European Research Studies Journal
Volume XXV, Issue 4, 2022

pp. 415-429

Demographic and Technological Factors Shaping the Labour Market in Poland on the Threshold of the Fourth Industrial Revolution

Submitted 14/11/22, 1st revision 27/11/22, 2nd revision 16/12/22, accepted 30/12/22

Maria Miczyńska - Kowalska[1]

Abstract:

Purpose: *The purpose of this article is to identify and assess the main trends in the Polish labour market in the years 2008-2020 and to answer the question to what extent changes in the labour market are caused by technological and demographic factors.*
Design/methodology/approach: *The dynamic changes taking place in the contemporary labour market are related to demographic and technological factors. They cause a number of problems in the area of employment. The technological factors shaping Economy 4.0 give rise to fears about the human presence being eliminated from the labour market. The analysis is based on the data of the Central Statistical Office.*
Findings: *The study indicates that demographic changes play a vital role in achieving priority objectives related to the growth of employment and its quality. It is a result of transformations in the number and structure of the Polish population. Furthermore, the study emphasises the importance of technological factors. Also, it pays attention to the structure of employment in particular sectors, as well as IT-related industries; it gives the number of employees by age and indicates their multi-generational character, and it mentions the alarming social process of ageing. The structure of employment is undergoing transformations due to the need for changes in qualifications and competencies.*
Practical implications: *The analysis makes it possible to conclude that the Polish labour market faces the prospect of shrinking labour resources, which is a great challenge for the economy, considering that most labour market indicators depend not only on changes in employment, but also on the supply of labour resources, i.e., changes in the number and structure of the population. Other crucial factors include the level and structure of education of employees, who should have knowledge and qualifications in the field of IT to work in Economy 4.0. In the manufacturing process, the risk of eliminating humans and replacing them with robots is increasing.*
Originality/value: *The current study is one of the first analysis of the emerging labour market in Poland on the threshold of the fourth industrial revolution.*

Keywords: *Labour market, demographic, technological factors, fourth industrial revolution.*

JEL Codes: *J1, J4.*
Paper type: *Research Paper/ Case Study.*

[1]*University of Life Sciences in Lublin Poland, Faculty of Agrobioengineering, orcid: 0000-0003-0013-6349, e-mail: maria.miczynska@up.lublin.pl;*

1. Introduction

The Polish labour market is characterised by high dynamics of change resulting from the systemic transformation and the emergence of unemployment. The persistence of a high unemployment rate for a long time after the transformation period contributed to the development of vocational education and the improvement of knowledge and qualifications. Today, the level of education is increasingly differentiating demographic cohorts. Most people with a degree are aged between 25 and 29 years.

The rate of persons with a degree is the lowest among those aged over 50. This change is due to the assumption that knowledge, education and high professional qualifications constitute a factor of socio-economic development (Jezior, 2017). After Poland joined the EU, the situation in the domestic labour market changed compared to the 1990s. Poland gained free access to EU labour markets. Economic migration reduced unemployment rates. Today, the employer's market is being replaced with the opposite trend: the "employee's market". Certain professions suffer from shortages of workers.

Poland is also experiencing the undesirable phenomenon of brain drain, causing well-educated young people to leave for western labour markets to earn higher salaries. The Polish labour market on the threshold of Economy 4.0 is also affected by demographic and technological factors.

The aim of this article is to identify and assess the main trends in the Polish labour market in the years 2008–2020 and to answer the question of whether changes in the labour market are caused by technological factors associated with Economy 4.0, by demographic factors or by both at the same time. The study indicates that demographic changes play a vital role in achieving priority objectives related to the growth of employment and its quality. It is a result of transformations in the number and structure of the Polish population. The study also pays attention to technological factors, as the current phase of development is referred to as Economy 4.0.

2. Economy on the Threshold of the Fourth Industrial Revolution and its Impact on the Labour Market

The history of economic development can be divided into four periods. The first one was the industrial revolution in the 18th century in the wake of the invention and application of the steam engine; the second one was the industrial revolution in the 19th century following the invention of electricity, Henry Ford's assembly line and mass production; the third one was the revolution of the 1970s, with the partial automation of production by means of programmable controllers with computer memory (the use of technology has allowed for the automation of the entire production process without human intervention); the fourth industrial revolution is connected with the use of IT and communication technologies in industry, building on the achievements of the third industrial revolution – computerised production

systems are also equipped with network connections and their digital (twin) systems are created.

This enables communication with other facilities and the transfer of information about the devices themselves. This is thus one step further towards the automation of production. It involves the automation of the production process, which does not require labourers.

The fourth industrial revolution is identified with "the connection of devices within digital ecosystems and the deepening of integration within horizontal and vertical value chains, as well as with cognification, i.e., the process of creating increasingly smart objects, devices and services, as well as with the redefinition of existing business models and with dynamic changes in the labour market, resulting, inter alia, in the disappearance of traditional and the emergence of new jobs requiring increasingly complex qualifications and digital competencies and creative problem solving (Wiśniewski and Sadowska-Sanarska, 2020).

