital: A Critique of Political Economy.* London: Penguin Books.

Mokyr, J., Vickers, C., & Ziebarth, N. L. (2015). The history of technological anxiety and the future of economic growth: Is this time different? *Journal of Economic Perspectives*, *29*(3), 31–50. https://doi.org/10.1257/jep.29.3.31

Nelson, R. R., & Winter, S. G. (1985). *An Evolutionary Theory of Economic Change*. London: Belknap Press.

Neves, F., Campos, P., & Silva, S. (2019). Innovation and employment: An agent-based approach. *Journal of Artificial Societies and Social Simulation*, *22*(1), 1-15, https://doi.org/10.18564/jasss.3933

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis. *International Journal of Qualitative Methods*, *16,* 1-13, https://doi.org/10.1177/1609406917733847

OECD/Eurostat. (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, The Measurement of Scientific and Technological Activities*. Paris: OECD.

Oliveira, T., & Holland, S. (2017). Flexible labor, flexible production and innovation by agreement: International comparisons contesting the lindbeck-snower insider-outsider thesis and "structural reforms" in the European Union. *European Journal Of Comparative Economics*, *14*(1), 89–107. https://doi.org/10.25428/1824-2979/201701-89-107

Orsatti, G., Perruchas, F., Consoli, D., & Quatraro, F. (2020). Public procurement, local labor markets and green technological change. Evidence from US commuting zones. *Environmental and Resource Economics*, *75*(4), 711–739. https://doi.org/10.1007/s10640-020-00405-4

Papaioannou, T., & Srinivas, S. (2019). Innovation as a political process of development: Are neo-Schumpeterians value neutral? *Innovation and Development*, *9*(1), 141–158. https://doi.org/10.1080/2157930X.2018.1535872

Perry, C. (1998). Processes of a case study methodology for postgraduate research in marketing. *European Journal of Marketing*, *2*(9/10), 785-802. https://doi.org/10.1108/03090569810232237

Pianta, M. (2006). *Innovation and Employment*. London: Oxford University Press.

Piwowar-Sulej, K. (2010). Evolution of an employee position in an organization. In A. P. Balcerzak (Ed.), *Enterprise in Highly Competitive Environment* (pp. 233–244). Toruń: Wyd. Naukowe Uniwersytetu Mikołaja Kopernika.

Piwowar-Sulej, K. (2021). Human resources development as an element of sustainable HRM – with the focus on production engineers. *Journal*

of Cleaner Production, *278*, 124008. https://doi.org/10.1016/j.jclepro.2020.124008

Piwowar-Sulej, K., & Podsiadły, K. (2020). Wpływ zmian na polskim rynku pracy na wdrażanie innowacji technologicznych w przemyśle cukierniczym. *Przegląd Organizacji*, *1*, 29–35. https://doi.org/10.33141/po.2020.01.03

Piwowar-Sulej, K., & Podsiadły, K. (2019). Relationships between technological innovation and labour market - results of literature studies. In A. P. Balcerzak & I. Pietryka (Eds.), *Proceedings of the 10th International Conference on Applied Economics Contemporary Issues in Economy: Economics* (pp. 311–318). Toruń: Institute of Economic Research.

Podsiadły, K. (2019a). Chocobakery as innovative food products portfolio responding to consumer expectations. *Electronic Journal of Polish Agricultural Universities*, *22*(2), 1-15. https://doi.org/10.30825/5.EJPAU.173.2019.22.2

Podsiadły, K. (2019b). Corporate social responsibility for cocoa bean farming – initiatives of key chocolate producers. In E. Mazur-Wierzbicka & D. Janczewska (Eds.), *Społeczna Odpowiedzialność Biznesu - Perspektywa Zarządzania i Ekonomii* (pp. 261-273). Łódź: Społeczna Akademia Nauk.

Polkowska, D., & Filipek, K. (2020). Grateful precarious worker? Ukrainian migrants in Poland. *Review of Radical Political Economics*, *52*(3), 564–581. https://doi.org/10.1177/0486613419857295

Przeździak, M. (2019). Confectionery market in Poland. *Food From Poland*, *34*. Retrieved from http://www.foodfrompoland.pl/paper/art_id,24704-61/confectionery-market-in-poland/place,1/

Pszczoła, D. E. (2013). Chocolate Everything. *Food Technology*, *67*(4). Retrieved from https://www.tib.eu/de/suchen/id/BLSE:RN332645997/Chocolate-Everything?cHash=14a0cb9ccce69ac45531ea6dc8090cf2

Ramskogler, P. (2021). Labour market hierarchies and the macro-economy – Do labour market dualities affect wage growth in Europe? *Structural Change and Economic Dynamics*, *56*, 154–165. https://doi.org/10.1016/j.strueco.2020.10.001

Rifkin, J. (1995). *The End of Work: The Decline of the Global Labour Force and the Dawn of the Post Market Era*. New York: G.P. Putnam's Sons.