In Economy 4.0, well-educated specialists possessing advanced skills related to modern technologies are becoming desired employees. According to human capital theory, differences in wage levels and job opportunities are due to differences in workers' human capital. Human capital consists of education, qualifications, skills, professional experience, professional aptitude, entrepreneurship, enthusiasm and innovation (Zieliński, 2017).

Such forces are driving the fourth revolution as: Internet of Things, artificial intelligence, blockchain, autonomous vehicles, 3D printing, big data and advanced robotisation (Wiśniewski and Sadowska-Sanarska, 2020). Many traditional jobs are being replaced by modern technologies. The changes in labour resources under the influence of the 4.0 revolution involve limited employment in specific jobs, reduced human labour in performing simple activities, as well as complex work with the use of artificial intelligence.

Workers involved in IT technologies, social workers and health care professionals, scientists, teachers, engineers, anyone with expertise, workers engaged in the sale of goods and services as well as workers with specific skills are in increasing demand. Construction, transport, medical, catering, service and financial workers are sought after on the labour market. Electricians, welders, drivers, cooks and nurses are still needed (Wiśniewski and Sadowska-Sanarska, 2020).

While commenting on the ongoing changes in the labour market accompanied by the progressive technicisation and automation of the economy, Rifkin (1995) notes that as early as the early 1990s, American companies dismissed vast numbers of workers due to the use of modern technologies (Rifkin, 1995). The quoted author stresses that the first wave of automation affected blue-collar workers, while the new

revolution threatens employees of the middle corporate section – the middle class (Rifkin, 2011).

While analysing detailed data obtained from the labour statistical yearbooks of the Central Statistical Office for the years 2008-2020 in Poland, one can see that they confirm the indicated trends concerning the demand for and growth of employment in branches classified as modern technologies. Table 1 shows employees by sectors and sections qualified as modern technologies in thousands.

Table 1. *Employees by sectors and sections in thousands in the years 2008–2020. Sections classified as modern technologies.*

	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018	2019	2020
Manufacture of computers, electronic appliances and optical products	63.5	60.6	65.4	62.0	54.6	60.2	60.5	60.3	65.8	64.7	63.5	63.4
Computer programming and IT consultancy activities	69.5	74.0	82.7	92.9	116.9	132.6	155.2	178.6	200.3	215.8	229.9	244.4
Professional, scientific and technical activities	472.6	480.2	481.3	518.2	553.3	588.7	615.7	654.9	680.0	707.0	721.5	738.6

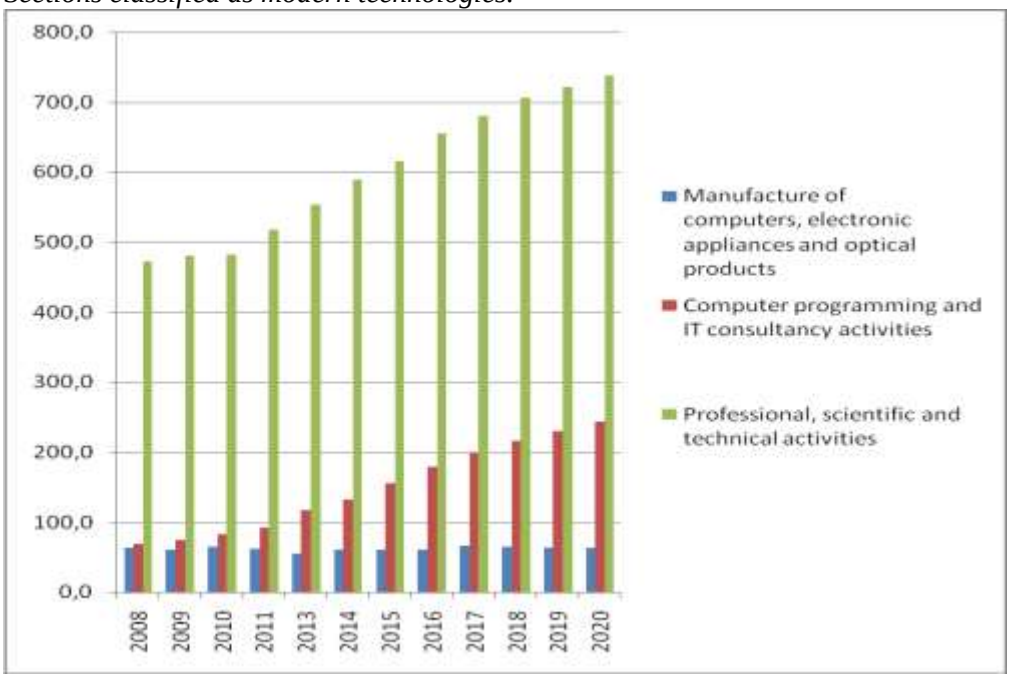
Source: *Own work based on the Labour Statistical Yearbook for 2010, 2012, 2015, 2017, 2019 and 2021.*

The ongoing changes in employment are illustrated below in Figure 1.

Figure 1 shows that employment in the manufacturing of products perceived as necessary for the development of modern technologies in Poland remains stable at 63.5 thousand employees.

Due to the processes of automation of production, this section is saturated with workers and does not require an increase in employment. The section of programming and IT consultancy saw an almost fourfold increase in employment in the period under review, from 69.5 thousand employees in 2008 to 244.4 thousand in 2020. In the case of employees in professional, scientific and technical activities, the increase is nearly twofold, from 472.6 thousand employees in 2008 to 738.6 thousand in 2022.

Figure 1. *Employees by sectors and sections in thousands in the years 2008–2020. Sections classified as modern technologies.*



Source: *Table 1.*

3. Labour Market in Poland

The literature provides numerous definitions and approaches to the labour market. For the purpose of this article, it is assumed that it is "an area of activity which involves a confrontation between free labour resources and job offers, i.e., an interaction of demand and supply of labour. It is also indicated that equilibrium in the labour market is impossible to achieve" (Klementowska and Flaszyńska, 2018).

It should be recognised that the demand for workers is to a considerable extent determined by the amount of investment on the basis of which new jobs are created, as well as by vacancies left by retiring employees. The demand for workers also depends on the process of globalisation, technological progress, (Simon, 1996) automation and jobless economic growth.

The supply of labour depends primarily on demographic factors: the birth rate, as well as on wage policy. In general, the changes that are taking place in the labour market today are caused by the process of globalisation and the development of modern technologies.

In Poland, the situation concerning the employment structure appears interesting. In the period under review, employment in industrial processing, trade and car repair as

well as agriculture, forestry and fishery remained at a high level. There was also high demand for employees in education, transport and other service activities. These sectors of the economy do not see such high dynamics of change as the sections described as innovative, cf. Table 1. Data on employment by dominant sectors and sections for 2008-2020 are shown in Table 2.

Table 2. *Employees by sectors and sections in thousands in the years 2008–2021. Sections with the highest employment rates.*

	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018	2019	2020
Industrial manufacturing	2,591.8	2,420.6	2,436.5	2,443.6	2,421.1	2,517.8	2,582.1	2,679.5	2,773.3	2,811.8	2,835.0	2,801.1
Trade and repair of motor vehicles	2,287.2	2,179.5	2,189.1	2,158.8	2,121.9	2,176.6	2,222.1	2,290.5	2,347.9	2,360.9	2,377.3	2,327.6
Agriculture, hunting, forestry, fishery	2,128.3	2,124.9	2,376.1	2,376.7	2,379.0	2,384.9	2,384.8	2,385.5	2,386.0	2,382.9	2,378.2	2,373.7
Retail trade	1,276.7	1,217.6	1,232.9	1,222.0	1,183.9	1,215.6	1,222.0	1,261.1	1,272.6	1,275.4	1,266.8	1,239.1
Education	1,058.1	1,071.9	1,079.9	1,084.7	1,100.3	1,124.2	1,137.8	1,152.9	1,173.1	1,189.0	1,205.9	1,204.1
Construction	877.5	882.7	865.2	909.2	810.5	820.0	840.0	879.3	913.9	967.0	997.6	1016.4
Transport and storage	733.2	693.7	701.4	727.9	730.0	743.7	767.3	818.6	874.6	901.0	933.7	933.5
Other service activities	202,4	204,4	200,7	215,9	259,3	260,0	272,9	293,1	309,5	322,3	323,0	322,8
Mining and quarrying	184.7	183.4	173.0	175.6	168.6	160.2	148.0	139.8	138.2	138.6	140.1	134.8

Source: *Own work based on the Labour Statistical Yearbook for 2010, 2012, 2015, 2017, 2019 and 2021.*

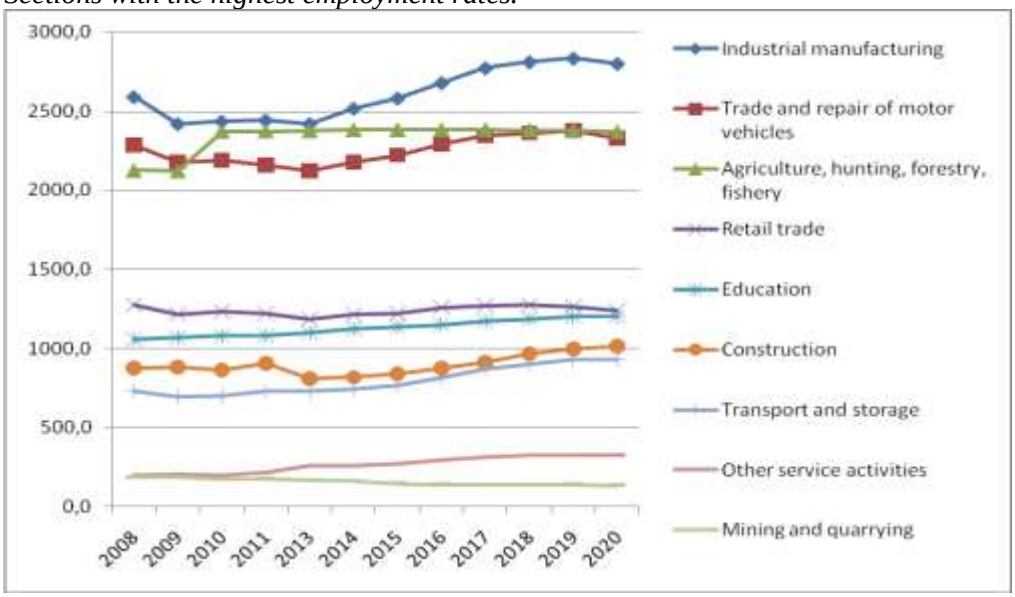
A graphical representation of the data from Table 2 is shown in Figure 2.