Rogalska, J. (2017). W poszukiwaniu wzrostów. Rynek słodyczy i przekąsek w Polsce. Warszawa: The Nielsen Company.

Rosenberg, N. (1994). *Exploring the Black Box Technology, Economics, and History*. California: Stanford University.

Rutkowska, M., & Sulich, A. (2020). Green jobs on the background of Industry 4.0. *Procedia Computer Science*, *176*, 1231–1240. https://doi.org/10.1016/j.procs.2020.09.132

Schumpeter, J.A. (1941). Business cycles: A theoretical, historical and statistical analysis of the capitalist process. *Journal of the Royal Statistical Society*. https://doi.org/10.2307/2980037

Schumpeter, J.A. (1934). *The Theory of Economic Development: An Inquiry Into Profits, Credit, Interest, and the Business Cycle*. London: Transaction Publisher.

Sitek, S., & Zuzańska-Żyśko, E. (2015). Classification of labour markets in the Silesian Province (Poland). *Environmental & Socio-Economic Studies*, *3*(1), 43-52. https://doi.org/10.1515/environ-2015-0056

Smith, A., Stenning, A., Rochovská, A., & Świątek, D. (2008). The emergence of a working poor: Labour markets, neoliberalisation and diverse economies in post-socialist cities. *Antipode*, *40*(2), 283–311. https://doi.org/10.1111/j.1467-8330.2008.00592.x

Soete, L., & ter Weel, B. (2001). Computers and employment: The truth about e-skills. *EIB Papers European Economic Growth: The Impact of New Technologies*, *6*(1), 133–150. Retrieved from https://www.eib.org/attachments/efs/eibpapers/eibpapers_2001_v06_n01_en.pdf#page=135

Solow, R. M. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics*, *70*(1), 65–94. https://doi.org/10.2307/1884513

Stenn, T. L. (2013). The four pillars of fair trade: Consumers. In *The Cultural and Political Intersection of Fair Trade and Justice* (pp. 29–47). New York: Palgrave Macmillan. https://doi.org/10.1057/9781137331489_3

Stern, B. J. (1937). Resistance to the adoption of technological innovations. In *Technological Trends and National Policy* (p. 404). National Resources Committee. Retrieved from https://archive.org/details/technologicaltre1937unitrich/page/n7/mode/2up

Szeptycki, A. (2016). Poland-Ukrainian Relations. *Revista UNISCI*, *40*. https://doi.org/10.5209/rev_RUNI.2016.n40.51806

Tarde, G. (1902). L'Invention considérée comme moteur de l'évolution sociale. *Revue Internationale de Sociologie, 7,* 561-574.

Trompisch, P. (2017). The implications of Industry 4.0 on the future of work. *Elektrotechnik Und Informationstechnik*. https://doi.org/10.1007/s00502-017-0531-1

Tvrdoň, M. (2016). Decomposition of unemployment: The case of the Visegrad group countries. *E+M Ekonomie a Management*, *19*(1), 4–16. https://doi.org/10.15240/tul/001/2016-1-001

Ugur, M., Awaworyi Churchill, S., & Solomon, E. (2018). Technological innovation and employment in derived labour demand models: A hierarchical meta-regression analysis. *Journal of Economic Surveys*, *32*(1), 50-82, https://doi.org/10.1111/joes.12187

Ulph, A., & Ulph, D. (1989). Labor markets and innovation. *Journal of the Japanese and International Economies*, *3*(4), 403–423. https://doi.org/10.1016/0889-1583(89)90011-7

Vivarelli, M. (1996). Technical change and employment. A twofold critique. *TSER Conference on "Technology, Economic Integration and Social Cohesion"* (pp. 1-42). Paris, France.