The dominant employment is in the section of industrial processing and has been steadily increasing from 2,591.8 thousand employees in 2008 to 2,801.1 thousand employees in 2020. The second dominant section in employment is trade and repair of motor vehicles, which has also seen a slight, steady increase in employment from 2,287.2 thousand employees in 2008 to 2,327,6 thousand employees in 2020.

Agriculture, forestry, hunting and fishing have a large share in employment. This section saw a substantial increase in employment from 2,124.9 thousand in 2009 to 2,376.1 thousand in 2010, and the rate remained stable by 2020. A similar trend can be observed in retail trade. Further, in education, there is a steady increase in employment from 1,058.1 thousand employees in 2008 to 1,204.1 thousand in 2020. A similar trend can be noticed in the construction industry. The mining industry is the only one to gradually shrink, with employment decreasing from 184.7 thousand in 2008 to 134.8 thousand in 2020.

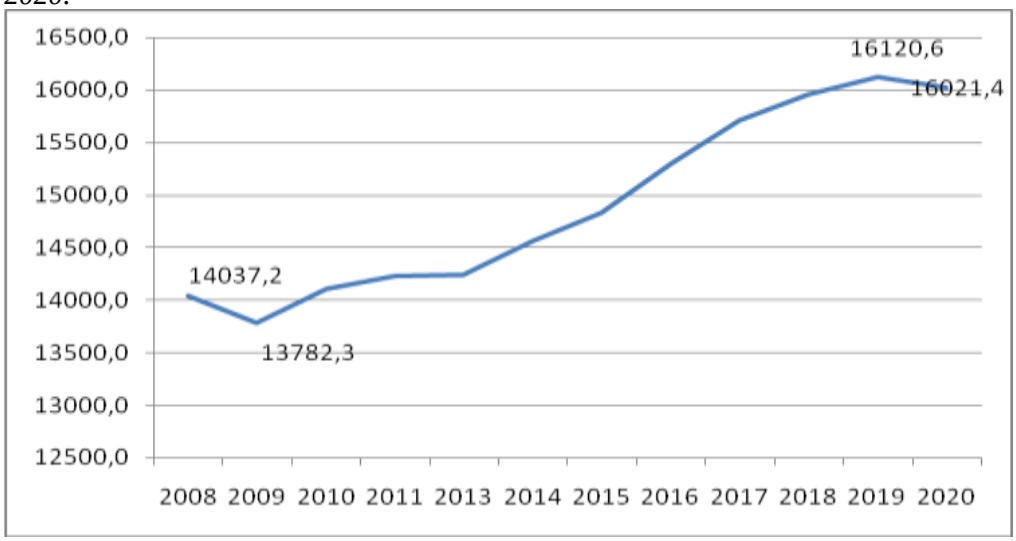
The period under review saw an overall increase in employment from 14,037.2 thousand workers in 2008 to 16,120.6 in 2019. The data are illustrated in Figure 3.

Figure 2. *Employees by sectors and sections in thousands in the years 2008–2021. Sections with the highest employment rates.*



Source: *Table 2*

Figure 3. *Increase in the number of employees in thousands between 2008 and 2020.*



Source: *Own work based on the Labour Statistical Yearbook for 2010, 2012, 2015, 2017, 2019 and 2021.*

In summary, the labour market in Poland is developing at a very satisfactory rate. The demand for employees is steadily increasing. The level of unemployment is decreasing. This translates directly into the economic development of the country. The transformation of the Polish Economy into a 4.0 economy is in its early stages. Employment in the area of modern technologies is growing, but it is not dominant. The development of technology does not reduce employment in other sectors of the economy.

4. Demographic Factors and the Labour Market

In addition to technological factors, understood as the demand for employees in modern technology sectors, the labour market is also significantly affected by demographic factors. The contemporary Polish labour market is facing the phenomenon of multi-generationalism. As a matter of fact, the phenomenon has always existed, but today the situation is different than before due to the differences between generations (Klementowska and Flaszyńska 2018). It is caused, inter alia, by technological progress, changes in the educational process, the way of communication, etc.

Several generations coexist on the labour market: employees of the Mature generation, i.e., people who grew up during the war; baby boomers, born after World War II; generation X, who grew up in the People's Republic of Poland; generation Y, also known as the millennial generation, i.e. people born between the second half of the 1980s and the second half of the 1990s; and generation Z – people born after 1995.

Each of these generations has different qualities that characterise them as employees. They also have had different opportunities on the labour market. Most of the generation born before World War II is already retired. They were workers with diverse educational backgrounds. Individuals born after the Second World War are described as hard-working. Most of them were not intent on obtaining a degree. Pragmatic considerations had a dominant influence on their choice of profession.

Representatives of generation X believe that only hard work leads to success. They hold stability in high esteem and are generally responsible. The millennials, as opposed to the previous generations, value free time more and often choose flexible forms of employment. Compared to their older colleagues, they are more demanding and courageous. They do not like routine and change jobs more often. They are relatively well educated, know foreign languages and new technologies.

However, they often have difficulties in finding their way on the labour market due to their limited experience and high financial aspirations. Mismatched qualifications and infantilism also pose a difficulty for this age group to find employment. They are most often multitaskers. Representatives of generation Z have a good command of new technologies.

Nevertheless, due to the lack of experience, they often remain unemployed or are employed in unattractive, temporary jobs, in the grey market or under flexible forms of employment.

The problem that must be addressed with respect to this group of young workers is thus the high unemployment rate. The labour market quickly verifies the suitability of the young generation for the available jobs. Young people often cannot navigate the labour market. They are ignorant of the employers' expectations and do not know how to make a good impression on a potential employer. The problems faced by future employees include a lack of knowledge about the professions that are and will be needed in Economy 4.0, a lack of information about trends related to computerisation and automation of work processes, and the disappearance of some jobs and creation of new professions.

Young people nowadays are characterised by a phenomenon referred to as "protracted transition" (Maksim, 2021) which involves a tendency to delay the decision-making typical of adulthood, including decisions to enter the labour market. The phenomenon is also connected with a tendency to prolong the period of education.

It is worth noting that after Poland's accession to the EU, young people began to attach increasing importance to higher education. This led to the development of the information society and the increased importance of knowledge in the economy. It should be noted, however, that the courses chosen by young people after Poland's accession to the EU included mainly the humanities and social sciences, with engineering and science far behind.

The students who chose the humanities/social sciences, however, were often less satisfied with their choices and received lower salaries. At the same time, it should be stressed that the amount of pay varied according to location, i.e., the city or region where the employee has a job (Jelonek, 2020). Table 3 and Figure 4 shows data on the unemployment of people in each age category.

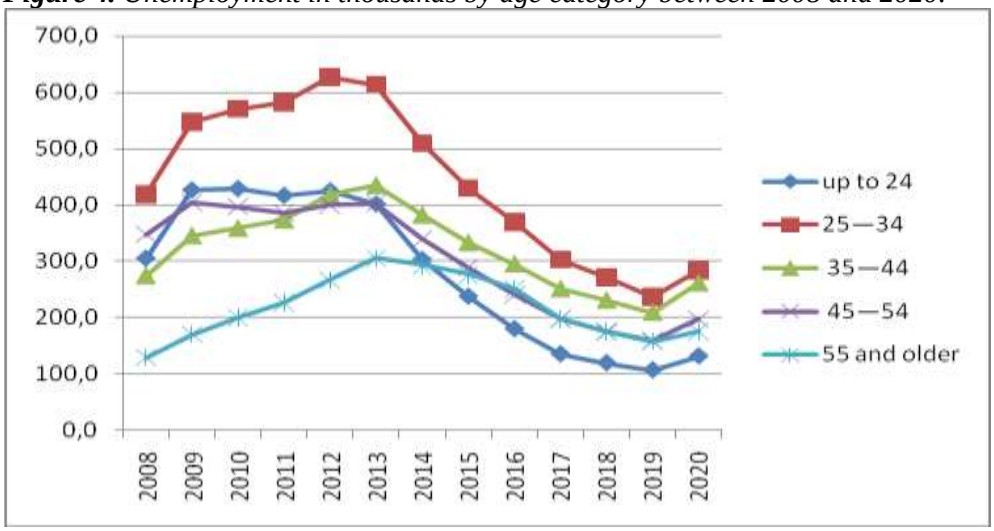
Table 3. *Unemployment in thousands by age category between 2008 and 2020.*

YEARS	Total	Aged				
		up to 24	25-34	35-44	45-54	55 and older
2008	1,473.8	304.6	418.7	273.9	347.9	128.7
2009	1,892.7	425.9	547.8	345.4	404.4	169.2
2010	1,954.7	428.3	570.9	358.8	397.2	199.6
2011	1,982.7	416.1	581.9	373.4	385.3	226.0
2012	2136.8	424.2	627.5	418.1	400.4	266.7
2013	2,157.9	401.0	613.6	435.4	403.0	304.9
2014	1,825.2	302.0	509.4	382.1	339.6	292.1
2015	1,563.3	236.8	429.8	332.9	287.9	275.9

2016	1,335.2	179.2	370.1	295.0	239.7	251.1
2017	1,081.7	134.3	303.0	250.6	197.0	196.8
2018	968.9	118.6	271.7	230.1	173.9	174.6
2019	866.4	106.1	236.6	208.3	157.9	157.4
2020	1,046.4	130.8	283.9	260.8	196.0	174.9