Vonortas, N. S., & Xue, L. (1997). Process innovation in small firms: Case studies on CNC machine tools. *Technovation*, *17*(8), 427–438. https://doi.org/10.1016/S0166-4972(97)00016-3

Wachsen, E., & Blind, K. (2016). More labour market flexibility for more innovation? Evidence from employer–employee linked micro data. *Research Policy*, *45*(5), 941–950. https://doi.org/10.1016/j.respol.2016.01.020

Wielądek, R. (2016). *Enhancing the Innovative Capacity of the Polish Economy.* Brussel: European Commission.

Witkowska, D. (2016). Comparison of women's situation in the labour market in the former GDR and Poland. *Comparative Economic Research*, *19*(2), 129-148. https://doi.org/10.1515/cer-2016-0017

Wolf, E. (2019). *How Old Should or Can a Source Be for My Research?* Southern New Hampshire: University Library.

Yin, R. K. (2014). *Case Study Research: Design and Methods* (5th ed.). Thousand Oaks, CA: SAGE Publications.

Abstrakt

CEL: *Celem teoretycznym niniejszej pracy jest zbadanie natury relacji „innowacje technologiczne - rynek pracy" przedstawianych w publikacjach z ostatnich 11 lat, indeksowanych w bazach Scopus i Web of Science. Celem empirycznym artykułu jest zbadanie zależności między wskazanymi zmiennymi w firmach działających w branży cukierniczej w Polsce.* ***METODYKA:*** *W pracy wykorzystano takie metody jak studia literaturowe oraz badania empiryczne oparte na podejściu mieszanym, łączące metodę ankiety on-line (z inżynierami branży cukierniczej) z metodą studium przypadku.* ***WYNIKI:*** *Publikacje z ostatnich lat, poruszające problemy analizowanych relacji, nie przedstawiają specyfiki Polski i branży cukierniczej. Publikacje te jednak częściej niż tradycyjna literatura przedmiotu prezentują wielorakie relacje między analizowanymi zmiennymi, nie skupiając się tylko na zagadnieniu bezrobocia technologicznego. Tymczasem 50% badanych pracowników utożsamia właśnie utratę pracy z efektem wdrożenia innowacji technologicznych. Pozostali respondenci są przekonani, że innowacje technologiczne mają neutralny ilościowy wpływ na wewnętrzny rynek pracy. Na podstawie metody studium przypadku stwierdzono, że innowacje technologiczne wpływają na rynek pracy (zarówno wewnętrzny, jak i zewnętrzny) częściej niż zmiany na tym rynku wpływają na innowacje, a analizowany wpływ jest raczej negatywny. Ponadto badania empiryczne pokazują, że innowacje technologiczne są pozytywnie powiązane ze zmianami jakościowymi na wewnętrznym rynku pracy.* ***IMPLIKACJE:*** *W artykule podkreślono potrzebę uczenia się przez całe życie, co sanowi grunt dla rozwoju oferty instytucji edukacyjnych. Menedżerowie najwyższego szczebla powinni identyfikować umiejętności, które ich pracownicy mają teraz a które powinni posiadać w przyszłości.* ***ORYGINALNOŚĆ I WARTOŚĆ:*** *W artykule przedstawiono został autorski model umożliwiającą przeprowadzenie analizy wzajemnych zależności miedzy innowacjami technologicznymi a rynkiem pracy, który naukowcy mogą dalej rozwijać i wykorzystywać w kolejnych projektach badawczych. Autorzy przeprowa-*

dzili ponadto pionierskie badania, oparte na złożonych ramach, obejmujących różne rodzaje wpływów (od negatywnego przez neutralny do pozytywnego), traktujących rynek pracy i innowacje technologiczne względem siebie jako zmienne zależne lub niezależne, a także dwa typy rynku pracy.
Słowa kluczowe: *rynek pracy, zatrudnienie, innowacje technologiczne, innowacje procesowe, wzajemne relacje, przemysł cukierniczy*

Biographical notes

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Krzysztof Podsiadły is a Ph.D. candidate in the interdisciplinary course, master's degree in agricultural sciences, and a senior scientist in the RDQ technical center of one of the world's largest snacks companies. His research area is linked with different aspects of the confectionery industry, such as all types of innovations, new technologies, project management, and the labor market.

Conflicts of interest

The authors declare no conflict of interest.

Citation (APA Style)

Piwowar-Sulej, K., & Podsiadły, K. (2022). Technological innovation and the labor market: The two-way non-reciprocal relationships with a focus on the confectionery industry in Poland. *Journal of Entrepreneurship, Management, and Innovation*, *18*(2), 135-171. https://doi.org/10.7341/20221835