Source: *Own work based on the Labour Statistical Yearbook for 2010, 2012, 2015, 2017, 2019 and 2021.*

Figure 4. *Unemployment in thousands by age category between 2008 and 2020.*



Source: *Table 3.*

The data show that unemployment was increasing in all age categories until 2013. The largest number of unemployed was in the 25-34 age group. The group of people under the age of 24 was slightly behind, which is obviously due to the fact that young people are increasingly interested in higher education. Those aged 55 and over were in the best situation. 2013 marked a peak in demand for workers and from then there was a steady decline in unemployment in all age groups until 2019. After 2019, the unemployment rate rose in all age groups. It is reasonable to assume that due to the recession in the economy caused by the coronavirus pandemic and the war in Ukraine this trend will continue.

One of the major demographic challenges that Poland is facing is the ageing of the population. which also has a negative impact on the labour market. The ageing of the population means that fewer children are being born and the number of working-age people is falling as opposed to the number of people at retirement-age. It follows that an ever-smaller number of employees on the labour market supports an ever-larger number of pensioners. One of the challenges of today may thus be to enable people at retirement-age to find their way on the labour market. This may be hampered, however, by the health of many older people, who decide to retire despite lower incomes due to poor health.

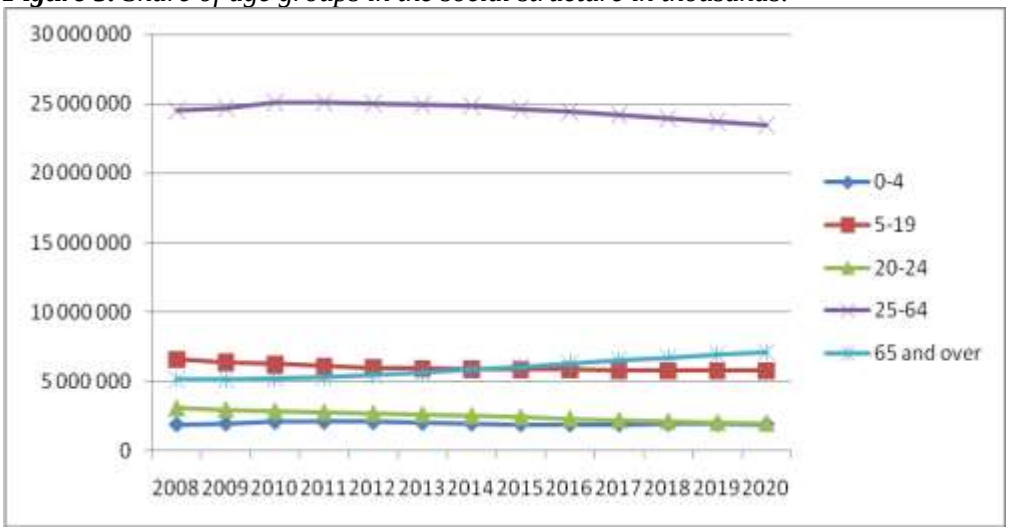
This is a major problem in the face of low fertility rates and increasing life expectancy, both of which are reducing the labour supply. The share of age groups in the population structure is shown in Table 4 and Figure 5.

Table 4. *Share of age groups in the population structure in thousands between 2008 and 2020.*

Population	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0–4	1,888,342	1 952 800	2,066,623	2,072,768	2,056,255	1,994,096	1,936,077	1,891,675	1,880,723	1,896,151	1,916,734	1,918,464	1,902,236
5–19	6,561,391	6,359,040	6,213,483	6,060,933	5,959,021	5,901,639	5,866,571	5,840,605	5,812,407	5,793,804	5,773,501	5,771,543	5,770,408
20–24	3,076,737	2,957,225	2,848,527	2,775,143	2,697,005	2,610,442	2,522,308	2,411,283	2,302,001	2,206,730	2,113,877	2,029,469	1,969,685
25–64	24,539,856	24,694,019	25,059,351	25,079,731	25,030,310	24,927,316	24,801,907	24,628,541	24,436,457	24,223,356	23,988,553	23,745,550	23,472,384
65 and over	5,146,287	5,161,470	5,190,409	5,325,015	5,487,713	5,672,608	5,874,047	6,076,418	6,303,405	6,520,247	6,732,360	6,947,019	7,119,985

Source: *Own work based on the Labour Statistical Yearbook for 2010, 2012, 2015, 2017, 2019 and 2021.*

Figure 5. *Share of age groups in the social structure in thousands.*

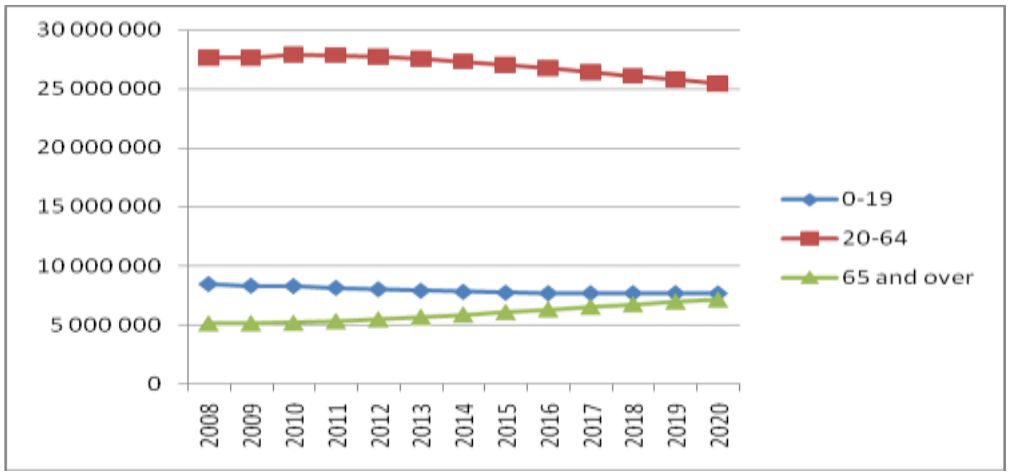


Source: *Table 4.*

The largest group of the Polish population in the period under review consists of working-age people, aged 25-64. However, the group is seeing a progressive downward trend. Interestingly, while the school-age group of those aged 5-19 sees a visible decrease, the retirement-age group of those aged 65 and over is becoming ever-larger.

In 2014, retirement-age people became more numerous than school-age people. The group of those aged 20-24 (including both school leavers and learners) is also steadily shrinking. Similarly, the share of the youngest groups is systematically decreasing. To obtain a more complete picture of the labour market potential, it is worth comparing the three age groups: pre-working-age, working-age and retirement-age. This comparison is presented in Figure 6, below.

Figure 6. *Pre-working, working and retirement-age groups in thousands between 2008 and 2020.*



Source: *Table 4.*

The presented picture, unfortunately, shows the social process of ageing. The number of people at retirement-age is increasing. Working-age people form a large but systematically shrinking group. Unfortunately, the number of children and young people up to the age of 19 is falling. It is worrying that the number of people at retirement and pre-working-age is coming closer together.

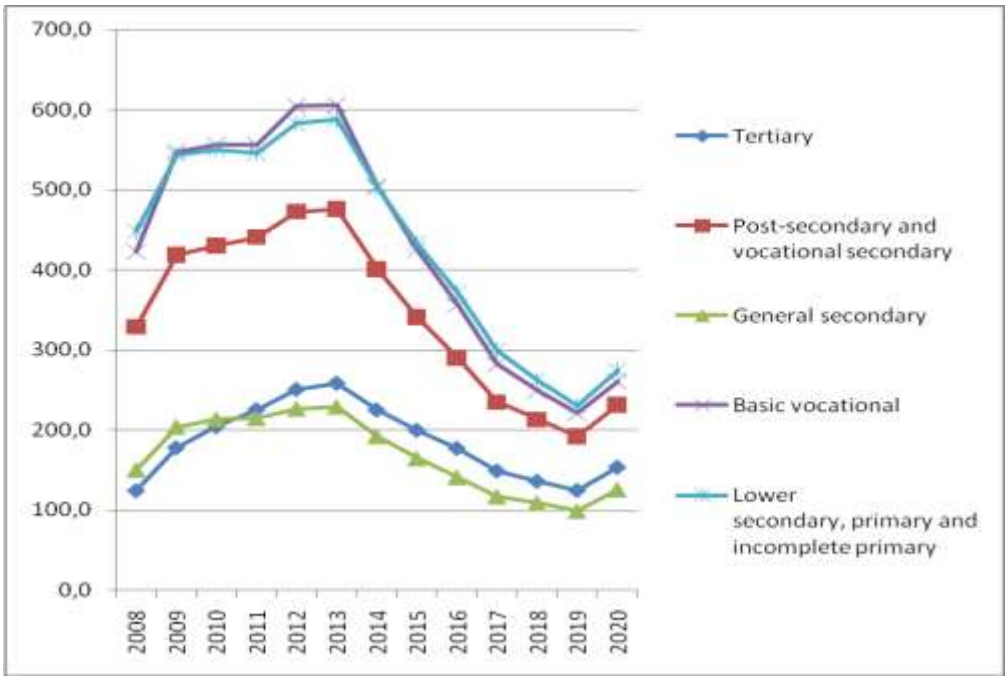
From a demographic point of view, the point at which there are fewer people with the potential to enter the labour market than people leaving it results in a deficit of workers on the market.

Another important issue is the educational structure of the population in the age of technicisation, in which the demand for highly qualified staff is growing. It can thus be expected that unemployment rates will be lowest among people with higher and secondary education. This is confirmed by the data presented in Figure 7.

The lowest registered unemployment rate is among people with higher and secondary education. It can be seen, however, that since 2013 the disproportion between unemployment of well- and less-educated people has been decreasing. This means that the Polish labour market, in addition to the demand for highly qualified, well-educated staff, is also characterised by the demand for blue-collar jobs that do not require education.

This confirms the thesis that Economy 4.0 in the Polish reality is still a distant future. Nevertheless, concerns are raised by the social process of ageing, including the fact that a large group of people is past working-age and that young people have relatively high unemployment rates.

Figure 7. *Educational structure of the population in thousands between 2008 and 2020.*



Source: *Own work based on the Labour Statistical Yearbook for 2010, 2012, 2015, 2017, 2019 and 2021.*

The above facts indicate that the labour market in Poland is closely related to demographic conditions. Both Poland and Europe have a demographic order resulting from the second demographic transition. This transition was characterised by a change in the fertility pattern: a decline in the number of births, a delay in having children, higher age of motherhood, fewer marriages and more divorces, and the ageing of the population.

5. Conclusions

The analysis makes it possible to conclude that the Polish labour market faces the prospect of shrinking labour resources, which is a great challenge for the economy, considering that most labour market indicators depend not only on changes in employment, but also on the supply of labour resources, i.e. changes in the number and structure of the population.

Other crucial factors include the level and structure of education of employees, who should have knowledge and qualifications (Stiglitz, 2020) in the field of IT to work in Economy 4.0. In the manufacturing process, the risk of eliminating humans and replacing them with robots is increasing. The structure of employment is undergoing transformations due to the need for changes in qualifications and competencies.

The data show, however, that this problem does not affect Poland. Nevertheless, high competencies and qualifications are in high demand on the labour market, along with higher and secondary education.

The following conclusions can be thus formulated:

- Fears of workers being eliminated from the labour market in the face of Economy 4.0 are not justified, at least for now.
- In Poland, however, in the years 2008-2020 the knowledge and qualifications of employees were improving while demand and employment in the high-tech sector were increasing.
- During the discussed period, the employment rates in manufacturing, trade and car repair, agriculture, forestry and fishery also remained high; high demand was also seen in education, transport and other service activities.
- During the period under review, there was an overall increase in employment from 14,037.2 thousand in 2008 to 16,120.6 in 2019.
- Employment in the area of advanced technology is not dominant and the development of technology does not affect the reduction of employment in other sectors of the economy in Poland.
- The Polish labour market is to a significant extent determined by demographic factors; it faces the social process of ageing and a high level of unemployment rates among young people aged 25-34.
- People with higher and secondary education are more likely to find a job.

It should be assumed that the challenges that the Polish labour market is facing, apart from the social process of ageing, include the mobility of employees, teamwork skills, decision-making in risky situations, increasing use of modern information technologies and new forms of employment.

It should also be noted that a decrease in unemployment in Poland in the most recent years has resulted in shortages of workers, especially in some branches and professions. These are mainly low-paid and blue-collar jobs, which are not very attractive for Poles. In this situation, it is worth taking into account substitution migration and the influx of workers to Poland, mainly from its eastern neighbours, a situation which, however, may be hampered by the war in Ukraine.

References:

Jelonek, M. 2020. Z uczelni na rynek pracy. Indywidualne decyzje, mechanizmy społeczne a polityki publiczne, Wydawnictwo Naukowe Scholar, Warszawa.

Jezior, J. 2017. Wyższe wykształcenie a rynek pracy. Studium metodologiczno-empiryczne, Wydawnictwo UMCS, Lublin.

Klementowska, A., Flaszyńska, E. 2018. Rynek pracy a zmiany pokoleniowe (stan i prognozy), Zakład Poligraficzny PIXEL, Zielona Góra.

Maksim, M. 2021. Ze szkoły na rynek pracy. Modele, koncepcje i instrumenty wsparcia, TNOiK Dom Organizatora, Toruń.

Rifkin, J. 1995. The End of Work: The Decline of the Global Labor Force and the Dawn of the Post-Market Era. New York.

Rifkin, J. 2011. The Third Industrial Revolution. New York.

Simon, J.C. 1996. Unerstanding and Using Information Technology. West Publishing Company, St. Paul MN.

Stiglitz, J.E. 2020. People, Power and Profits. Progressive Capitalism for an Age of Disconentge. Penguine Books, UK.

Wiśniewski, Z., Sadowska-Snarska, C. 2020. Praca i rynek pracy w perspektywie gospodarki 4.0. Wydawnictwo Adam Marszalek, Toruń.

Zieliński, M. 2017. Rynek pracy w teoriach ekonomicznych. Wydawnictwo CeDEWu Sp. z.o.o., Warszawa.

Rocznik Statystyczny Pracy. 2010. Warszawa, https://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-pracy-2010,7,3.html.

Rocznik Statystyczny Pracy. 2012. Warszawa, https://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-pracy-2012,7,3.html.

Rocznik Statystyczny Pracy. 2015. Warszawa, https://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-pracy-2015,7,3.html.

Rocznik Statystyczny Pracy. 2017. Warszawa, https://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-pracy-2017,7,3.html.

Rocznik Statystyczny Pracy. 2019. Warszawa, https://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-pracy-2019,7,3.html.

Rocznik Statystyczny Pracy. 2021. Warszawa, https://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-pracy-2021,7,3.html.